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GEOGRAPHIC INFORMATION SYSTEM FOR COASTAL AREA MANAGEMENT AND PLANNING PROJECT

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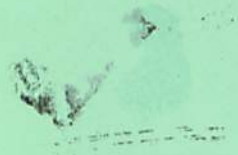

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GISCAMP Project

Technical Report

on the

Geographic Information Systems Application for Coastal Area Management and Planning, Lingayen Gulf Area, Philippines

Part I

CONTENTS

Geographic Information Systems Applications for Coastal Area Management and Planning in the Lingayen Gulf Area, Philippines

Introduction

The provinces of Pangasinan and La Union border the 2,100 km^2 Lingayen Gulf in northwestern Luzon, Philippines. The area was the pilot site of the Association of Southeast Asian Nation/US Coastal Resource Management Program for its first regional attempt to promote integrated coastal area management (CAM). The output of the CRMP was a CAM plan aimed at the sustainable development of coastal resources in the Lingayen Gulf area. Significant multiple resource use conflicts pervade in the gulf area which the plan is trying to mitigate.

The completion of the CAM plan and its possible implementation by the National Economic and Development Authority Region I Office (NRO) will require substantial revision to respond to changes in the management area. This is particularly important in light of the current development thrust of the Philippine government to industrialize some areas in Region I and has not been adequately considered in the CAM plan. As such, information management, especially spatial data is needed in order to ensure timely formulation of management options for decision making and policy considerations relative to the development and management programs for the Lingayen Gulf area.

Geographic information systems (GIS) technology has been chosen as the most appropriate tool for spatial data management but this requires pilot testing to determine its suitability and relevance under local institutional setting. Thus. the Geographic Information Systems for CAM and Planning Project (GISCAMP) was implemented with the Lingayen Gulf area as the pilot site to address spatial data management as a complementary mechanism for efficient and timely utilization of information for decision making. The GISCAMP was a 2-year project (September 1991 - February 1994) funded by IDRC with ICLARM as the executing agency.

Rationale and Objectives

One of the recommended strategies of the CAM plan for the Lingayen Gulf is the development of a zonation scheme for both land use and water space utilization. On a broader context, the zonation scheme should consider the downstream impact of hinterland activities so that appropriate management options and policy actions can be formulated to deal with linked habitats such as

forests. Indeed, the CAM plan has addressed such issue with a proposal to rehabilitate the Upper Agno River System watershed (NEDA Region I 1992). The Agno River Basin largely drains into the Lingayen Gulf. Studies on the basin however, have been largely focused on water resource assessment for development purpose with very minimal consideration on the ecological aspect, particularly on the management and conservation of forests. In order to determine what actions to undertake with respect to the rehabilitation of the watershed, it is necessary to quantify the downstream impact of watershed activities such as land use changes in the basin and sediment yield. Thus, critical areas can be determined for rehabilitation activities.

The zonation scheme proposed in the CAM plan is essentially based on ecological and resource management considerations but more focus on the coastal waters component such aquaculture, mangrove rehabilitation, fisheries and marine critical habitats. The terrestrial component such as agriculture, forest land, industrial areas and tourism sites is not well defined. Impacts of development activities, both short- and long-term, for tourism, agriculture, industrialization and urban expansion remain to be assessed and incorporated into the zonation scheme.

The original objectives of the GISCAMP essentially emphasized on all aspects related to zonation but without considering a comprehensive zonation scheme and the impact of development pressures. In light of the recommendations of the CAM plan and recent development programs for the Lingayen Gulf area, the original objectives with respect to the application of GIS for CAM are modified to include a comprehensive zonation in the context of a 6-year development program.

Objectives

1. To evaluate coastal land use changes and marine space utilization with respect to fishing, commercial fry collection, marine parks, mangrove reforestation, aquaculture development, tourism, human settlements and artificial reef sites and their impacts using GIS.

2. To determine the sphere of influence of upland watershed activities in terms of sediment and pollutant influx into coastal areas and their impacts thereof using GIS.

3. To differentiate between natural and anthropogenic changes in the coastal zone, where possible, to pinpoint areas of intense human activities so that appropriate management guidelines can be instituted and to delineate areas for conservation.

4. To develop a zonation scheme for the Lingayen Gulf areas that is consistent with the principles of sustainable development.

5. To establish a databank on spatial and attribute information relevant to CAM and planning at the pilot site.

Methodology

To meet the above objectives, the terrestrial and water components are divided into sectors represented as activities. There are 9 activities with Activity 9 as the integration of Activities 1 to 8 and the development programs for the Lingayen Gulf. The 9 activities are:

Activity 1 *Impact of upland watershed and lowland land use activities on the coastal zone.*

Activity 2 *Impact of human settlement development and expansion on the coastal area.*

Activity 3 *Delineation of fishing zones in Lingayen Gulf.*

Activity 4 *Delineation of fry grounds in Lingayen Gulf.*

Activity 5 *Identification and assessment of marine park and artificial reef zones.*

Activity 6 *Identification and assessment of coastal tourism areas.*

Activity 7 *Identification and assessment of mangrove reforestation areas.*

Activity 8 *Identification and assessment of areas for aquaculture development.*

Activity 9 *Zonation scheme for the coastal zone of Lingayen Gulf.*

Specific GIS procedures are designed for each activity using a GIS software called Spatial Analysis System (SPANS) developed by INTERA TYDAC Technologies of Canada (Version 5.22) for PC microcomputer. Spreadsheets, text editors and database management system (DBMS) are used for processing and analysis of attribute information prior to importation into the GIS. Remotely sensed data (March 1990 Landsat Thematic Mapper) were used to update topographic and thematic maps. Rectification was done by the National Mapping and Resource Information Authority (NAMRIA) using microBrian, an application based image processing system developed by CSIRO and MPA International Pty Ltd of Australia. Ground truthing using Global Positioning System was conducted by the project staff and some information on coral reef

cover was provided by the Marine Science Institute of the University of the Philippines. Photo interpretation of aerial photographs was also conducted by NAMRIA.

To facilitate GIS analysis, each activity follows a standard procedure:

1. Specific objective - defines an objective where GIS can be applied.

2. Information and data needs - define what data are needed in doing the GIS analysis and in what format the data should be collected and processed

3. Flow of processing tasks - define the transformation of data for GIS analysis and the GIS functions to execute in order to meet the objective.

Information and data needs are of two types - map and attribute data. Maps include topographic maps, nautical charts and thematic maps (e.g., soils, slopes, physiography) as well as remote sensed data. Maps including the aerial photographs are digitized using the digitizing package of SPANS called TYDIG (Version 4.3) while remotely sensed data are in digital format imported into SPANS as raster (grid) files. Digitizing was done using a 24" x 36" CALCOMP drawing board II model 33360 with 16 button cursor. Attribute data like population data, number of fishing boats and rainfall data, etc. are encoded in spreadsheets and DBMS following SPANS format and imported as table files. Many of the attribute data collected have to undergo preprocessing to ensure data consistency, detect and correct errors, aggregation and resampling. The latter are for large datasets. Most of the attribute data are point data. Point data are processed in SPANS either as surface maps, point maps or maps with some zone of influence/interest using the buffer function. These various map layers are then overlaid according to specific objectives according to the procedure enumerated above.

An Assessment of the Land Resources in the Provinces of Benguet, La Union, Pangasinan and Tarlac, particularly the Agno River Basin

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Abstract

Land resources in the provinces of Benguet, La Union, Pangasinan and Tarlac were assessed using geographic information systems including the Agno River Basin. Assessment dealt with existing land use patterns, land use change relative to the 1981 forest resource inventory, soil loss and nonpollution source areas. Implications of the findings with respect to the development of the study area, especially for Lingayen Gulf as well as the limitations of this study are discussed. Some recommendations are made to improve the results of the present study and to cushion any economic development earmarked for the four provinces.

Introduction

The Agno River Basin is situated in nine Provinces within four administrative regions (Region I, II, III and the Cordillera Autonomous Region). Its headwaters are located in the boundary of Benguet and Ifugao provinces with a total area of 7,640 km^2 that includes the allied basins in the south part of La Union and Benguet. The allied basins are the Bued and Pantal Rivers (NWRC 1983, JICA/DPWH 1991).

The Agno River drains into the Lingayen Gulf and is a major contributor of sediment load along the gulf including mine tailings. In addition, it periodically causes flooding in the Pangasinan plain, especially during the rainy seasons. Two hydroelectric dams are located in the basin - Ambuklao and Binga

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in Benguet while several irrigation systems are built, mostly in the Pangasinan plain. Hence, development of the water resources of the basin and flood control are important programs of the government.

Major economic activities in the basin are agriculture and mining. Although water resources development is a priority program, very minimal consideration has been given to forest management as an important strategy for water resources conservation and soil erosion, especially in the upper watershed. Siltation of the dams occurred as a result of deforestation along the tributaries while sedimentation occurred throughout the length of the river system due to soil erosion and mine tailing discharge with varying downstream impacts. Major issues affecting the basin are denudation of forests, discharge of mine tailings, erosion and flooding (Briones 1988, NWRC 1983, JICA/DPWH 1991). This paper assesses land use changes and sediment loading in the provinces of Benguet, La Union, Pangasinan and Tarlac as well as the Agno River Basin and their impacts on land development in the coastal areas of Lingayen Gulf.

Methodology

The study area covered four provinces--Benguet, La Union, Pangasinan and Tarlac. The Agno River Basin is a subset of the study area. The basin boundary was delineated by the National Water Resources Council from 1:250,000 topographic maps but the eastern and southern boundaries followed that of the provincial boundaries of Benguet and Tarlac. The study consisted of three parts using geographic information systems (GIS): (a) documentation of land use/cover changes, (b) assessment of soil erosion, and (c) assessment of critical nonpoint pollution sources. The GIS software used is called spatial analysis system (SPANS) developed by INTERA TYDAC of Canada.

For the documentation of land use/cover changes, the 1990 land use/cover, 1981 forest cover, slope, municipal boundaries, sub-basin and basin boundaries including river systems were digitized from various thematic and topographic maps with scales ranging from 1:50,000 to 1:250,000. The land use map was prepared by the Bureau of Soil and Water Management (BSWM) of the Department of Agriculture (DA) while the forest resource condition map was produced by the Forestry Management Bureau of the Department of the Environment and Natural Resources (FMB-DENR). The forest resource condition map was based on the forest inventory of Regions I and III in 1981 using both aerial photographs and field survey under the second National Forest Resources Inventory (BFD 1987a and b). Details of the land use maps (e.g., description of land use/cover, soil types, etc.) can be found in the land resources evaluation project reports for the four provinces (BSWM 1985a, b, c and d). Elevation map was constructed by surface interpolation of digitized spot heights using the triangulated irregular network (TIN) technique (Weibel and Heller

1991). A slope-elevation factor map was generated by overlaying the slope and elevation maps.

Analysis of land use/cover changes were made by two maps overlay process and selectively determined areas of change per specific category (i.e., land use/cover category). The resultant maps were subjected to area analysis including cross tabulation with municipalities and sub-basins of the Agno River Basin, slope and elevation factors. Area analysis was also conducted with the 1990 land use and 1981 forest resource condition maps.

Two models were used in this study. The first model was the determination of sediment loading using the Universal Soil Loss Equation (USLE) (McElroy et al. 1976). The second model was to determine critical areas for nonpoint pollution sources within proximity to water sources (Sivertun et al. 1988). Maps used were soil texture, land use and slope. Attribute data were rainfall, soil erodibility indices, cropping and management factors, drainage density and sediment delivery ratios. Rainfall erosivity map was generated from rainfall data using TIN. Appropriate corrections including computation for missing data were made on the rainfall records to ensure data consistency for the 27 rainfall stations located within and outside of the study areas (Linsley et al. 1988).

The USLE is an empirical, deterministic and lumped model using regression analysis for predicting sheet and rill erosion (McElroy et al. 1976). The sediment loading function is:

$$Y(S)_E = \sum_{i=1}^{n} [A_i(R \bullet K \bullet L \bullet S \bullet C \bullet P \bullet S_d)_1] \qquad (1)$$

where:

$Y(S)_E$	=	sediment loading from surface erosion in t/yr;
n	=	number of subareas in the study area;
A_i	=	area extent of subarea i, km^2;
R	=	rainfall erosivity factor;
K	=	soil erodibility factor, t/ha per R unit;
L	=	slope-length factor, dimensionless ratio;
S	=	slope-steepness factor, dimensionless ratio;
C	=	vegetation cover factor (land use), dimensionless ratio;
P	=	erosion control practice factor, dimensionless ratio;
S_d	=	sediment delivery ratio, dimensionless ratio.

The derivation and/or values of the various parameters were computed/taken

from various sources: rainfall erosivity and soil erodibility factors (Mitchell and Bubenzer 1980, Landon 1984); slope length-steepness factor (David and Collado n.d.); vegetation cover and erosion control practice factors (David 1987, David and Collado n.d.); sediment delivery ratio (McElroy et al. 1976).

For the nonpoint pollution critical areas, the model determines areas with significantly higher contribution to pollution loading into receiving water than other areas (Sivertun et al. 1988, Reinelt et al. 1989). Nonpoint pollutants are suspended solids, nitrogen, phosphorus and agricultural runoffs. The model uses some parameters from the USLE and has the following form:

$$P = [(K*S*W)/4]*L \quad (2)$$

where

P = product map;
K = soil erodibility index;
S = slope;
W = water course representing distance from river bank; and
L = cropping factor.

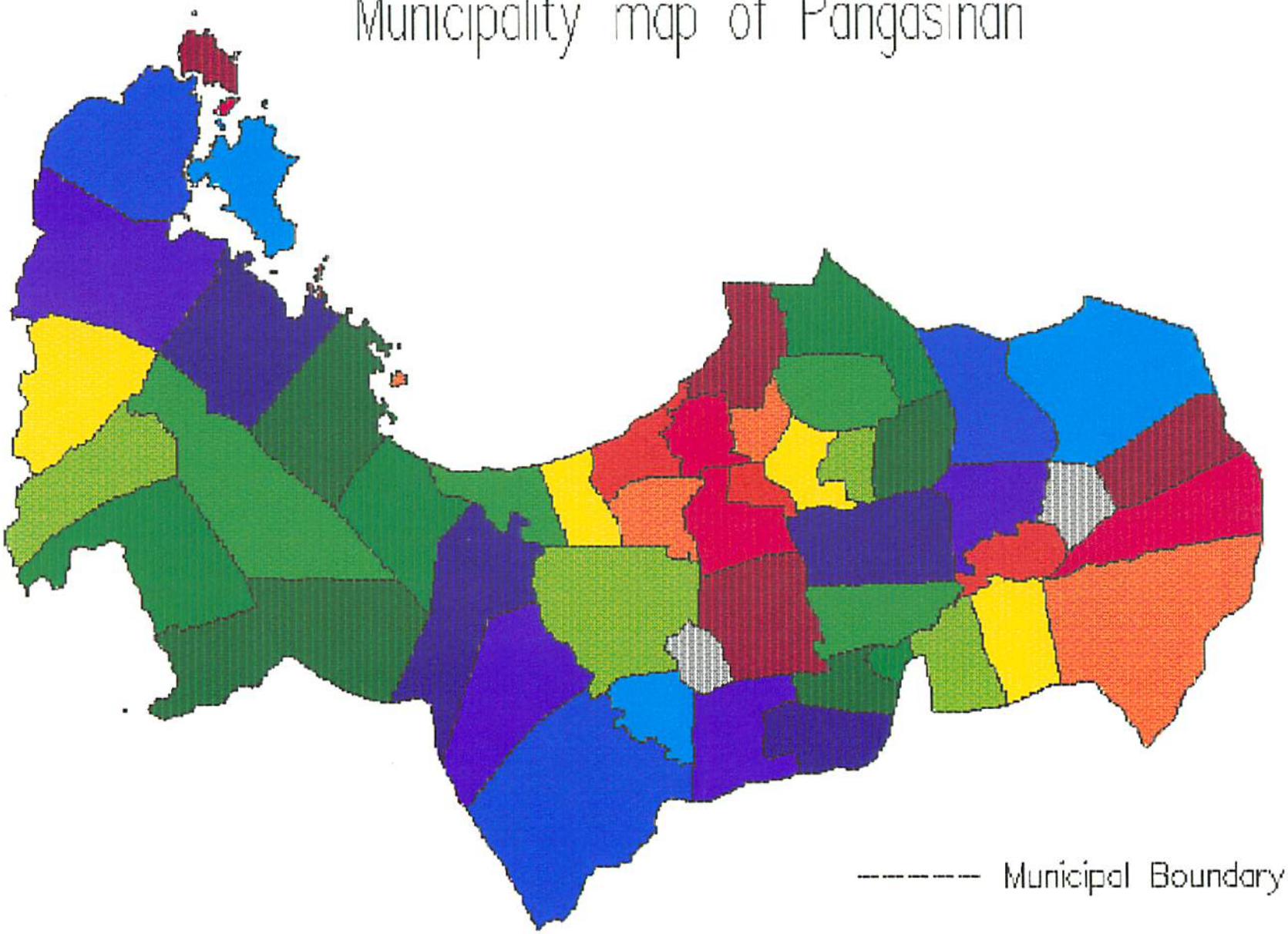
Spatial modelling in table form was made for Eqs. (1) and (2). In the latter, the histogram generated was used to reclassify the model result into discrete intervals. Area analysis including area cross tabulation were conducted on the results of the two models with elevation, slope, land use, sub-basin and municipality.

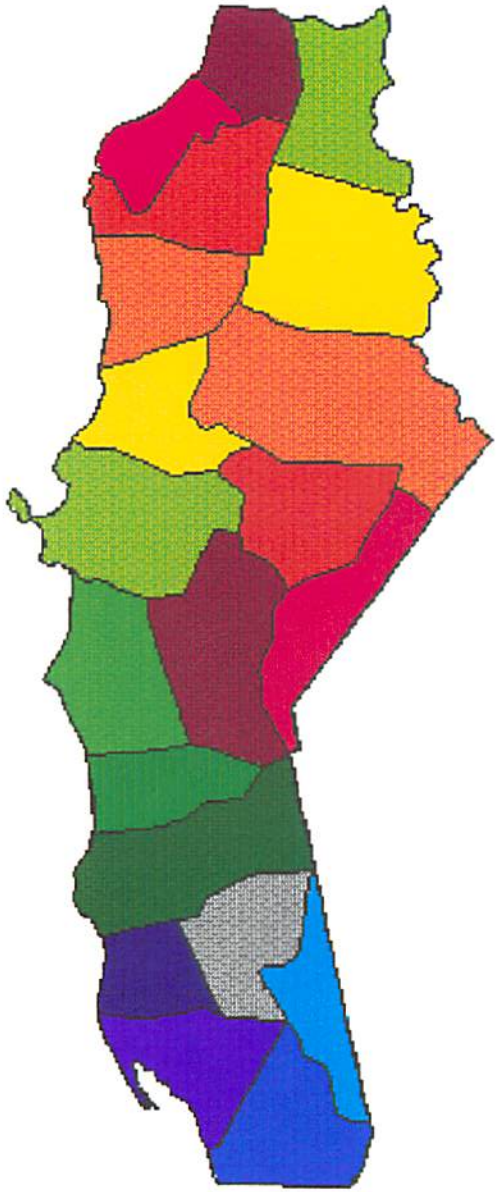
Results and Discussion

Land resource management and land use changes

The study area comprises 4 provinces, namely, Benguet, La Union, Pangasinan and Tarlac. The Agno River Basin is a a subset of the study area composed of 60 sub-basins. Land use patterns in the study area vary considerably with ricefield as the dominant land use comprising 3,654.2 km^2 (about 30%) of land area (Table 1). Dominant covers are grasslands (3,555.6 km^2 or about 29%) followed by forests with associated land uses (1,693.3 km^2 or about 14%). Forestlands with 90-100% forest cover comprised about 570.2 km^2 (4.7%) found mostly in the eastern part of Pangasinan and the western part of Tarlac bordering Zambales. Based on the 1990 survey of BSWM, only Pangasinan and Tarlac have areas with 90-100% forest cover, presumably composed of old growth dipterocarp. Within the Agno River Basin, dominant land use in the Tarlac-Zambales (S1 to S22 basins) area including the central plain (CP) is

Municipality map of Pangasinan



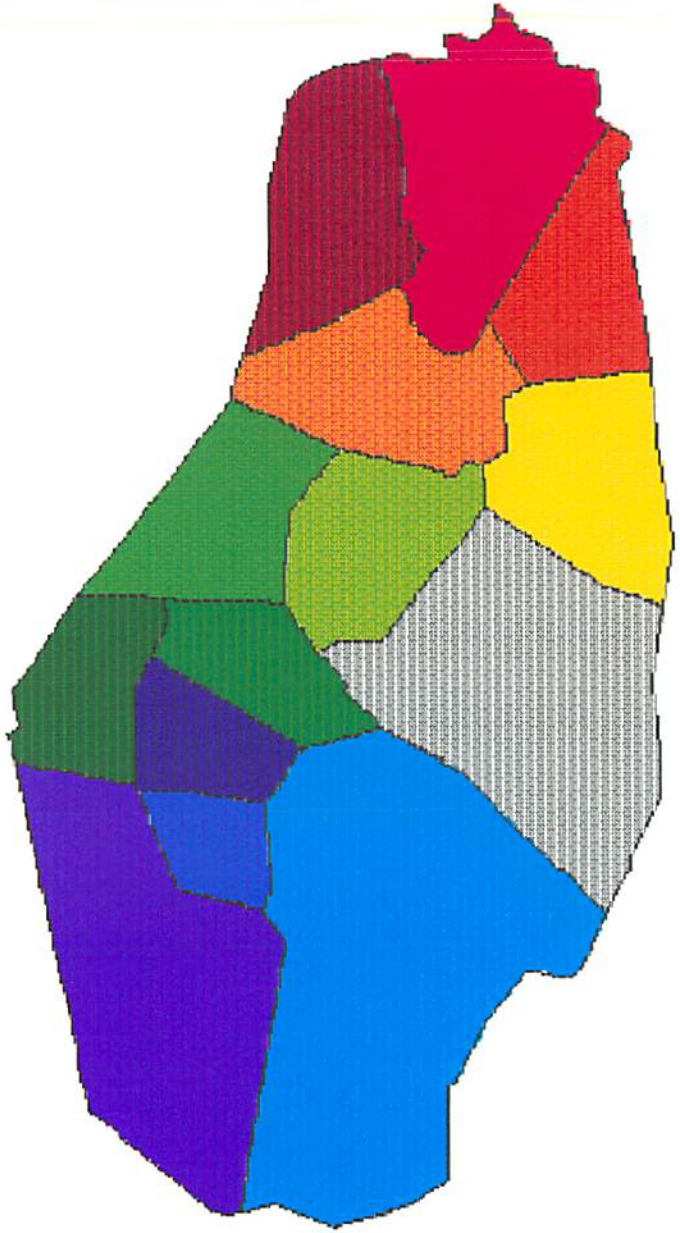


Municipality map of La Union

Legend

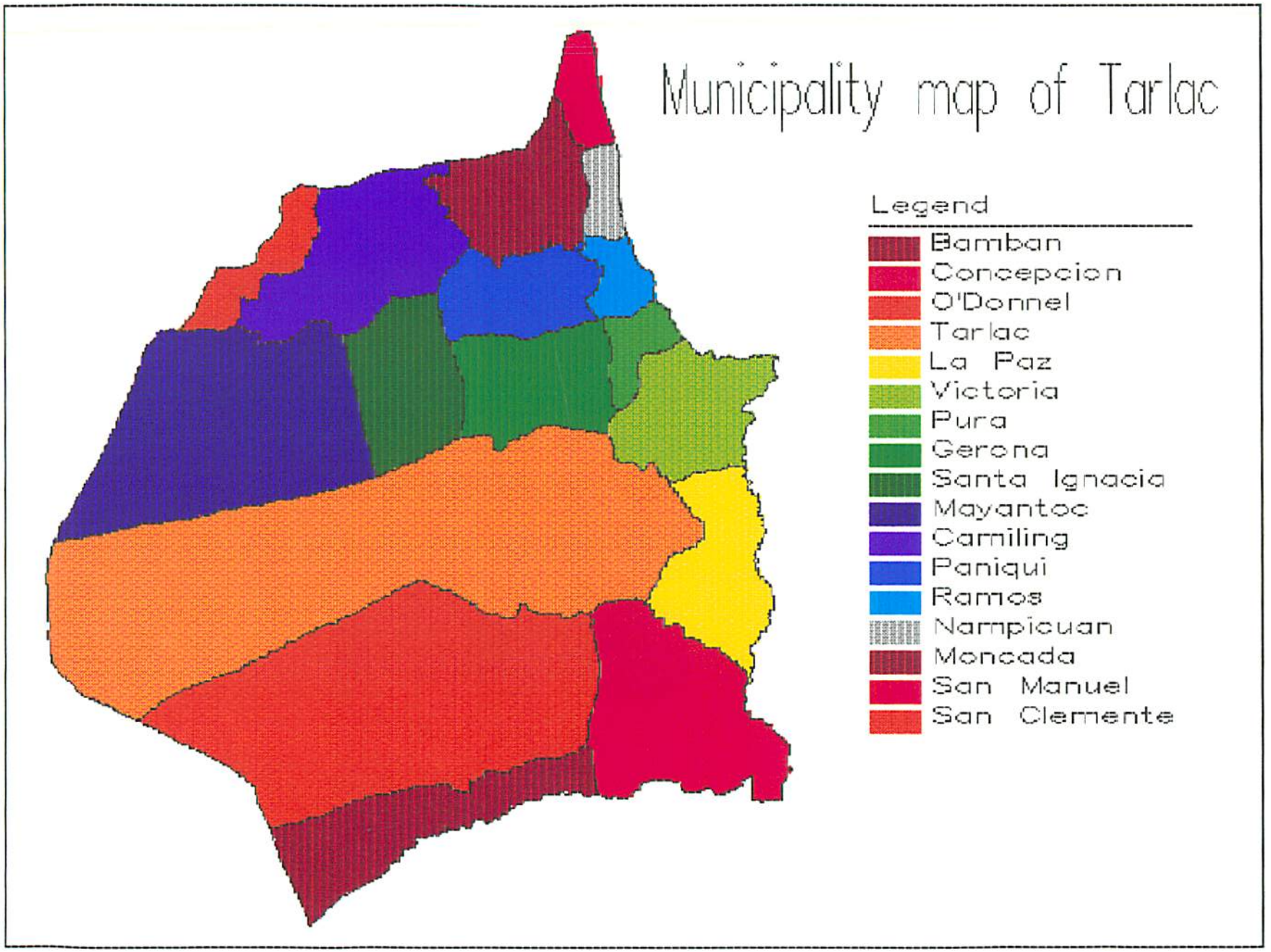
- Bangar
- Luna
- Balaoan
- Bacnotan
- San Juan
- San Fernando
- Bauang
- Caba
- Aringay
- Agoo
- Sto. Tomas
- Rosario
- Pugo
- Tubao
- Naguilian
- Burgos
- Bagulin
- San Gabriel
- Santol
- Sudipen

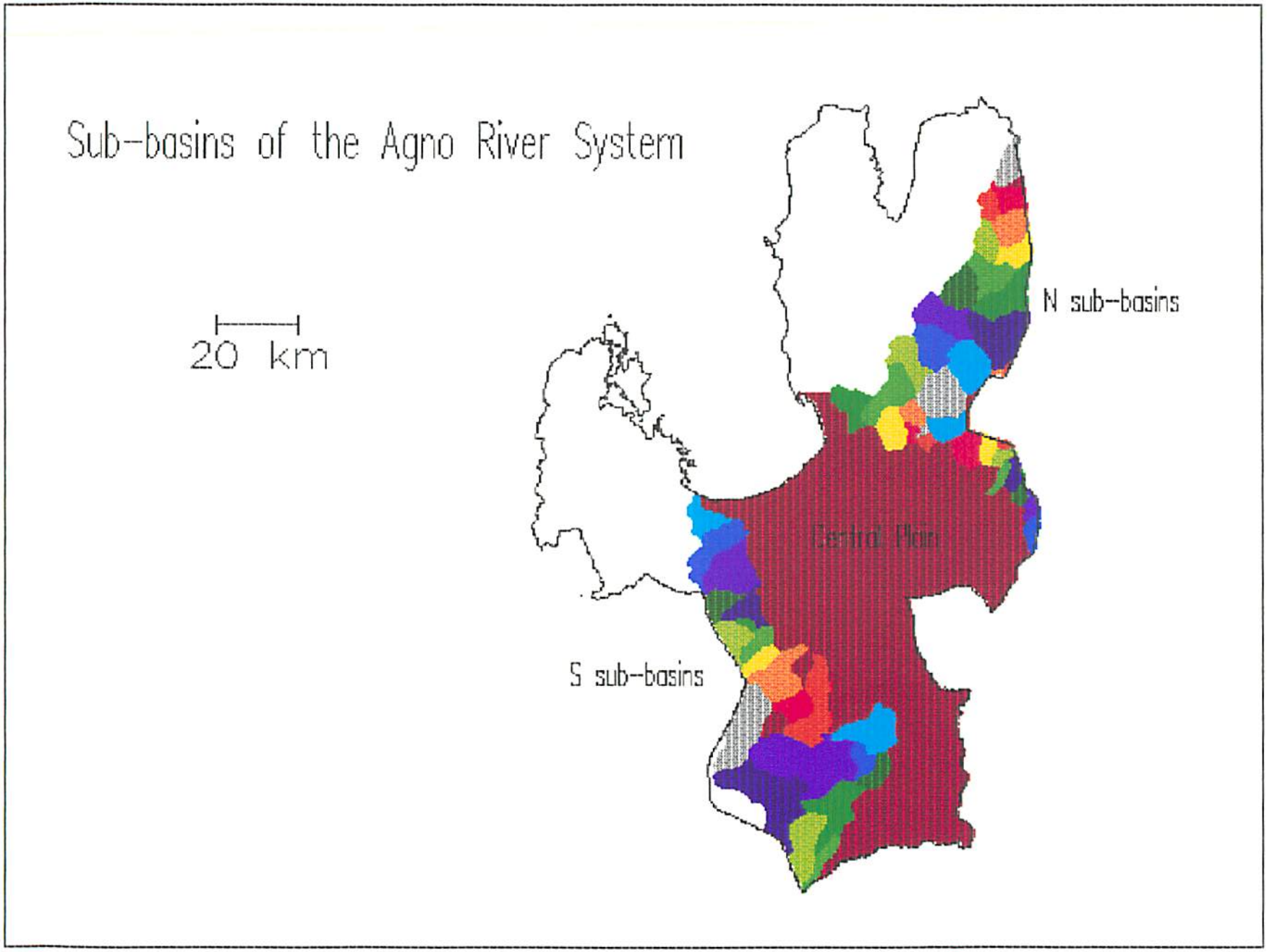
Municipality map of Benguet



Legend

- Bakun
- Mankayan
- Buguias
- Kibungan
- Kabayan
- Atok
- Kapangan
- Tublay
- Sablan
- La Trinidad
- Tuba
- Baguio City
- Itogon
- Bokod

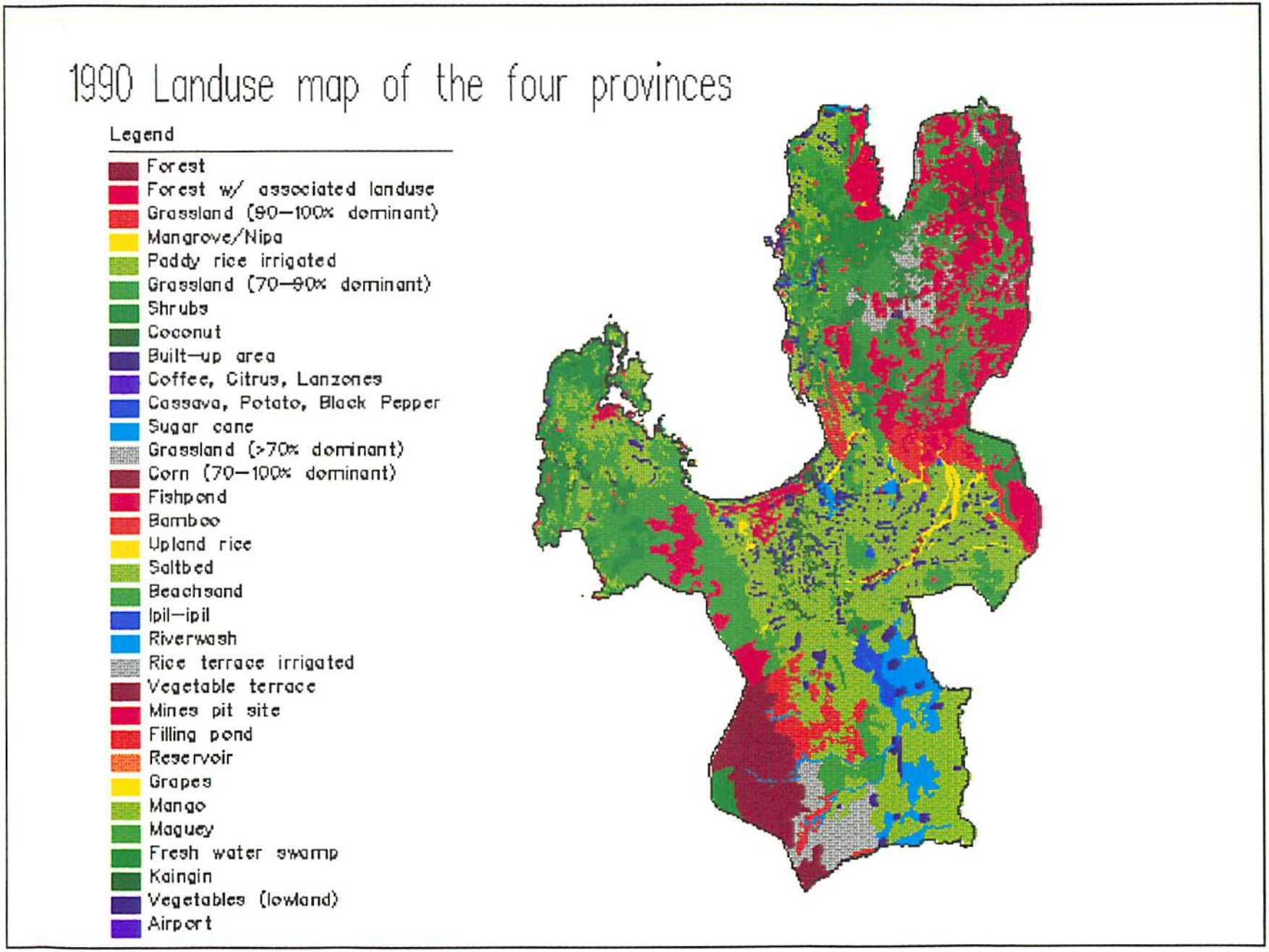

Municipality map of Tarlac
Legend
Bamban
Concepcion
O'Donnel
Tarlac
La Paz
Victoria
Pura
Gerona
Santa Ignacia
Mayantoc
Camiling
Paniqui
Ramos
Nampicuan
Moncada
San Manuel
San Clemente


Sub-basins of the Agno River System
20 km
N sub-basins
Central Plain
S sub-basins

Area analysis of the 1990 land use map for Benguet, La Union, Pangasinan and Tarlac.

Clas	Land Use	Area (%)	Cumm	Area (km sq)
1	Forest	4.68	4.68	570.20
2	Forest w/ associated landuse	13.89	18.57	1,693.30
3	Grassland (90-100% dominant)	4.72	23.29	574.70
5	Mangrove/Nipa	0.11	23.40	13.87
6	Paddy rice irrigated	29.06	52.46	3,542.40
7	Grassland (70-90% dominant)	10.33	62.79	1,258.60
8	Shrubs	9.12	71.90	1,111.50
9	Coconut	1.09	73.99	132.50
10	Built-up area	3.47	76.46	423.00
11	Coffee, Citrus, Lanzones	0.02	76.48	2.30
12	Cassava, Potato, Black Pepper	0.73	77.21	88.59
13	Sugar cane	2.82	80.03	344.20
14	Grassland (<70% dominant)	14.13	94.16	1,722.30
15	Corn (70-100% dominant)	0.14	94.30	17.40
16	Fishpond	1.19	95.49	145.89
17	Bamboo	0.01	95.50	0.80
19	Upland rice	0.06	95.56	7.20
20	Saltbed	0.06	95.62	7.70
21	Beachsand	0.08	95.70	9.50
26	Ipil-ipil	0.01	95.71	1.30
27	Riverwash	1.74	97.45	211.54
28	Rice terrace irrigated	0.86	98.31	104.60
29	Vegetable terrace	1.24	99.55	151.70
30	Mines pit site	0.07	99.62	8.90
31	Filling pond	0.01	99.63	0.90
32	Reservoir	0.05	99.68	6.60
33	Grapes	0.01	99.69	0.90
34	Mango	0.04	99.73	5.10
35	Maguey	0.03	99.76	3.50
36	Fresh water swamp	0.12	99.88	15.20
37	Kaingin	0.01	99.89	0.50
38	Vegetables (lowland)	0.10	99.99	11.60
39	Airport	0.00	100.00	0.30
Total of 33 classes		100.00		12,188.59

1990 Landuse map of the four provinces

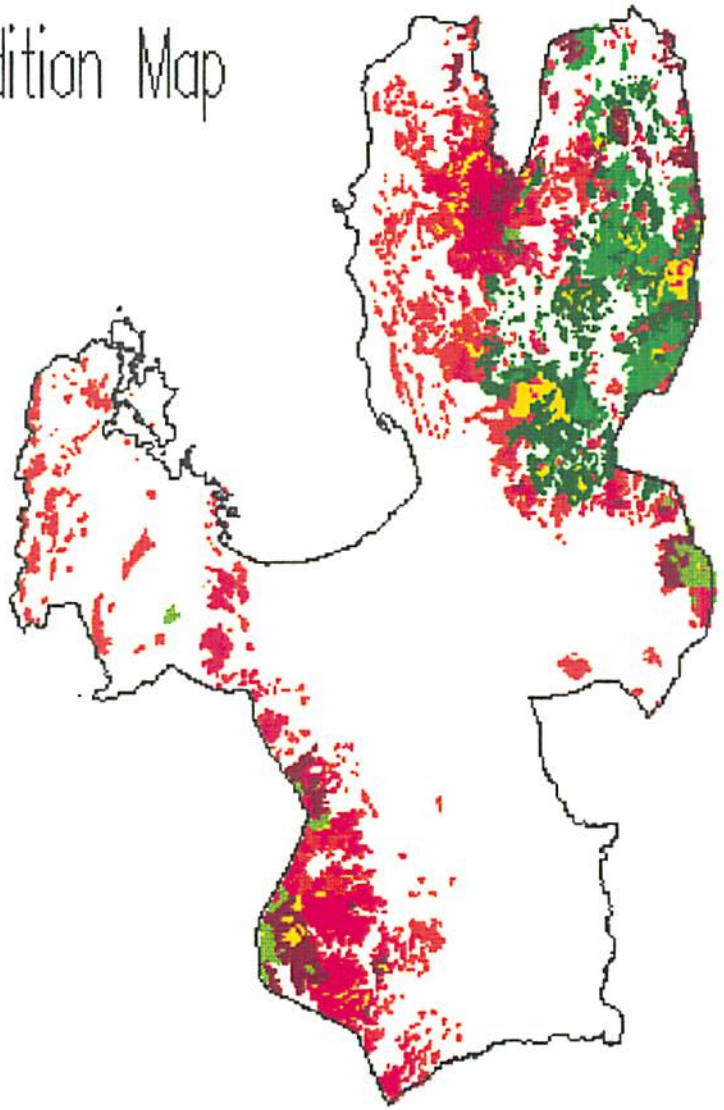


irrigated ricefields (2,808.41 km^2) and dominant cover is grassland/shrubs (1,410.31 km^2). In the Cordillera (N1 to N37 basins) area, forest with associated land uses has an aggregate area of 859.71 km^2 followed by grassland/shrubs (744.89 km^2). Forest can only be found in the Tarlac-Zambales and the central plain area (513.98 km^2).

In Benguet, extensive areas of forest with associated land uses occur but these are mostly consisted of grasses and shrubs. It is the second dominant land use/cover (1,169.19 km^2) after grasslands. Most of it are found in the municipalities of Itogon and Bokod. Grassland with 70-90% cover and shrubs are also extensive (1,278.26 km^2). In La Union, grassland/shrubs are the dominant land cover (808.94 km^2, 56%) followed by forest with associated landuses. This latter category is usually a mixed of agriculture and grass cover unlike that of Benguet. Both categories are extensive throughout hilly and/or mountainous municipalities like Aringay, Pugo, Tubao and Rosario. Agriculture is also significant (342.95 km^2, 23%) with ricefield as the most important and extensive. For Pangasinan, the dominant landuse is agriculture (2,352.06 km^2 , 46%) followed by grassland/shrubs (1,074.88 km^2, 21%). Within agriculture, ricefield comprised about 89% of total area and is extensive throughout the province. About 89.08 km^2 of old growth dipterocarp forests are found in the municipalities of Sison, Mangatarem, San Manuel and San Nicolas. In Tarlac, the dominant land use is irrigated ricefields (1,191.16 km^2, 39%) and are extensive through all municipalities. Old growth dipterocarp forest is the second dominant land use (562.83 km^2, 18%). Grassland and shrubs combined have an aggregate total of 774.39 km^2 or 25% of total provincial area but about 40% are located above 50 m elevation and >15% slope. Forest areas are located in the municipalities of Camp O'Donnell, Bamban, Mayantoc, Tarlac and San Clemente. Tarlac is known for its sugar cane production which covers 9% of total land area.

One of the issues affecting the basin is deforestation which resulted in soil erosion causing siltation of rivers and reservoirs (Ambuklao and Binga). In order to assess the extend of land use change with respect to forestlands, the 1981 forest resource condition map was evaluated against the 1990 land use/cover map. The 1981 forest resource condition map has the following categories: virgin forest (dipterocarp), residual forest (dipterocarp), brushland (grasslands and shrubs), mossy and unproductive forest (mostly dwarf trees), pine virgin forest, pine residual forest and open/cultivated (all categories not included elsewhere). Terminology used in the report differs from the maps. For example, closed and open pine forest referred to in the report are pine virgin and pine residual, respectively, in the forest resource condition map while submarginal forest is called unproductive forest. The virgin forest (dipterocarp) is distinguished into two categories-old growth above and below 800 m elevation. Residual forest generally refers to logged-over forest resulting from a selective logging system (i.e., Philippine Selective Logging System) (Hart 1989).

1980 Forest Resource Condition Map



Legend

- Virgin Forest
- Residual Forest
- Brushland
- Open/Cultivated
- Mossy/Unproductive Forest
- Pine Virgin
- Pine Residual

In the 1981 forest inventory project for Region I which included Abra, Ilocos Norte, Ilocos Sur and Mountain Province, the effective forest cover was about 22% (excluding brushlands) within forestlands (BFD 1987a). Dipterocarp forest were found mostly in Abra while pine forest were largely found in Benguet and Mountain Province. Within the study area, dipterocarp forest were mostly located in Tarlac bordering Zambales (Region III) (BFD 1987b). Estimated areal cover for dipterocarp (virgin and residual) was 119,484 ha (34.7%) while pine virgin and pine residual was 92,987 ha (27%). Table 2 shows the distribution of forest cover per province between forest lands and certified alienable and disposable lands (A & D) based on the forest inventory project. Area measurement for the total forest cover in the four provinces was higher by 16,894 ha in this present study, especially for dipterocarp (11% more than the report). The difference could be due to digitizing, delineation of the forest boundary during photointerpretation or in the transfer of data from aerial photographs and satellite images to maps as well as the fact that estimates were made at 1:50,000 scale whereas the digitized source maps were at 1:250,000 scales. Significant areas of closed and open pine forest existed in Benguet. Based on the 1981 inventory, closed pine forest (with >30% crown cover) was 35,598 ha while open pine forest (10-30% crown cover) was 56,438 ha which were lower than this study by 3%. The reasons for such discrepancy may be due to digitizing and the scale of the map used. The pine forest cover was patchy and small which may not have been fully captured during digitizing.

There are two types of land use/cover change - conversion and modification (Meyer and Turner 1992). Conversion refers to change into another category such as forest lands into agriculture areas while modification refers to change of conditions within the same category (i.e., rice to watermelons). Intensification is considered part of modification. With respect to conversion, a large part of the virgin forest was turned into grasslands/brushlands (13,989.7 ha or 31%) possibly through swidden agriculture although the immediate primary cause may be due to logging. Tarlac for example, has the highest relative conversion through logging in Region III (BFD 1987b). Modification into forestlands with associated land use (largely agriculture) comprised 17,591.3 ha (39%). Residual forests are typically logged-over with very minimal encroachment of agriculture or other activities. Within the basin, about 36,858.7 ha (43% of the total residual forest area) had been converted to brushland while 27,605.9 ha reverted back to forestland. Such afforestation was probably due to land abandonment which encouraged regrowth of trees. Substantial areas of residual forest were shown to be classified as forestland with associated land use (19,233 ha, 6%) in the 1990 land use but this could be an unchanged condition or possibly intensification of activities rather than conversion. Overall, the major conversion categories of forestlands were brushlands followed by agriculture. Modification into forestland with associated land use is significant and extensive for all forest cover types (Table 3).

The 1981 forest inventory.

Forest Cover	Forestlands	Certified A & D	Total (ha)	Total Dipterocarp	Total Pine	Total Brushland
BENGUET						
Dipterocarp						
Dipterocarp, residual	1,695	100	1,795	1,795		
Pine forest, closed	35,598	199	35,797		35,797	
Pine forest, open	56,438	1,197	57,635		57,635	
Submarginal forest	199		199			
Mossy forest	3,689		3,689			
Brushland	34,601	6,382	40,983			40,983
Total	132,220	7,878	140,098			
LA UNION						
Dipterocarp	389		389	389		
Dipterocarp, residual	875	778	1,653	2,431		
Pine forest, closed	195		195			195
Pine forest, open	1,070		1,070			1,070
Submarginal forest						
Mossy forest						
Brushland	17,800	28,889	46,689			46,689
Total	20,329	29,667	49,996			
PANGASINAN						
Dipterocarp	2,105		2,105	2,105		
Dipterocarp, residual	19,247	100	19,347	19,447		
Pine forest, closed	200		200		200	
Pine forest, open	902		902		902	
Submarginal forest	601		601			
Mossy forest	3,408		3,408			
Brushland	24,360	14,536	38,896			38,896
Total	50,823	14,636	65,459			

Forest Cover	Forestlands	Certified A & D	Total (ha)	Total Dipterocarp	Total Pine	Total Brushland
TARLAC						
Dipterocarp	6,390		6,390	6,390		
Dipterocarp, residual	30,012	290	30,302	30,592		
Pine forest, closed						
Pine forest, open						
Submarginal forest	774		774			
Mossy forest	3,776		3,776			
Brushland	9,681	1,936	11,617			11,617
Total	50,633	2,226	52,859			
Grand total	254,005	54,407	308,412	63,149	95,799	138,185

Kummer (1992) suggested that the major cause of primary forest denudation is logging both legal and illegal. The resulting condition paved the way for rapid conversion or modification. Such pattern may be evident in some of the dipterocarp forest modified into forest with associated land use category in the 1990 land use map. Other factors, however, may also played key roles such as subsistence harvest for fuelwood, farming of root crops (typically associated with shifting cultivation) and harvest for charcoal. In the case of pine virgin forest, clearance due to forest fires was an additional factor (BFD 1987a).

Under Presidential Decree (PD) 705 amending the Forestry Reform Code, public domain lands with 18% or over slope cannot be classified as A & D (HSRC 1982, Hart 1989). In the 1981 forest inventory, some A & D lands were within forestlands in Benguet (1,496 ha), La Union (778 ha), Pangasinan (200 ha) and Tarlac (290 ha). It is presumed that these lands were above 18% slope. In the 1990 land use inventory, there are agricultural land at 25% slope and above. Benguet is a mountainous province and in terms of land use patterns, it differs significantly with La Union, Pangasinan and Tarlac which have vast alluvial plains. In Benguet, an aggregate of about 20,018 ha are at ≥25% and >50 m elevation where approximately 19,572 ha are at ≥800 m elevation. Very minimal encroachment of agriculture is found in Tarlac (about 263 ha ricefields) at ≥25% slope and ≥50 m elevation. In Pangasinan, about 9,784 ha of agriculture lands are located at ≥25% slope of which 7,739 ha are at 50-800 m elevations. La Union, on the other hand, has 8,506 ha of ricefields at ≥25% slope of which 8,173 ha are located at 50-800 m elevations. These areas are under permanent cultivation.

There are also some agricultural lands between 18% and 25% slopes but it cannot be quantified because the slope interval set by BSWM were 8-15% and 15-25%. Generally, slopes below 18% are considered suitable as agricultural lands. Given this consideration and without looking at physiographic and soil characteristics, the hectarage of underutilized areas (mainly grasslands and shrubs below 15%) are:

Benguet	5,350 ha at 50 to ≥800 m elevation
La Union	9,266 ha at <5 to 800 m elevation
Pangasinan	48,948 ha at <5 to 800 m elevation
Tarlac	45,797 ha at <5 to 800 m elevation

Although the areas under Tarlac are substantial, no analysis was conducted to compare these areas with areas affected by the lahar from Mt. Pinatubo. Similarly, substantial forest areas were also destroyed as a result of the volcanic eruption in 1991.

Assessment of land use change for Benguet cannot be equated with areas like Tarlac and Zambales. Benguet as in the case with other provinces in the Cordillera Autonomous Region (CAR) is basically a mountainous land where majority of settlements are located in high elevation and even in steep slopes. Generally, steeply sloped areas are referred to as uplands (World Bank 1989). In this case, one can loosely call Benguet as uplands. In contrast to provinces like Pangasinan and Tarlac, most settlements are located in the lowlands. In this latter situation, changes in the upland areas could be related to vertical migration (from lowland to upland) whereas in Benguet, land use changes could be attributed to lateral expansion of economic and demographic activities as well because historically, people have been living in these areas. No attempt was made to assess land use pattern in Benguet with respect to demographic pressure.

Soil erosion and nonpoint pollution critical areas

Soil erosion is the gross amount of soil detached and transported by either water or wind. The extent of soil erosion is affected by several factors including slope, rainfall pattern and land use practices (Mitchell and Bubenzer 1980). According to World Bank (1989), soil erosion is generally ranked as the most serious environmental problem in the Philippines because more than half of the land is over 18% slope. Soil erosion in the Agno River Basin is a significant concern in terms of agriculture, water resource development and forest conservation. Quantitative estimation, however, is limited such as those conducted on flood control by the JICA/DPWH (1991)[3]. The method used was based on estimating the sediment yield of some land use parameters (forest, bare lands and land fall/slide) taken from 1980-1981 aerial photographs. The study showed that average sediment yield for the Cordillera sub-basins is 18.5 million m^3/year (29.6 million t/year) while the Tarlac-Zambales sub-basins is 14.4 million m^3/year (23.04 million t/year). A UNDP/NWRC study reported that 50% of the basin is susceptible to erosion but no sediment yield estimate was given (NWRC 1983).

In this study, soil erosion is quantified using the Universal Soil Loss Equation (USLE) which is an empirical model (McElroy et al. 1976). Although some of the parameters are location specific, the USLE has been used in different

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3 There are several studies on soil loss estimation for Benguet and La Union as graduate theses/dissertations at the University of the Philippines in Los Baños, Laguna and Benguet State University (formerly Mountain State Agricultural College) as well as reports by the Environment Research and Development Bureau (formerly Forest Research Institute). Assessment of these reports/papers is yet to be made for re-estimation/validation of the USLE parameters for Benguet and La Union.

parts of the world under various climatic and land cover conditions with varying success (Mitchell and Bubenzer 1980, World Bank 1989). In the Philippines, the USLE has been used in small watersheds like the Magat and Pantabangan watersheds. This study draws extensively from the works of David (1987) and David and Collado (n.d.), particularly in the estimation of the slope-length factor (LS), cropping (C) and management (P) factors, although validation of the results is yet to be made. For the whole four provinces, only gross soil loss was estimated. Sediment yield was calculated for the Agno River Basin only since only the basin's sediment delivery ratio which is that portion of eroded soil delivered into the receptor water, was determined. The gross soil loss and sediment yield of the Agno River Basin are found in tables annexed to this report. Also, gross soil loss across slopes, elevation, land use and the municipalities of Benguet, La Union, Pangasinan and Tarlac are in tables annexed to this report. The sediment yield is compared to the JICA/DPWH (1991) study as shown in Table 4.

Gross soil loss estimate of the 59 sub-basins ranged from 6.62 to 5,143.90 t/ha/year. For sediment yield, it ranged from 181 to 23,779,454 t/year. The basin with the lowest soil loss and sediment yield are N26 and N19, respectively. The latter has low drainage density and consisted only of two land use categories - forest with associated land uses (typically grasslands) and grassland (70-90% dominant). Some of the sub-basins with highest sediment yield are about the same as those in the JICA/DPWH (1991) report. Basin N1 has the highest gross soil loss while highest sediment yield is S6. It is possible that the contributing factor in basin N1 is the presence of vegetable terrace (3,754 ha). Area cross tabulation between gross soil loss and land use showed that about 4,820 ha of vegetable terrace have gross soil loss >500 t/ha/year. Also, about 9,347 ha of vegetable terrace are located at >40% slope and $\geq$800 m elevation. Basin S6 is located in Tarlac, Tarlac and a dam (Balog Balog) is under construction in its upper watershed (JICA/DPWH 1991). Possible contributing factors to the high sediment yield in Basin S6 in terms of land use are the dominance of grasslands (<90% dominant) at 9.093 ha, ricefield (3,779) ha and riverwash (1,144 ha). Drainage density is relatively high. In contrast with Benguet, grasslands in Tarlac are mixed of agriculture and other land uses. Agriculture in grasslands is typically seasonal such as rice cultivation.

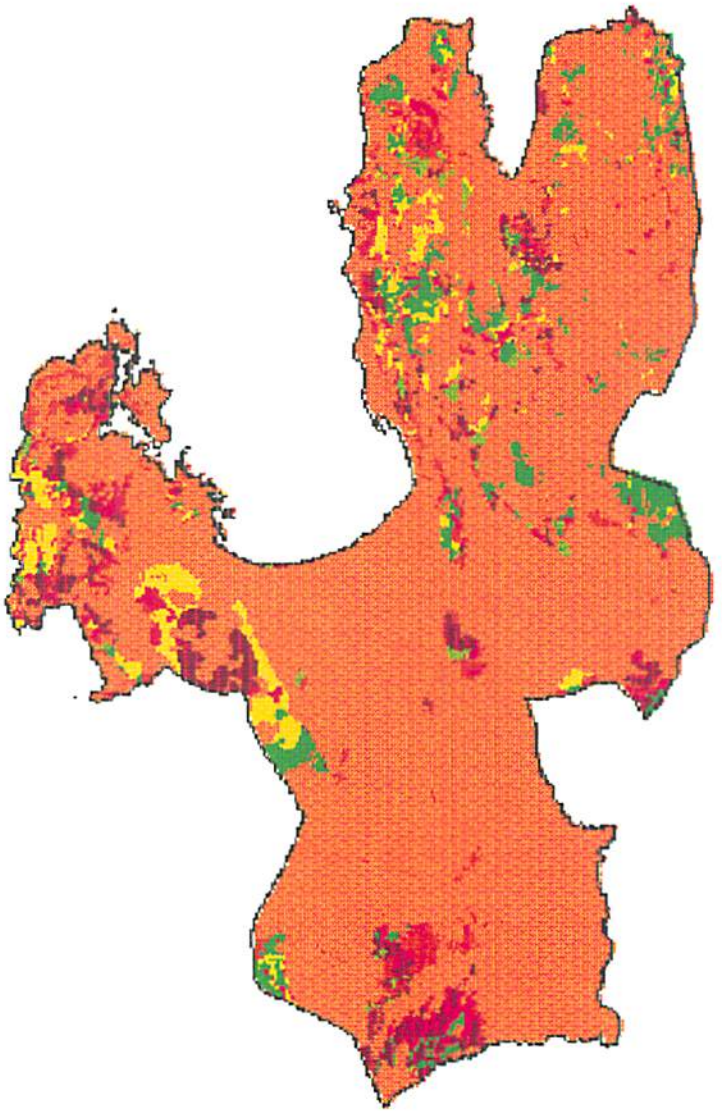
By land use category within the study area, grassland (<70% dominant) has the highest total gross soil loss at 58,936 t/ha/year with a total area of 172,230 ha (14.12% of the study area). Vegetable terraces has total gross soil loss of 22,491.52 t/ha/year but the total area is only 15,170 ha (1.24% of study area). These are located in Benguet at steep slopes and high elevation. This shows that conservation practices may be inadequate.

Slope, loss of vegetable cover, poor conservation practice and high drainage density contribute to soil erosion. Typically, municipalities with

Gross soil loss

Legend

- < 100 (t/ha/year)
- 100 - 200
- 200 - 300
- 300 - 400
- 400 - 500
- 500 - 600
- 600+



Comparison of the sediment yield between JICA/DPWH (1991) and GISCAMP.

Basin	(JICA) Area (Km^2) [A]	(JICA) Sediment Rate ($m^3/km^2/yr$) [B]	(JICA) Yield (t/yr) [C]	(GISCAMP) Yield (t/yr) [D]
S1	119	12,143	2,312,027.20	12,795,579
S2	39	15,157	945,796.80	2,418,824
S3	121	5,474	1,059,766.40	3,355,055
S4	29	1,300	60,320.00	474,138
S5	283	9,469	4,287,563.20	18,576,929
S6	254	8,207	3,335,324.80	23,779,454
S7	34	1,432	77,900.80	196,821
S8	138	1,316	290,572.80	1,945,451
S9	221	6,400	2,263,040.00	472,292
S10	20	5,208	166,656.00	86,482
S11	42	2,907	122,094.00	562,590
S12	190	3,066	932,064.00	154,996
S13	105	5,147	864,696.00	823,190
S14	146	7,898	1,844,972.80	1,121,674
S15	130	10,738	2,233,504.00	2,858,580
S16	21	13,100	440,160.00	1,003,273
S17	43	13,367	919,649.60	133,112
S18	64	11,925	1,221,120.00	361,941
S19	8	2,657	34,009.60	435,974
S20	54	4,448	384,307.20	3,791,939
S21	72	3,782	435,686.40	1,126,179
S22	129	4,351	898,046.40	291,691
N1	48	4,208	323,174.40	280,137
N2	56	2,510	224,896.00	39,981
N3	60	6,750	648,000.00	4,530,272
N4	33	3,471	183,268.80	1,868,165
N5	55	5,457	480,216.00	5,672,829
N6	68	5,995	652,256.00	1,003,111
N7	41	5,422	355,683.20	1,075,623
N8	72	6,469	745,228.80	904,370
N9	103	4,660	767,968.00	1,432,449
N10	81	7,429	962,798.40	315,159
N11	143	6,076	1,390,188.80	4,234,534
N12	100	10,557	1,689,120.00	5,645,541
N13	80	6,627	848,256.00	5,305,839
N14	111	28,280	5,022,528.00	4,915,615
N15	94	4,361	655,894.40	89,630
N16	105	9,779	1,642,872.00	13,627
N17	85	4,785	650,760.00	1,983,180
N18	151	8,803	2,126,804.80	9,257
N19	119	18,107	3,447,572.80	181
N20	40	14,587	933,568.00	1,415,762
N21	53	15,322	1,299,305.60	223,974

Basin	(JICA) Area (Km^2) [A]	(JICA) Sediment Rate ($m^3/km^2/yr$) [B]	(JICA) Yield (t/yr) [C]	(GISCAMP) Yield (t/yr) [D]
N22	50	3,086	246,880.00	502,452
N23	39	3,510	219,024.00	9,571
N24	29	6,815	316,216.00	53,486
N25	69	6,082	671,452.80	1,664,390
N26	73	5,895	688,536.00	6,929
N27	93	3,245	482,856.00	64,711
N28	75	7,964	955,680.00	356,165
N29	15	8,083	193,992.00	16,452
N30	16	3,070	78,592.00	303,748
N31	21	5,148	172,972.80	852,881
N32	66	4,289	452,918.40	274,526
N33	66	2,174	229,574.40	151,817
N34	44	3,102	218,380.80	9,948,910
N35	80	4,501	576,128.00	8,026,761
N36	102	4,621	754,147.20	8,351,755
N37	67	3,654	391,708.80	7,610,679

Note: [C] = [A] x [B] x 1.6 t/m^3 (weight of sediment)

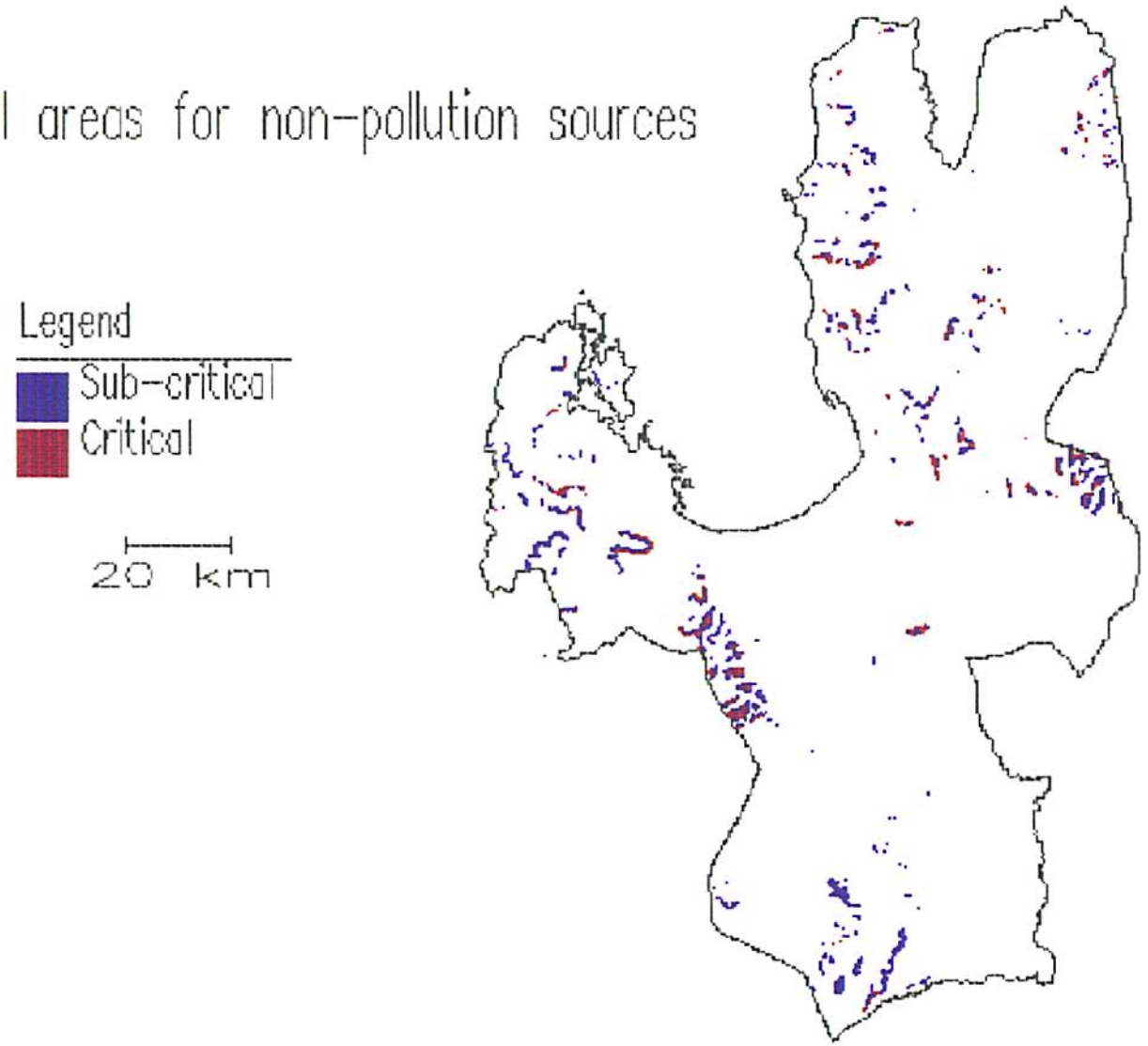
rugged terrain have high gross soil loss. Municipalities with total gross soil loss of >4,000 t/ha/year per province are: Pangasinan - Bani, Anda, Dasol, Infanta, Mangatarem, Sison and San Manuel; Benguet - Mankayan, Buguias, Tublay, La Trinidad, Tuba, Itogon and Bobok; La Union - Agoo, Tubao and Naguilian; and Tarlac - Bamban, O'Donnell and Tarlac. Municipalities with over 7,000 t/ha/year soil loss are Mankayan, Bokod, Agoo, Bamban and O'Donnell.

The values of the USLE parameters used in this study have not been validated. At best, the results give a rough estimates on the soil loss associated with rill and sheet erosion. Comparison with the JICA/DPWH (1991) showed that sediment yield (t/ha/year) results of the 59 sub-basins in this study are much higher. Difference between the two studies' means is highly significant. Apart from the difference in methodology, there is about ten years difference on the land cover used by both studies. Comparison with the sediment yield for 10 sub-basins that drains into the Ambuklao Dam, the result of this study is three times that of JICA/DPWH (1991). This study, therefore, recommends the reassessment of the soil erosion profile of the Agno River Basin, particularly in the refinement of the soil erodibility index (K) and vegetation cover factor (C) so that there will be a basis of refining existing water and land resources (e.g., reforestation) programs.

Pollution from nonpoint sources requires some flexible approach in management (Sivertun et al. 1988). Most pollutants from such sources are suspended sediments, nitrogen, phosphorus and agricultural runoffs. To some extend, nonpoint pollution sources are difficult to contain because they can be everywhere. By targeting critical areas, it is possible to optimize water quality improvement. Critical areas refers to potential areas that will have significantly higher contribution to pollution than other areas and are usually located at steep slope and within proximity to water sources (Reinelt et al. 1989). Sub-critical areas, on the other hand, can contribute to pollution loading, especially when significant land use changes take place, particularly intensification and conversion. This study conducted map modelling using some of the parameters of the USLE. No validation of the results has been conducted and therefore, the findings must be interpreted as rough indications of nonpollution sources. Tables on area and area cross tabulation with land use, erosion, slope, elevation and municipality are annexed to this report. A summary of the findings is given below.

In this study, critical areas in the Agno Basin has an aggregate of 11,190 ha while sub-critical areas comprised about 30,740 ha. About 83% and 66% of the critical and sub-critical areas, respectively, are located above 15% slope category and >150 m elevation. About 76% and 77% of the critical and sub-critical areas, respectively, are found within lands categorized by the BSWM having moderate to very erosion. Suspended sediment due to soil erosion is among the important pollutants from nonpoint sources in the Agno River Basin (about 60% of the

Critical areas for non-pollution sources



critical areas are located within the basin). By land use categories, critical and sub-critical areas have the following areal extent:

Land Use	Critical	Sub-critical
Grasslands (<90% dominant)	7,650 ha	- 19,650 ha
Shrubs	330 ha	6,190 ha
Ricefields	1,960 ha	2,780 ha
Vegetable terrace	780 ha	1,200 ha

Major critical and sub-critical areas within the municipalities of Benguet, La Union, Pangasinan and Tarlac by hectarage are:

Municipality	Critical	Sub-critical
Buguias	542 ha	962 ha
Tuba	415 ha	1,548 ha
Bauang	360 ha	388 ha
Aringay	411 ha	1,055 ha
Naguilian	515 ha	733 ha
Mabini	1,171 ha	1,673 ha
Bugallon	514 ha	1,434 ha
Aguilar	589 ha	1,177 ha
Mangatarem	913 ha	1,639 ha
Sison	324 ha	372 ha
San Nicolas	1,309 ha	2,496 ha
Bamban	212 ha	958 ha
O'Donnell	102 ha	3,136 ha
Tarlac	28 ha	1,682 ha

The land use under most of the critical and sub-critical areas are grasslands with slope >15% and ricefields except for Buguias with its extensive vegetable terraces. This indicates that any unplanned or unmanaged activities which could result in conversion or significant modification will increase and/or enhance pollutant loading into the receptor waters. The municipalities with substantial critical and sub-critical areas have some rugged or hilly topography in addition to high drainage density. Moreover, some of the abovementioned municipalities showed high gross soil loss. Thus, significant land use change in these municipalities, particularly in areas of steep slopes will have an impact on surface water quality. Although assessment is needed to determine the detailed spatial characteristics of these areas relative to slope, land use and municipal jurisdiction, it will suffice to infer from the results that any form of conversion or modification should be allowed only with proper environmental consideration.

Implications of this study

Land use change in the study area has been extensive, particularly with forestlands. Although reforestation projects are ongoing (JICA/DPWH 1991), areas so far covered are not extensive. Of the 39 ongoing/existing reforestation projects with an aggregate total area of 76,394.5 ha, only 2,793 ha had been planted as of 1989. The same report estimated that 50% of the sediment yield within Agno River Basin can be controlled through reforestation equivalent to an area of about 100,000 ha. There are also rehabilitation of the watershed and erosion control projects within the whole length of the basin. To date, there are 14 projects ongoing or completed. In this study, conversion of forestland into brushland and agriculture is significant. Thus, reforestation should also target those areas which had been converted to brushlands. For agriculture areas which are in forestlands (i.e., public domain), efforts must be made to stop farming and introduce social forestry program, instead.

Mining is an important economic sector, especially for Benguet (Briones 1987). The discharge of mine tailings have severely affected lowland areas. Although filling ponds and control measures have been emplaced, mining tailings from previous discharges are now widespread in the gulf, particularly along the rivermouth of Agno River in Lingayen and Pantalan-Sinocalan Rivers. The beach strip on both sides of the Agno River showed pyritic floats sometimes as thick as 3 mm. Long-term impact of these tailings remains to be assessed.

With respect to soil loss, the results of this study can only be taken as rough indications of the effect of existing land use patterns on soil management. Soil loss is significant in areas with poor conservation practices, especially agriculture in steep slopes such as vegetable terrace and seasonal croppings. About twenty municipalities in the four provinces showed >4,000 t/ha/year total gross soil loss. In areas with high gross soil loss as well as in nonpoint pollution critical and sub-critical areas, significant land use change (i.e., conversion, modification and intensification) will have impact on surface water quality as well as increase sediment loading into the river systems and eventually, the Lingayen Gulf. The study area has extensive grasslands of varying percentage cover. Conversion or modifications of these areas must conform to the provisions under Presidential Proclamation 2146[4] so that negative environmental impact can be minimized.

Evaluating the findings of this study relative to the Lingayen Gulf coastal areas has important implications. Unregulated activities in the uplands, especially associated with mining are affecting the water quality of the gulf as

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4 Proclaims certain areas and types of projects as environmentally critical and within the scope of an environmental impact statement.

well as surface waters draining into the Pangasinan plain. Siltation and flooding frequently occur during rainy seasons due to soil erosion and inadequate flood control measures both in the uplands and lowlands. Land use change in the lowlands, in this case, the coastal and adjacent municipalities of La Union and Pangasinan will significantly increase sediment and pollution load into the gulf. Given the industrialization program within the two provinces, it is necessary to undertaken environmental impact assessment on all large-scale projects earmarked for the areas, especially those with polluting effects. Since the Lingayen Gulf has been declared as an environmentally critical area by Presidential Proclamation (PP) 156 dated 25 March 1993, it is but crucial to enforce the provisions of PP 2146 for any developments within the Agno River Basin and the lowlands of La Union and Pangasinan.

Conclusion

This study assessed land use pattern and change within the provinces of Benguet, La Union, Pangasinan and Tarlac. Forest cover has been significantly reduced since the inventory conducted in 1980-1981. Conversion to brushland and agriculture were the major proximate causes although logging under the Philippine Selecting Logging System was the primary cause. Several reforestation projects including watershed rehabilitation and erosion control projects are either ongoing or completed but so far, areal extent is not extensive. Existing land use pattern showed that there is significant encroachment of agriculture into forestlands (>25% slope). These are found in Benguet (20,018 ha), Pangasinan (9,784 ha) and La Union (8,506 ha).

Soil erosion is one of the major environmental problems affecting the Agno River Basin as a result of vegetation cover loss, inadequate conservation practice in agricultural areas and conversion to other land uses. Although the result of this study requires validation, significant gross soil loss (>4,000 t/ha/year) occurred in twenty municipalities of the study area. Nonpoint pollution source areas with critical and sub-critical categories are located in fourteen municipalities. Most of these municipalities have rugged terrain. In terms of land use patterns, areas with high gross soil loss are grassland with varying percentage of vegetation cover and agricultural areas (ricefield and vegetable terraces). Similarly, land use patterns have been noted in areas under critical and sub-critical categories for nonpoint pollution. Conversion or modification including intensification of these areas can exacerbate present environmental problems unless adequate regulatory measures are followed including enforcement of thereof.

It is recommended that a reassessment of the soil erosion profile of the four provinces, especially the Agno River Basin be undertaken as well as the refinement of the USLE parameters under local conditions.

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Tables on single area and area cross tabulation analysis for 1990 Land use/cover

Area cross tabulation of the 1990 land use map in the municipalities of Pangasinan (Part I).

Area (km sq.)
Total %
Row %
Col %

Land Use	San Fabian	Mangaldan	Dagupan	Calasiao	Binmaley
Forest with associated land uses	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
Grassland (>90% dominant)	30.97	0.00	0.00	0.00	0.00
	3.33	0.00	0.00	0.00	0.00
	92.30	0.00	0.00	0.00	0.00
	41.15	0.00	0.00	0.00	0.00
Mangroves/nipa	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
Ricefield, irrigated	25.16	19.14	11.41	32.83	17.69
	2.71	2.06	1.23	3.53	1.90
	6.31	4.80	2.86	8.24	4.44
	33.43	41.89	22.52	61.71	36.80
Grassland (70-90% dominant)	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
Shrubs	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
Coconut	5.02	7.68	6.65	12.79	0.00
	0.54	0.83	0.71	1.38	0.00
	9.32	14.25	12.34	23.74	0.00
	6.67	16.81	13.12	24.03	0.00
Built-up Areas	6.96	8.32	7.01	6.14	2.03
	0.75	0.89	0.75	0.66	0.22
	9.63	11.51	9.69	8.49	2.81
	9.25	18.21	13.83	11.54	4.23

Land Use	San Fabian	Mangaldan	Dagupan	Calasiao	Binmaley
Sugar cane	0.00	7.69	0.00	0.00	0.00
	0.00	0.83	0.00	0.00	0.00
	0.00	45.41	0.00	0.00	0.00
	0.00	16.84	0.00	0.00	0.00
Grassland (<70% dominant)	0.72	0.00	0.00	0.00	0.00
	0.08	0.00	0.00	0.00	0.00
	0.40	0.00	0.00	0.00	0.00
	0.95	0.00	0.00	0.00	0.00
Fishponds	0.55	1.91	25.41	1.32	28.22
	0.06	0.21	2.73	0.14	3.04
	0.57	1.98	26.29	1.36	29.20
	0.73	4.19	50.15	2.47	58.72
Beach sand	0.11	0.00	0.19	0.00	0.12
	0.01	0.00	0.02	0.00	0.01
	2.62	0.00	4.87	0.00	3.00
	0.14	0.00	0.38	0.00	0.25
Riverwash	5.78	0.94	0.00	0.00	0.00
	0.62	0.10	0.00	0.00	0.00
	84.31	13.73	0.00	0.00	0.00
	7.68	2.06	0.00	0.00	0.00
Freshwater swamps	0.00	0.00	0.00	0.13	0.00
	0.00	0.00	0.00	0.01	0.00
	0.00	0.00	0.00	7.89	0.00
	0.00	0.00	0.00	0.25	0.00
Total	75.26	45.68	50.67	53.21	48.06
	8.09	4.91	5.45	5.72	5.17

Land Use	San Carlos	Lingayen	Labrador	Sual	Alaminos	Total
Forest with	0.00	0.00	40.89	0.67	0.00	41.56
associated land uses	0.00	0.00	4.40	0.07	0.00	4.47
	0.00	0.00	98.38	1.62	0.00	
	0.00	0.00	35.98	0.46	0.00	
Grassland (>90%	0.00	0.00	0.00	2.58	0.00	33.55
dominant)	0.00	0.00	0.00	0.28	0.00	3.61
	0.00	0.00	0.00	7.70	0.00	
	0.00	0.00	0.00	1.78	0.00	
Mangroves/nipa	3.06	2.85	0.00	0.00	0.00	5.92
	0.33	0.31	0.00	0.00	0.00	0.64
	51.77	48.23	0.00	0.00	0.00	
	1.72	4.78	0.00	0.00	0.00	
Ricefield, irrigated	115.43	28.67	13.91	41.32	92.83	398.37
	12.42	3.08	1.50	4.44	9.98	42.85
	28.97	7.20	3.49	10.37	23.30	
	64.95	48.00	12.24	28.47	57.78	
Grassland (70-90%	0.00	0.00	0.00	5.47	10.50	15.97
dominant)	0.00	0.00	0.00	0.59	1.13	1.72
	0.00	0.00	0.00	34.24	65.76	
	0.00	0.00	0.00	3.77	6.54	
Shrubs	0.00	0.00	0.00	0.96	2.55	3.51
	0.00	0.00	0.00	0.10	0.27	0.38
	0.00	0.00	0.00	27.23	72.77	
	0.00	0.00	0.00	0.66	1.59	
Coconut	20.09	0.00	0.67	0.97	0.00	53.87
	2.16	0.00	0.07	0.10	0.00	5.79
	37.30	0.00	1.25	1.80	0.00	
	11.31	0.00	0.59	0.67	0.00	
Built-up Areas	27.83	5.41	0.00	2.15	6.45	72.30
	2.99	0.58	0.00	0.23	0.69	7.78
	38.49	7.48	0.00	2.98	8.93	
	15.66	9.05	0.00	1.48	4.02	
Sugar cane	0.00	0.67	0.24	8.25	0.09	16.94
	0.00	0.07	0.03	0.89	0.01	1.82
	0.00	3.97	1.41	48.68	0.53	
	0.00	1.13	0.21	5.68	0.06	
Grassland (<70%	0.00	0.00	54.88	82.07	40.89	178.56
dominant)	0.00	0.00	5.90	8.83	4.40	19.21
	0.00	0.00	30.74	45.96	22.90	
	0.00	0.00	48.30	56.55	25.45	

Land Use	San Carlos	Lingayen	Labrador	Sual	Alaminos	Total
Fishponds	9.61	18.55	3.05	0.69	7.34	96.64
	1.03	2.00	0.33	0.07	0.79	10.39
	9.94	19.20	3.15	0.71	7.59	
	5.40	31.07	2.68	0.47	4.57	
Beach sand	0.00	3.57	0.00	0.00	0.00	3.99
	0.00	0.38	0.00	0.00	0.00	0.43
	0.00	89.51	0.00	0.00	0.00	
	0.00	5.98	0.00	0.00	0.00	
Riverwash	0.13	0.00	0.00	0.00	0.00	6.86
	0.01	0.00	0.00	0.00	0.00	0.74
	1.96	0.00	0.00	0.00	0.00	
	0.08	0.00	0.00	0.00	0.00	
Freshwater swamps	1.57	0.00	0.00	0.00	0.00	1.70
	0.17	0.00	0.00	0.00	0.00	0.18
	92.11	0.00	0.00	0.00	0.00	
	0.88	0.00	0.00	0.00	0.00	
Total	177.72	59.72	113.64	145.13	160.65	929.73
	19.12	6.42	12.22	15.61	17.28	

Area cross tabulation of the 1990 land use map for the municipalities of Pangasinan (Part II).

Area (km sq.)
Total %
Row %
Col %

Land Use	Bani	Bolinao	Anda	Santiago	Siapar Island	Hundred Islands	Cabalitian Island	Agno	Burgos	Total
Grassland (>90% dominant)	5.12	0.00	0.00	0.00	0.00	0.00	0.00	1.81	1.90	8.83
	0.69	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.26	1.19
	58.04	0.00	0.00	0.00	0.00	0.00	0.00	20.47	21.49	
	2.35	0.00	0.00	0.00	0.00	0.00	0.00	1.30	1.54	
Mangroves/nipa	0.00	0.40	0.00	1.43	0.00	0.00	0.00	0.42	0.00	2.26
	0.00	0.05	0.00	0.19	0.00	0.00	0.00	0.06	0.00	0.30
	0.00	17.88	0.00	63.58	0.00	0.00	0.00	18.54	0.00	
	0.00	0.25	0.00	6.67	0.00	0.00	0.00	0.30	0.00	
Ricefield, irrigated	85.31	22.78	37.56	5.68	0.22	0.00	0.00	29.41	43.29	224.25
	11.49	3.07	5.06	0.76	0.03	0.00	0.00	3.96	5.83	30.20
	38.04	10.16	16.75	2.53	0.10	0.00	0.00	13.12	19.30	
	39.08	14.02	50.92	26.41	11.45	0.00	0.00	21.22	35.17	
Grassland (70-90% dominant)	0.00	0.00	0.00	0.39	0.00	1.20	0.00	0.00	0.00	1.58
	0.00	0.00	0.00	0.05	0.00	0.16	0.00	0.00	0.00	0.21
	0.00	0.00	0.00	24.53	0.00	75.47	0.00	0.00	0.00	
	0.00	0.00	0.00	1.81	0.00	100.00	0.00	0.00	0.00	
Shrubs	43.26	109.11	14.22	5.86	1.73	0.00	0.00	81.80	28.98	284.96
	5.83	14.69	1.92	0.79	0.23	0.00	0.00	11.02	3.90	38.37
	15.18	38.29	4.99	2.05	0.61	0.00	0.00	28.71	10.17	
	19.82	67.13	19.28	27.24	88.55	0.00	0.00	59.01	23.54	
Coconut	0.00	9.07	4.47	6.41	0.00	0.00	0.00	8.14	3.50	31.58
	0.00	1.22	0.60	0.86	0.00	0.00	0.00	1.10	0.47	4.25
	0.00	28.71	14.14	20.29	0.00	0.00	0.00	25.78	11.07	
	0.00	5.58	6.06	29.81	0.00	0.00	0.00	5.87	2.84	
Built-up Areas	1.12	0.67	0.55	0.00	0.00	0.00	0.00	1.12	1.30	4.77
	0.15	0.09	0.07	0.00	0.00	0.00	0.00	0.15	0.18	0.64
	23.51	14.11	11.60	0.00	0.00	0.00	0.00	23.51	27.27	
	0.51	0.41	0.75	0.00	0.00	0.00	0.00	0.81	1.06	
Sugar cane	4.35	1.66	4.50	0.00	0.00	0.00	0.19	0.00	0.00	10.70
	0.59	0.22	0.61	0.00	0.00	0.00	0.03	0.00	0.00	1.44
	40.64	15.50	42.04	0.00	0.00	0.00	1.82	0.00	0.00	
	1.99	1.02	6.10	0.00	0.00	0.00	11.50	0.00	0.00	

Land Use	Bani	Bolinao	Anda	Santiago	Siapar Island	Hundred Islands	Cabalitian Island	Agno	Burgos	Total
Grassland (<70%	56.39	13.58	6.20	1.05	0.00	0.00	0.00	14.31	43.61	135.13
dominant)	7.59	1.83	0.83	0.14	0.00	0.00	0.00	1.93	5.87	18.20
	41.73	10.05	4.59	0.77	0.00	0.00	0.00	10.59	32.27	
	25.83	8.35	8.41	4.86	0.00	0.00	0.00	10.32	35.42	
Corn (>70%	0.00	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.60
dominant)	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08
	0.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	0.00	0.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Fishponds	22.02	0.54	5.02	0.69	0.00	0.00	0.00	0.67	0.00	28.94
	2.97	0.07	0.68	0.09	0.00	0.00	0.00	0.09	0.00	3.90
	76.10	1.86	17.35	2.37	0.00	0.00	0.00	2.32	0.00	
	10.09	0.33	6.81	3.20	0.00	0.00	0.00	0.48	0.00	
Saltbeds	0.00	0.00	1.24	0.00	0.00	0.00	0.00	0.00	0.00	1.24
	0.00	0.00	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.17
	0.00	0.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	1.68	0.00	0.00	0.00	0.00	0.00	0.00	
Ipil-ipil	0.70	0.61	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.32
	0.09	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18
	53.41	46.59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	0.32	0.38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Riverwash	0.00	0.00	0.00	0.00	0.00	0.00	1.49	0.48	0.00	1.97
	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.06	0.00	0.27
	0.00	0.00	0.00	0.00	0.00	0.00	75.76	24.24	0.00	
	0.00	0.00	0.00	0.00	0.00	0.00	88.50	0.34	0.00	
Maguey	0.00	3.51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.51
	0.00	0.47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.47
	0.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	0.00	2.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Freshwater swamps	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.52	0.52
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.07
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.42	
Kaingin	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.46	0.00	0.46
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.06
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	0.00	
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.33	0.00	
Total	218.28	162.53	73.75	21.50	1.96	1.20	1.69	138.63	123.09	742.61
	29.39	21.89	9.93	2.89	0.26	0.16	0.23	18.67	16.58	

Area cross tabulation of the 1990 land use map for the municipalities of Pangasinan (Part III).

Area (km sq.)
Total %
Row %
Col %

Land Use	Mabini	Dasol	Infanta	Bugallon	Aguilar	Mangatarem
Forest	0.00	0.00	0.00	0.00	0.00	14.36
	0.00	0.00	0.00	0.00	0.00	0.95
	0.00	0.00	0.00	0.00	0.00	100.00
	0.00	0.00	0.00	0.00	0.00	5.01
Forest with	25.17	0.76	65.98	11.01	14.24	41.26
Associate landuses	1.66	0.05	4.36	0.73	0.94	2.73
	15.89	0.48	41.65	6.95	8.99	26.04
	11.10	0.45	28.22	7.08	9.85	14.40
Grassland (>90%	1.90	0.70	0.00	0.00	0.00	4.54
dominant)	0.13	0.05	0.00	0.00	0.00	0.30
	26.57	9.83	0.00	0.00	0.00	63.60
	0.84	0.41	0.00	0.00	0.00	1.58
Mangrove/nipa	0.00	0.00	0.00	5.72	0.00	0.00
	0.00	0.00	0.00	0.38	0.00	0.00
	0.00	0.00	0.00	100.00	0.00	0.00
	0.00	0.00	0.00	3.68	0.00	0.00
Ricefield, irrigated	17.33	30.55	18.54	48.44	41.78	119.80
	1.15	2.02	1.23	3.20	2.76	7.92
	3.70	6.51	3.95	10.33	8.91	25.55
	7.64	17.93	7.93	31.14	28.90	41.80
Shrubs	46.40	34.21	27.13	0.00	0.00	0.00
	3.07	2.26	1.79	0.00	0.00	0.00
	43.07	31.75	25.18	0.00	0.00	0.00
	20.46	20.08	11.60	0.00	0.00	0.00
Coconut	2.67	1.30	0.00	1.54	0.00	3.26
	0.18	0.09	0.00	0.10	0.00	0.22
	7.70	3.74	0.00	4.43	0.00	9.38
	1.18	0.76	0.00	0.99	0.00	1.14
Built-up Areas	0.46	0.99	0.51	5.57	5.59	11.68
	0.03	0.07	0.03	0.37	0.37	0.77
	0.79	1.69	0.87	9.54	9.57	20.00
	0.20	0.58	0.22	3.58	3.86	4.08

Land Use	Mabini	Dasol	Infanta	Bugallon	Aguilar	Mangatarem
Sugar cane	0.00	0.06	0.00	1.84	0.00	0.00
	0.00	0.00	0.00	0.12	0.00	0.00
	0.00	0.48	0.00	14.63	0.00	0.00
	0.00	0.04	0.00	1.18	0.00	0.00
Grassland (<70%	132.89	94.54	118.43	80.80	82.32	86.79
dominant)	8.79	6.25	7.83	5.34	5.44	5.74
	21.38	15.21	19.06	13.00	13.25	13.97
	58.59	55.48	50.65	51.94	56.94	30.28
Corn (>70%	0.00	0.00	0.00	0.00	0.00	0.00
dominant)	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00
Fishponds	0.00	0.79	3.23	0.63	0.00	0.00
	0.00	0.05	0.21	0.04	0.00	0.00
	0.00	17.04	69.45	13.50	0.00	0.00
	0.00	0.46	1.38	0.40	0.00	0.00
Saltbeds	0.00	6.50	0.00	0.00	0.00	0.00
	0.00	0.43	0.00	0.00	0.00	0.00
	0.00	100.00	0.00	0.00	0.00	0.00
	0.00	3.81	0.00	0.00	0.00	0.00
Riverwash	0.00	0.00	0.00	0.00	0.66	1.76
	0.00	0.00	0.00	0.00	0.04	0.12
	0.00	0.00	0.00	0.00	18.49	49.58
	0.00	0.00	0.00	0.00	0.45	0.62
Freshwater swamps	0.00	0.00	0.00	0.00	0.00	3.15
	0.00	0.00	0.00	0.00	0.00	0.21
	0.00	0.00	0.00	0.00	0.00	43.96
	0.00	0.00	0.00	0.00	0.00	1.10
Total	226.82	170.40	233.81	155.55	144.59	286.61
	15.00	11.27	15.46	10.29	9.56	18.95

Land Use	Urbiztondo	Basista	Malasiqui	Sta. Barbara	Mapandan	Total
Forest	0.00	0.00	0.00	0.00	0.00	14.36
	0.00	0.00	0.00	0.00	0.00	0.95
	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	
Forest with Associate landuses	0.00	0.00	0.00	0.00	0.00	158.42
	0.00	0.00	0.00	0.00	0.00	10.48
	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	
Grassland (>90% dominant)	0.00	0.00	0.00	0.00	0.00	7.14
	0.00	0.00	0.00	0.00	0.00	0.47
	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	
Mangrove/nipa	0.00	0.00	0.00	0.00	0.00	5.72
	0.00	0.00	0.00	0.00	0.00	0.38
	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	
Ricefield, irrigated	38.59	18.91	71.49	53.46	10.04	468.94
	2.55	1.25	4.73	3.54	0.66	31.01
	8.23	4.03	15.25	11.40	2.14	
	71.51	63.27	59.97	77.03	45.75	
Shrubs	0.00	0.00	0.00	0.00	0.00	107.73
	0.00	0.00	0.00	0.00	0.00	7.12
	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	
Coconut	8.14	7.44	9.41	0.97	0.00	34.73
	0.54	0.49	0.62	0.06	0.00	2.30
	23.44	21.42	27.10	2.80	0.00	
	15.09	24.89	7.89	1.40	0.00	
Built-up Areas	3.27	3.48	10.96	11.52	4.38	58.41
	0.22	0.23	0.73	0.76	0.29	3.86
	5.60	5.96	18.77	19.72	7.49	
	6.06	11.64	9.20	16.59	19.95	
Sugar cane	0.00	0.00	0.00	3.14	7.53	12.56
	0.00	0.00	0.00	0.21	0.50	0.83
	0.00	0.00	0.00	24.97	59.93	
	0.00	0.00	0.00	4.52	34.31	
Grassland (<70% dominant)	0.00	0.00	25.35	0.31	0.00	621.45
	0.00	0.00	1.68	0.02	0.00	41.10
	0.00	0.00	4.08	0.05	0.00	
	0.00	0.00	21.26	0.45	0.00	

Land Use	Urbiztondo	Basista	Malasiqui	Sta. Barbara	Mapandan	Total
Corn (>70%	0.00	0.00	0.87	0.00	0.00	0.87
dominant)	0.00	0.00	0.06	0.00	0.00	0.06
	0.00	0.00	100.00	0.00	0.00	
	0.00	0.00	0.73	0.00	0.00	
Fishponds	0.00	0.00	0.00	0.00	0.00	4.65
	0.00	0.00	0.00	0.00	0.00	0.31
	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	
Saltbeds	0.00	0.00	0.00	0.00	0.00	6.50
	0.00	0.00	0.00	0.00	0.00	0.43
	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	
Riverwash	0.00	0.00	1.14	0.00	0.00	3.56
	0.00	0.00	0.08	0.00	0.00	0.24
	0.00	0.00	31.93	0.00	0.00	
	0.00	0.00	0.95	0.00	0.00	
Freshwater swamps	3.96	0.06	0.00	0.00	0.00	7.17
	0.26	0.00	0.00	0.00	0.00	0.47
	55.21	0.83	0.00	0.00	0.00	
	7.34	0.20	0.00	0.00	0.00	
Total	53.96	29.89	119.22	69.40	21.94	1,512.20
	3.57	1.98	7.88	4.59	1.45	

Area cross tabulation of the 1990 land use map for the municipalities of Pangasinan (Part IV).

Land Use	San Jacinto	Manaoag	Laoac	Pozorrubio	Sison	Binalonan
Forest	0.00	0.00	0.00	0.00	21.21	0.00
	0.00	0.00	0.00	0.00	2.24	0.00
	0.00	0.00	0.00	0.00	28.39	0.00
	0.00	0.00	0.00	0.00	18.94	0.00
Grassland (>90% dominant)	0.11	0.00	0.00	0.21	21.97	2.97
	0.01	0.00	0.00	0.02	2.32	0.31
	0.09	0.00	0.00	0.19	19.83	2.68
	0.34	0.00	0.00	0.26	19.62	4.57
Ricefield, irrigated	13.86	25.62	21.63	52.21	35.36	37.87
	1.46	2.71	2.29	5.52	3.74	4.00
	3.05	5.64	4.76	11.49	7.78	8.33
	45.71	55.81	69.25	65.56	31.56	58.26
Grassland (70-90% dominant)	0.00	0.00	0.00	0.00	1.27	0.00
	0.00	0.00	0.00	0.00	0.13	0.00
	0.00	0.00	0.00	0.00	1.93	0.00
	0.00	0.00	0.00	0.00	1.13	0.00
Shrubs	0.00	0.00	0.00	0.00	15.98	0.00
	0.00	0.00	0.00	0.00	1.69	0.00
	0.00	0.00	0.00	0.00	61.04	0.00
	0.00	0.00	0.00	0.00	14.27	0.00
Built-up Areas	5.71	8.74	3.87	8.07	1.72	6.81
	0.60	0.92	0.41	0.85	0.18	0.72
	7.73	11.84	5.24	10.93	2.33	9.23
	18.82	19.04	12.39	10.13	1.53	10.48
Coffee, citrus, lanzones	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00
Cassava, potatoes, black pepper	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00

Land Use	San Jacinto	Manaoag	Laoac	Pozorrubio	Sison	Binalonan
Sugar cane	1.90	2.33	3.08	3.14	0.00	10.65
	0.20	0.25	0.33	0.33	0.00	1.13
	8.99	11.05	14.59	14.87	0.00	50.50
	6.26	5.08	9.85	3.94	0.00	16.39
Grassland (<70% dominant)	7.38	9.22	0.00	14.10	9.84	0.00
	0.78	0.97	0.00	1.49	1.04	0.00
	16.06	20.06	0.00	30.69	21.42	0.00
	24.33	20.08	0.00	17.71	8.79	0.00
Corn (>70% dominant)	0.00	0.00	1.43	0.00	0.00	0.00
	0.00	0.00	0.15	0.00	0.00	0.00
	0.00	0.00	36.92	0.00	0.00	0.00
	0.00	0.00	4.59	0.00	0.00	0.00
Riverwash	1.37	0.00	1.23	1.91	4.66	4.24
	0.15	0.00	0.13	0.20	0.49	0.45
	2.19	0.00	1.95	3.05	7.43	6.77
	4.53	0.00	3.92	2.40	4.16	6.53
Mango	0.00	0.00	0.00	0.00	0.00	2.45
	0.00	0.00	0.00	0.00	0.00	0.26
	0.00	0.00	0.00	0.00	0.00	100.00
	0.00	0.00	0.00	0.00	0.00	3.77
Total	30.33	45.91	31.24	79.64	112.02	65.00
	3.20	4.85	3.30	8.42	11.84	6.87

Land Use	Urdaneta	Asingan	San Manu	San Nicolas	Tayug	Total
Forest	0.00	0.00	13.82	39.69	0.00	74.72
	0.00	0.00	1.46	4.19	0.00	7.90
	0.00	0.00	18.49	53.12	0.00	
	0.00	0.00	11.92	18.05	0.00	
Grassland (>90% dominant)	0.00	0.00	35.25	50.28	0.00	110.80
	0.00	0.00	3.73	5.31	0.00	11.71
	0.00	0.00	31.82	45.38	0.00	
	0.00	0.00	30.41	22.86	0.00	
Ricefield, irrigated	104.45	52.72	39.74	38.69	32.30	454.44
	11.04	5.57	4.20	4.09	3.41	48.02
	22.98	11.60	8.74	8.51	7.11	
	81.41	70.66	34.27	17.59	74.35	
Grassland (70-90% dominant)	0.00	0.00	1.39	63.00	0.00	65.65
	0.00	0.00	0.15	6.66	0.00	6.94
	0.00	0.00	2.12	95.95	0.00	
	0.00	0.00	1.20	28.64	0.00	
Shrubs	0.42	0.00	0.00	9.79	0.00	26.19
	0.04	0.00	0.00	1.03	0.00	2.77
	1.60	0.00	0.00	37.36	0.00	
	0.33	0.00	0.00	4.45	0.00	
Built-up Areas	19.64	7.31	2.51	4.44	4.99	73.80
	2.08	0.77	0.27	0.47	0.53	7.80
	26.62	9.90	3.40	6.01	6.76	
	15.31	9.79	2.16	2.02	11.49	
Coffee, citrus, lanzones	0.00	1.15	1.14	0.00	0.00	2.29
	0.00	0.12	0.12	0.00	0.00	0.24
	0.00	50.33	49.67	0.00	0.00	
	0.00	1.54	0.98	0.00	0.00	
Cassava, potatoes, black pepper	0.49	0.00	1.48	0.39	0.00	2.36
	0.05	0.00	0.16	0.04	0.00	0.25
	20.89	0.00	62.66	16.46	0.00	
	0.38	0.00	1.28	0.18	0.00	
Sugar cane	0.00	0.00	0.00	0.00	0.00	21.09
	0.00	0.00	0.00	0.00	0.00	2.23
	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	
Grassland (<70% dominant)	3.11	0.00	2.30	0.00	0.00	45.95
	0.33	0.00	0.24	0.00	0.00	4.86
	6.76	0.00	5.01	0.00	0.00	
	2.42	0.00	1.98	0.00	0.00	

Land Use	Urdaneta	Asingan	San Manu	San Nicolas	Tayug	Total
Corn (>70% dominant)	0.02	2.44	0.00	0.00	0.00	3.88
	0.00	0.26	0.00	0.00	0.00	0.41
	0.38	62.69	0.00	0.00	0.00	
	0.01	3.26	0.00	0.00	0.00	
Riverwash	0.18	11.00	18.31	13.65	6.16	62.71
	0.02	1.16	1.94	1.44	0.65	6.63
	0.29	17.53	29.20	21.77	9.81	
	0.14	14.74	15.80	6.21	14.17	
Mango	0.00	0.00	0.00	0.00	0.00	2.45
	0.00	0.00	0.00	0.00	0.00	0.26
	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	
Total	128.31	74.60	115.94	219.92	43.44	946.33
	13.56	7.88	12.25	23.24	4.59	

Area cross tabulation of the 1990 land use map for the municipalities of Pangasinan (Part V).

Area (km sq.)
Total %
Row %
Col %

Land Use	Natividad	San Quintin	Sta. Maria	Umingan	Balungao	Rosales
Forest with	23.62	49.52	0.00	21.62	0.00	0.00
associated land uses	2.50	5.23	0.00	2.28	0.00	0.00
	24.93	52.26	0.00	22.81	0.00	0.00
	27.54	43.37	0.00	8.39	0.00	0.00
Grassland (>90%	9.67	15.95	0.00	8.49	1.18	0.48
dominant)	1.02	1.69	0.00	0.90	0.12	0.05
	27.03	44.61	0.00	23.73	3.30	1.34
	11.27	13.97	0.00	3.29	1.54	0.73
Mangroves/nipa	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00
Ricefield, irrigated	18.08	33.66	34.22	151.74	44.04	47.77
	1.91	3.56	3.62	16.03	4.65	5.05
	3.29	6.12	6.23	27.61	8.01	8.69
	21.08	29.47	70.25	58.87	57.47	72.53
Shrubs	23.17	5.78	0.00	4.03	0.00	0.00
	2.45	0.61	0.00	0.43	0.00	0.00
	70.24	17.53	0.00	12.23	0.00	0.00
	27.02	5.06	0.00	1.56	0.00	0.00
Coconut	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00
Built-up Areas	3.99	6.17	5.45	6.29	5.36	4.62
	0.42	0.65	0.58	0.66	0.57	0.49
	8.01	12.39	10.95	12.64	10.77	9.27
	4.65	5.40	11.19	2.44	7.00	7.01
Cassava, potatoes,	3.29	0.02	0.00	0.00	0.00	0.00
black pepper	0.35	0.00	0.00	0.00	0.00	0.00
	33.08	0.15	0.00	0.00	0.00	0.00
	3.83	0.01	0.00	0.00	0.00	0.00

Land Use	Natividad	San Quintin	Sta. Maria	Umingan	Balungao	Rosales
Sugar cane	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00
Grassland (<70% dominant)	0.28	1.00	0.00	60.53	25.08	9.50
	0.03	0.11	0.00	6.40	2.65	1.00
	0.25	0.87	0.00	52.51	21.76	8.24
	0.33	0.88	0.00	23.48	32.73	14.43
Corn (>70% dominant)	0.00	0.00	0.48	0.00	0.00	0.69
	0.00	0.00	0.05	0.00	0.00	0.07
	0.00	0.00	5.28	0.00	0.00	7.59
	0.00	0.00	0.98	0.00	0.00	1.04
Riverwash	3.56	2.09	8.56	5.05	0.97	2.81
	0.38	0.22	0.90	0.53	0.10	0.30
	11.67	6.86	28.09	16.57	3.19	9.22
	4.15	1.83	17.57	1.96	1.27	4.26
Mango	0.11	0.00	0.00	0.00	0.00	0.00
	0.01	0.00	0.00	0.00	0.00	0.00
	100.00	0.00	0.00	0.00	0.00	0.00
	0.12	0.00	0.00	0.00	0.00	0.00
Freshwater swamps	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00
Total	85.75	114.19	48.71	257.75	76.63	65.86
	9.06	12.06	5.15	27.23	8.10	6.96

Land Use	Villasis	Sto. Toma	Alcala	Bautista	Bayambang	Total
Forest with	0.00	0.00	0.00	0.00	0.00	94.75
associated land uses	0.00	0.00	0.00	0.00	0.00	10.01
	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	
Grassland (>90%	0.00	0.00	0.00	0.00	0.00	35.76
dominant)	0.00	0.00	0.00	0.00	0.00	3.78
	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	
Mangroves/nipa	0.00	0.00	0.00	0.00	2.97	2.97
	0.00	0.00	0.00	0.00	0.31	0.31
	0.00	0.00	0.00	0.00	100.00	
	0.00	0.00	0.00	0.00	3.19	
Ricefield, irrigated	49.89	7.11	33.28	58.71	71.15	549.65
	5.27	0.75	3.52	6.20	7.52	58.07
	9.08	1.29	6.06	10.68	12.94	
	63.50	55.61	74.02	86.15	76.43	
Shrubs	0.00	0.00	0.00	0.00	0.00	32.98
	0.00	0.00	0.00	0.00	0.00	3.48
	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	
Coconut	0.00	0.00	0.08	2.44	4.72	7.23
	0.00	0.00	0.01	0.26	0.50	0.76
	0.00	0.00	1.03	33.68	65.29	
	0.00	0.00	0.17	3.57	5.07	
Built-up Areas	5.38	1.02	4.54	1.37	5.59	49.77
	0.57	0.11	0.48	0.15	0.59	5.26
	10.80	2.04	9.12	2.76	11.22	
	6.84	7.94	10.10	2.02	6.00	
Cassava, potatoes,	4.96	0.00	0.00	1.30	0.37	9.93
black pepper	0.52	0.00	0.00	0.14	0.04	1.05
	49.92	0.00	0.00	13.08	3.76	
	6.31	0.00	0.00	1.91	0.40	
Sugar cane	0.00	1.91	0.75	0.00	0.00	2.66
	0.00	0.20	0.08	0.00	0.00	0.28
	0.00	71.91	28.09	0.00	0.00	
	0.00	14.95	1.66	0.00	0.00	
Grassland (<70%	13.67	0.00	0.00	0.00	5.20	115.26
dominant)	1.44	0.00	0.00	0.00	0.55	12.18
	11.86	0.00	0.00	0.00	4.51	
	17.40	0.00	0.00	0.00	5.58	

Land Use	Villasis	Sto. Toma	Alcala	Bautista	Bayambang	Total
Corn (>70% dominant)	2.50	1.73	3.66	0.00	0.00	9.05
	0.26	0.18	0.39	0.00	0.00	0.96
	27.56	19.14	40.43	0.00	0.00	
	3.17	13.55	8.14	0.00	0.00	
Riverwash	2.18	1.02	2.23	0.08	1.94	30.47
	0.23	0.11	0.24	0.01	0.21	3.22
	7.16	3.33	7.30	0.25	6.37	
	2.78	7.94	4.95	0.11	2.09	
Mango	0.00	0.00	0.00	0.00	0.00	0.11
	0.00	0.00	0.00	0.00	0.00	0.01
	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	
Freshwater swamps	0.00	0.00	0.43	4.26	1.15	5.84
	0.00	0.00	0.05	0.45	0.12	0.62
	0.00	0.00	7.42	72.89	19.69	
	0.00	0.00	0.96	6.25	1.24	
Total	78.58	12.79	44.96	68.15	93.10	946.46
	8.30	1.35	4.75	7.20	9.84	

Area cross tabulation of the 1990 land use map for the municipalities of Benguet.

Area (km sq.)
Total %
Row %
Col %

Land Use	Bakun	Mankayan	Buguias	Kibungan	Kabayan
Forest with	90.69	106.55	48.71	73.24	104.82
Associated Landuses	3.33	3.91	1.79	2.69	3.85
	7.76	9.11	4.17	6.26	8.97
	55.47	47.41	40.08	45.39	66.22
Ricefield, irrigated	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
Grassland (90-70%	61.22	63.94	6.36	41.10	37.96
dominant)	2.25	2.35	0.23	1.51	1.39
	7.25	7.57	0.75	4.87	4.49
	37.45	28.45	5.24	25.47	23.98
Shrubs	0.00	6.81	1.33	23.38	0.00
	0.00	0.25	0.05	0.86	0.00
	0.00	2.89	0.56	9.91	0.00
	0.00	3.03	1.09	14.49	0.00
Built-up Areas	0.00	2.08	0.00	0.00	0.00
	0.00	0.08	0.00	0.00	0.00
	0.00	38.72	0.00	0.00	0.00
	0.00	0.92	0.00	0.00	0.00
Grassland (<70%	8.32	0.00	0.00	0.10	0.00
dominant)	0.31	0.00	0.00	0.00	0.00
	4.21	0.00	0.00	0.05	0.00
	5.09	0.00	0.00	0.06	0.00
Rice terraces	3.26	9.59	0.00	1.85	3.82
	0.12	0.35	0.00	0.07	0.14
	3.16	9.31	0.00	1.80	3.71
	1.99	4.27	0.00	1.15	2.42

Land Use	Bakun	Mankayan	Buguias	Kibungan	Kabayan
Vegetable terraces	0.00	35.78	65.13	21.69	10.50
	0.00	1.31	2.39	0.80	0.39
	0.00	23.59	42.94	14.30	6.92
	0.00	15.92	53.59	13.44	6.63
Mines	0.00	0.00	0.00	0.00	1.18
	0.00	0.00	0.00	0.00	0.04
	0.00	0.00	0.00	0.00	13.19
	0.00	0.00	0.00	0.00	0.75
Filling Ponds	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
Reservoirs	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
Total	163.48	224.75	121.54	161.36	158.29
	6.00	8.25	4.46	5.92	5.81

Land Use	Atok	Kapangan	Tublay	Sablan	La Trinidad
Forest with	62.88	6.78	15.74	9.69	11.17
Associated Landuses	2.31	0.25	0.58	0.36	0.41
	5.38	0.58	1.35	0.83	0.96
	45.28	4.65	16.46	9.17	14.28
Ricefield, irrigated	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
Grassland (90-70%	35.21	42.08	9.84	34.66	11.37
dominant)	1.29	1.54	0.36	1.27	0.42
	4.17	4.98	1.17	4.10	1.35
	25.36	28.87	10.29	32.80	14.53
Shrubs	8.14	36.46	24.86	28.74	1.76
	0.30	1.34	0.91	1.06	0.06
	3.45	15.46	10.54	12.18	0.75
	5.86	25.01	25.99	27.20	2.25
Built-up Areas	0.00	0.00	0.00	0.00	3.27
	0.00	0.00	0.00	0.00	0.12
	0.00	0.00	0.00	0.00	61.00
	0.00	0.00	0.00	0.00	4.18
Grassland (<70%	16.04	44.71	17.93	30.73	41.02
dominant)	0.59	1.64	0.66	1.13	1.51
	8.12	22.62	9.07	15.55	20.76
	11.55	30.67	18.74	29.08	52.41
Rice terraces	8.62	15.22	24.38	1.85	0.66
	0.32	0.56	0.89	0.07	0.02
	8.37	14.78	23.67	1.80	0.64
	6.21	10.44	25.49	1.75	0.84
Vegetable terraces	5.65	0.52	2.88	0.00	6.29
	0.21	0.02	0.11	0.00	0.23
	3.72	0.34	1.90	0.00	4.15
	4.07	0.36	3.01	0.00	8.04
Mines	1.87	0.00	0.00	0.00	2.72
	0.07	0.00	0.00	0.00	0.10
	20.87	0.00	0.00	0.00	30.38
	1.34	0.00	0.00	0.00	3.47

Land Use	Atok	Kapangan	Tublay	Sablan	La Trinidad
Filling Ponds	0.45	0.00	0.00	0.00	0.00
	0.02	0.00	0.00	0.00	0.00
	49.18	0.00	0.00	0.00	0.00
	0.32	0.00	0.00	0.00	0.00
Reservoirs	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
Total	138.85	145.78	95.63	105.67	78.26
	5.10	5.35	3.51	3.88	2.87

Land Use	Tuba	Baguio	Itogon	Bokod	Total
Forest with Associated Landuses	121.87	22.15	266.71	228.17	1,169.19
	4.47	0.81	9.79	8.38	42.92
	10.42	1.89	22.81	19.51	
	34.77	38.76	48.15	61.83	
Ricefield, irrigated	0.27	0.00	0.00	0.00	0.27
	0.01	0.00	0.00	0.00	0.01
	100.00	0.00	0.00	0.00	
	0.08	0.00	0.00	0.00	
Grassland (90-70% dominant)	135.04	23.26	234.35	108.32	844.70
	4.96	0.85	8.60	3.98	31.01
	15.99	2.75	27.74	12.82	
	38.53	40.70	42.31	29.35	
Shrubs	73.54	6.09	23.99	0.82	235.94
	2.70	0.22	0.88	0.03	8.66
	31.17	2.58	10.17	0.35	
	20.98	10.66	4.33	0.22	
Built-up Areas	0.01	0.00	0.00	0.00	5.36
	0.00	0.00	0.00	0.00	0.20
	0.28	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	
Grassland (<70% dominant)	13.04	2.54	17.30	5.89	197.62
	0.48	0.09	0.63	0.22	7.25
	6.60	1.29	8.75	2.98	
	3.72	4.44	3.12	1.59	
Rice terraces	5.42	1.52	7.45	19.36	103.01
	0.20	0.06	0.27	0.71	3.78
	5.26	1.48	7.24	18.79	
	1.55	2.67	1.35	5.25	
Vegetable terraces	0.39	1.58	0.63	0.63	151.67
	0.01	0.06	0.02	0.02	5.57
	0.26	1.04	0.41	0.41	
	0.11	2.77	0.11	0.17	
Mines	0.91	0.00	0.00	2.27	8.95
	0.03	0.00	0.00	0.08	0.33
	10.18	0.00	0.00	25.38	
	0.26	0.00	0.00	0.62	

Land Use	Tuba	Bagulo	Itogon	Bokod	Total
Filling Ponds	0.00	0.00	0.46	0.00	0.91
	0.00	0.00	0.02	0.00	0.03
	0.00	0.00	50.82	0.00	
	0.00	0.00	0.08	0.00	
Reservoirs	0.00	0.00	3.03	3.60	6.63
	0.00	0.00	0.11	0.13	0.24
	0.00	0.00	45.72	54.28	
	0.00	0.00	0.55	0.98	
Total	350.50	57.15	553.93	369.05	2,724.25
	12.87	2.10	20.33	13.55	

Area cross tabulation of the 1990 land use map for the municipalities of Tarlac.

Area (km sq.)
Total %
Row %
Col %

Land Use	Bamban	Concepcion	O'Donnel	Tarlac	La Paz	Victoria
Forest	44.76	0.00	97.79	239.46	0.00	0.00
	1.46	0.00	3.18	7.80	0.00	0.00
	7.95	0.00	17.37	42.55	0.00	0.00
	30.84	0.00	19.01	31.62	0.00	0.00
Forest with	0.00	0.00	0.00	0.00	0.00	0.00
associated land uses	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00
Grassland (>90%	9.50	0.00	28.40	60.14	0.00	0.00
dominant)	0.31	0.00	0.92	1.96	0.00	0.00
	3.30	0.00	9.86	20.88	0.00	0.00
	6.55	0.00	5.52	7.94	0.00	0.00
Mangroves/nipa	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00
Ricefield, irrigated	11.53	155.58	126.44	191.54	110.95	80.41
	0.38	5.07	4.12	6.24	3.61	2.62
	0.97	13.06	10.61	16.08	9.31	6.75
	7.95	72.59	24.58	25.29	90.10	66.17
Grassland (70-90%	0.00	0.00	25.47	95.13	0.00	0.00
dominant)	0.00	0.00	0.83	3.10	0.00	0.00
	0.00	0.00	19.68	73.52	0.00	0.00
	0.00	0.00	4.95	12.56	0.00	0.00
Shrubs	0.00	0.00	0.00	53.48	0.00	0.00
	0.00	0.00	0.00	1.74	0.00	0.00
	0.00	0.00	0.00	89.66	0.00	0.00
	0.00	0.00	0.00	7.06	0.00	0.00
Coconut	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00

Land Use	Bamban	Concepcion	O'Donnel	Tarlac	La Paz	Victoria
Built-up Areas	3.60	5.00	7.35	14.95	2.27	4.29
	0.12	0.16	0.24	0.49	0.07	0.14
	4.25	5.91	8.68	17.67	2.68	5.07
	2.48	2.33	1.43	1.97	1.84	3.53
Cassava, potatoes,	0.00	0.00	0.00	0.00	0.00	0.00
black pepper	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00
Sugar cane	5.60	47.37	15.80	37.41	9.92	36.82
	0.18	1.54	0.51	1.22	0.32	1.20
	2.00	16.90	5.64	13.35	3.54	13.14
	3.86	22.10	3.07	4.94	8.06	30.30
Grassland (<70%	65.59	0.00	198.47	31.82	0.00	0.00
dominant)	2.14	0.00	6.46	1.04	0.00	0.00
	22.06	0.00	66.76	10.70	0.00	0.00
	45.19	0.00	38.58	4.20	0.00	0.00
Riverwash	4.56	6.36	14.67	33.36	0.00	0.00
	0.15	0.21	0.48	1.09	0.00	0.00
	5.21	7.28	16.79	38.17	0.00	0.00
	3.14	2.97	2.85	4.40	0.00	0.00
Freshwater swamps	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00
Total	145.14	214.32	514.38	757.28	123.14	121.52
	4.73	6.98	16.75	24.66	4.01	3.96

Land Use	Pura	Gerona	Sta. Ignasi	Mayantoc	Camiling	Paniqui
Forest	0.00	0.00	0.00	173.15	0.00	0.00
	0.00	0.00	0.00	5.64	0.00	0.00
	0.00	0.00	0.00	30.76	0.00	0.00
	0.00	0.00	0.00	49.59	0.00	0.00
Forest with associated land uses	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00
Grassland (>90% dominant)	0.00	6.36	33.04	106.88	22.80	0.00
	0.00	0.21	1.08	3.48	0.74	0.00
	0.00	2.21	11.47	37.11	7.91	0.00
	0.00	5.34	28.07	30.61	12.42	0.00
Mangroves/nipa	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00
Ricefield, irrigated	6.69	47.28	77.72	58.36	128.66	18.36
	0.22	1.54	2.53	1.90	4.19	0.60
	0.56	3.97	6.53	4.90	10.80	1.54
	20.46	39.65	66.02	16.71	70.11	19.50
Grassland (70-90% dominant)	0.00	8.80	0.00	0.00	0.00	0.00
	0.00	0.29	0.00	0.00	0.00	0.00
	0.00	6.80	0.00	0.00	0.00	0.00
	0.00	7.38	0.00	0.00	0.00	0.00
Shrubs	0.00	0.00	3.09	0.00	3.08	0.00
	0.00	0.00	0.10	0.00	0.10	0.00
	0.00	0.00	5.18	0.00	5.16	0.00
	0.00	0.00	2.63	0.00	1.68	0.00
Coconut	0.00	0.00	0.00	0.00	0.61	0.00
	0.00	0.00	0.00	0.00	0.02	0.00
	0.00	0.00	0.00	0.00	100.00	0.00
	0.00	0.00	0.00	0.00	0.33	0.00
Built-up Areas	2.84	4.72	3.87	2.18	8.31	5.83
	0.09	0.15	0.13	0.07	0.27	0.19
	3.35	5.58	4.57	2.58	9.81	6.88
	8.68	3.96	3.29	0.62	4.53	6.19

Land Use	Pura	Gerona	Sta. Ignasi	Mayantoc	Camiling	Paniqui
Cassava, potatoes,	0.00	16.54	0.00	0.00	3.99	31.04
black pepper	0.00	0.54	0.00	0.00	0.13	1.01
	0.00	22.58	0.00	0.00	5.45	42.38
	0.00	13.87	0.00	0.00	2.17	32.97
Sugar cane	23.18	30.15	0.00	0.00	0.00	33.73
	0.76	0.98	0.00	0.00	0.00	1.10
	8.27	10.76	0.00	0.00	0.00	12.03
	70.87	25.28	0.00	0.00	0.00	35.83
Grassland (<70%	0.00	0.00	0.00	0.00	0.00	0.00
dominant)	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00
Riverwash	0.00	5.39	0.00	8.62	15.76	5.18
	0.00	0.18	0.00	0.28	0.51	0.17
	0.00	6.17	0.00	9.86	16.22	5.93
	0.00	4.52	0.00	2.47	8.58	5.51
Freshwater swamps	0.00	0.00	0.00	0.00	0.31	0.00
	0.00	0.00	0.00	0.00	0.01	0.00
	0.00	0.00	0.00	0.00	31.34	0.00
	0.00	0.00	0.00	0.00	0.17	0.00
Total	32.71	119.24	117.73	349.20	183.52	94.14
	1.07	3.88	3.83	11.37	5.98	3.07

Land Use	Ramos	Nampicuan	Moncada	San Man	San Clem	Total
Forest	0.00	0.00	0.00	0.00	7.68	562.83
	0.00	0.00	0.00	0.00	0.25	18.33
	0.00	0.00	0.00	0.00	1.36	
	0.00	0.00	0.00	0.00	10.79	
Forest with	0.00	0.00	0.00	0.00	0.54	0.54
associated land uses	0.00	0.00	0.00	0.00	0.02	0.02
	0.00	0.00	0.00	0.00	100.00	
	0.00	0.00	0.00	0.00	0.76	
Grassland (>90%	0.00	0.00	0.00	0.00	20.93	288.05
dominant)	0.00	0.00	0.00	0.00	0.68	9.38
	0.00	0.00	0.00	0.00	7.27	
	0.00	0.00	0.00	0.00	29.41	
Mangroves/nipa	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	
Ricefield, irrigated	7.56	20.36	67.40	45.38	36.93	1,191.16
	0.25	0.66	2.20	1.48	1.20	38.79
	0.63	1.71	5.66	3.81	3.10	
	23.87	80.27	56.19	90.74	51.89	
Grassland (70-90%	0.00	0.00	0.00	0.00	0.00	129.40
dominant)	0.00	0.00	0.00	0.00	0.00	4.21
	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	
Shrubs	0.00	0.00	0.00	0.00	0.00	59.65
	0.00	0.00	0.00	0.00	0.00	1.94
	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	
Coconut	0.00	0.00	0.00	0.00	0.00	0.61
	0.00	0.00	0.00	0.00	0.00	0.02
	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	
Built-up Areas	0.00	2.69	8.41	4.63	3.69	84.63
	0.00	0.09	0.27	0.15	0.12	2.76
	0.00	3.18	9.94	5.47	4.36	
	0.00	10.60	7.01	9.26	5.18	
Cassava, potatoes,	0.00	0.00	26.37	0.00	0.00	77.94
black pepper	0.00	0.00	0.85	0.00	0.00	2.54
	0.00	0.00	33.83	0.00	0.00	
	0.00	0.00	21.98	0.00	0.00	

Land Use	Ramos	Nampicuan	Moncada	San Man	San Clem	Total
Sugar cane	23.39	1.63	15.27	0.00	0.00	280.27
	0.76	0.05	0.50	0.00	0.00	9.13
	8.35	0.58	5.45	0.00	0.00	
	73.87	6.42	12.73	0.00	0.00	
Grassland (<70% dominant)	0.00	0.00	0.00	0.00	1.40	297.29
	0.00	0.00	0.00	0.00	0.05	9.68
	0.00	0.00	0.00	0.00	0.47	
	0.00	0.00	0.00	0.00	1.97	
Riverwash	0.72	0.69	1.82	0.00	0.00	97.13
	0.02	0.02	0.06	0.00	0.00	3.16
	0.82	0.79	2.09	0.00	0.00	
	2.26	2.71	1.52	0.00	0.00	
Freshwater swamps	0.00	0.00	0.69	0.00	0.00	1.00
	0.00	0.00	0.02	0.00	0.00	0.03
	0.00	0.00	68.66	0.00	0.00	
	0.00	0.00	0.57	0.00	0.00	
Total	31.67	25.37	119.95	50.01	71.17	3,070.49
	1.03	0.83	3.91	1.63	2.32	

Area cross tabulation of the 1990 land use map for the municipalities of La Union.

Area (km sq)
Total %
Row %
Col %

	Bangar	Luna	Balaoan	Bacnotan	San Juan
Forest with associated landuses	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
Grassland (>90% dominant)	0.00	0.00	0.00	1.25	0.66
	0.00	0.00	0.00	0.09	0.05
	0.00	0.00	0.00	1.33	0.70
	0.00	0.00	0.00	1.92	1.09
Ricefield, irrigated	18.09	20.24	23.72	25.10	25.02
	1.26	1.41	1.65	1.75	1.74
	5.84	6.53	7.65	8.10	8.07
	43.67	50.06	33.94	38.50	41.53
Grassland (70-90 dominant)	8.07	8.86	29.59	18.27	14.43
	0.56	0.62	2.06	1.27	1.00
	3.87	4.25	14.21	8.77	6.93
	19.47	21.91	42.34	28.02	23.95
Shrubs	0.00	1.57	8.08	15.79	12.89
	0.00	0.11	0.56	1.10	0.90
	0.00	0.42	2.17	4.24	3.46
	0.00	3.88	11.56	24.22	21.40
Coconut	1.90	0.00	0.00	0.00	0.00
	0.13	0.00	0.00	0.00	0.00
	38.60	0.00	0.00	0.00	0.00
	4.58	0.00	0.00	0.00	0.00
Built-up Areas	4.63	5.08	7.65	4.78	3.42
	0.32	0.35	0.53	0.33	0.24
	6.02	6.61	9.95	6.22	4.45
	11.18	12.56	10.94	7.33	5.68
Grassland (<70% dominant)	0.43	0.00	0.85	0.00	2.75
	0.03	0.00	0.06	0.00	0.19
	0.32	0.00	0.63	0.00	2.05
	1.05	0.00	1.22	0.00	4.56
Corn (>70% dominant)	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
Fishponds	0.52	1.18	0.00	0.00	0.00
	0.04	0.08	0.00	0.00	0.00
	3.34	7.54	0.00	0.00	0.00
	1.26	2.92	0.00	0.00	0.00

	Bangar	Luna	Balaoan	Bacnotan	San Juan
Bamboos	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
Ricefield, upland	0.00	0.00	0.00	0.00	0.10
	0.00	0.00	0.00	0.00	0.01
	0.00	0.00	0.00	0.00	1.45
	0.00	0.00	0.00	0.00	0.17
Beach sands	0.93	1.67	0.00	0.00	0.00
	0.06	0.12	0.00	0.00	0.00
	17.87	32.28	0.00	0.00	0.00
	2.24	4.14	0.00	0.00	0.00
Riverwash	6.86	0.00	0.00	0.00	0.97
	0.48	0.00	0.00	0.00	0.07
	35.17	0.00	0.00	0.00	4.98
	16.55	0.00	0.00	0.00	1.61
Rice terraces	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
Grapes	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
Mango	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
Vegetables, lowland	0.00	1.84	0.00	0.00	0.00
	0.00	0.13	0.00	0.00	0.00
	0.00	15.79	0.00	0.00	0.00
	0.00	4.54	0.00	0.00	0.00
Airport	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
Total	41.42	40.44	69.90	65.19	60.25
	2.88	2.82	4.87	4.54	4.19

	San Fernando	Bauang	Caba	Aringay	Agoo
Forest with associated landuses	0.00	0.00	0.00	14.89	0.00
	0.00	0.00	0.00	1.04	0.00
	0.00	0.00	0.00	8.95	0.00
	0.00	0.00	0.00	15.13	0.00
Grassland (>90% dominant)	3.35	0.46	0.00	2.57	3.03
	0.23	0.03	0.00	0.18	0.21
	3.56	0.49	0.00	2.73	3.22
	3.39	0.61	0.00	2.61	7.75
Ricefield, irrigated	19.88	18.54	10.23	18.31	17.24
	1.38	1.29	0.71	1.27	1.20
	6.42	5.98	3.30	5.91	5.56
	20.12	24.45	20.69	18.60	44.06
Grassland (70-90 dominant)	23.35	6.71	0.00	3.97	1.61
	1.63	0.47	0.00	0.28	0.11
	11.21	3.22	0.00	1.91	0.77
	23.63	8.85	0.00	4.04	4.12
Shrubs	28.85	19.42	13.22	23.93	10.74
	2.01	1.35	0.92	1.67	0.75
	7.75	5.22	3.55	6.43	2.88
	29.20	25.61	26.73	24.31	27.45
Coconut	0.00	1.54	0.00	1.48	0.00
	0.00	0.11	0.00	0.10	0.00
	0.00	31.31	0.00	30.09	0.00
	0.00	2.03	0.00	1.50	0.00
Built-up Areas	11.73	5.44	2.21	8.63	6.12
	0.82	0.38	0.15	0.60	0.43
	15.25	7.07	2.88	11.23	7.97
	11.87	7.17	4.47	8.77	15.65
Grassland (<70% dominant)	5.83	15.33	22.27	16.81	0.00
	0.41	1.07	1.55	1.17	0.00
	4.34	11.41	16.58	12.51	0.00
	5.90	20.21	45.03	17.07	0.00
Corn (>70% dominant)	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
Fishponds	2.54	1.31	0.00	6.08	0.27
	0.18	0.09	0.00	0.42	0.02
	16.22	8.40	0.00	38.84	1.72
	2.57	1.73	0.00	6.18	0.69

	San Fernando	Bauang	Caba	Aringay	Agoo
Bamboos	0.84	0.00	0.00	0.00	0.00
	0.06	0.00	0.00	0.00	0.00
	100.00	0.00	0.00	0.00	0.00
	0.85	0.00	0.00	0.00	0.00
Ricefield, upland	2.18	0.00	0.00	0.00	0.00
	0.15	0.00	0.00	0.00	0.00
	30.23	0.00	0.00	0.00	0.00
	2.21	0.00	0.00	0.00	0.00
Beach sands	0.00	0.99	0.60	0.42	0.10
	0.00	0.07	0.04	0.03	0.01
	0.00	19.02	11.53	8.07	2.02
	0.00	1.30	1.21	0.42	0.27
Riverwash	0.00	2.45	0.19	0.21	0.00
	0.00	0.17	0.01	0.01	0.00
	0.00	12.57	1.00	1.07	0.00
	0.00	3.23	0.39	0.21	0.00
Rice terraces	0.00	0.00	0.00	0.88	0.00
	0.00	0.00	0.00	0.06	0.00
	0.00	0.00	0.00	31.05	0.00
	0.00	0.00	0.00	0.90	0.00
Grapes	0.00	0.19	0.73	0.00	0.00
	0.00	0.01	0.05	0.00	0.00
	0.00	20.90	79.03	0.00	0.00
	0.00	0.26	1.48	0.00	0.00
Mango	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
Vegetables, lowland	0.01	3.45	0.00	0.25	0.00
	0.00	0.24	0.00	0.02	0.00
	0.13	29.65	0.00	2.18	0.00
	0.02	4.55	0.00	0.26	0.00
Airport	0.25	0.00	0.00	0.00	0.00
	0.02	0.00	0.00	0.00	0.00
	100.00	0.00	0.00	0.00	0.00
	0.26	0.00	0.00	0.00	0.00
Total	98.80	75.83	49.46	98.44	39.12
	6.88	5.28	3.44	6.85	2.72

	Sto. Tomas	Rosario	Pugo	Tubao	Naguilian
Forest with	0.00	0.00	5.12	16.58	0.00
associated landuses	0.00	0.00	0.36	1.15	0.00
	0.00	0.00	3.08	9.96	0.00
	0.00	0.00	11.76	29.17	0.00
Grassland (>90%	15.01	28.49	4.77	4.17	1.79
dominant)	1.05	1.98	0.33	0.29	0.12
	15.96	30.28	5.07	4.43	1.91
	24.27	41.14	10.94	7.33	1.89
Ricefield, irrigated	23.11	30.55	10.25	8.78	17.37
	1.61	2.13	0.71	0.61	1.21
	7.46	9.86	3.31	2.83	5.61
	37.36	44.12	23.52	15.45	18.29
Grassland (70-90	0.00	0.96	2.87	2.51	17.10
dominant)	0.00	0.07	0.20	0.17	1.19
	0.00	0.46	1.38	1.21	8.21
	0.00	1.38	6.58	4.42	18.01
Shrubs	16.34	5.60	18.88	3.54	18.60
	1.14	0.39	1.31	0.25	1.29
	4.39	1.50	5.07	0.95	5.00
	26.42	8.09	43.33	6.23	19.58
Coconut	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
Built-up Areas	2.70	3.64	0.64	3.24	4.00
	0.19	0.25	0.04	0.23	0.28
	3.52	4.74	0.84	4.22	5.21
	4.37	5.26	1.47	5.70	4.22
Grassland (<70%	0.46	0.00	0.60	17.72	22.50
dominant)	0.03	0.00	0.04	1.23	1.57
	0.34	0.00	0.44	13.19	16.75
	0.75	0.00	1.37	31.17	23.69
Corn (>70%	0.00	0.00	0.00	0.00	2.96
dominant)	0.00	0.00	0.00	0.00	0.21
	0.00	0.00	0.00	0.00	100.00
	0.00	0.00	0.00	0.00	3.11
Fishponds	3.75	0.00	0.00	0.00	0.00
	0.26	0.00	0.00	0.00	0.00
	23.95	0.00	0.00	0.00	0.00
	6.06	0.00	0.00	0.00	0.00

	Sto. Tomas	Rosario	Pugo	Tubao	Naguilian
Bamboos	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
Ricefield, upland	0.00	0.00	0.00	0.00	0.30
	0.00	0.00	0.00	0.00	0.02
	0.00	0.00	0.00	0.00	4.14
	0.00	0.00	0.00	0.00	0.31
Beach sands	0.48	0.00	0.00	0.00	0.00
	0.03	0.00	0.00	0.00	0.00
	9.22	0.00	0.00	0.00	0.00
	0.77	0.00	0.00	0.00	0.00
Riverwash	0.00	0.00	0.24	0.00	3.50
	0.00	0.00	0.02	0.00	0.24
	0.00	0.00	1.23	0.00	17.93
	0.00	0.00	0.55	0.00	3.68
Rice terraces	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
Grapes	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
Mango	0.00	0.00	0.00	0.00	1.28
	0.00	0.00	0.00	0.00	0.09
	0.00	0.00	0.00	0.00	50.59
	0.00	0.00	0.00	0.00	1.35
Vegetables, lowland	0.00	0.00	0.21	0.30	5.57
	0.00	0.00	0.01	0.02	0.39
	0.00	0.00	1.80	2.57	47.88
	0.00	0.00	0.48	0.53	5.87
Airport	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
Total	61.86	69.24	43.57	56.84	94.98
	4.31	4.82	3.03	3.96	6.61

	Burgos	Baguio	San Gabriel	Santol	Sudipen	Total
Forest with	0.00	0.00	40.47	61.04	28.29	166.40
associated landuses	0.00	0.00	2.82	4.25	1.97	11.58
	0.00	0.00	24.32	36.68	17.00	
	0.00	0.00	26.00	54.10	41.06	
Grassland (>90%	2.61	1.57	5.72	12.16	6.47	94.08
dominant)	0.18	0.11	0.40	0.85	0.45	6.55
	2.78	1.67	6.08	12.92	6.88	
	4.15	2.21	3.68	10.78	9.39	
Ricefield, irrigated	1.28	1.99	2.52	8.57	9.10	309.91
	0.09	0.14	0.18	0.60	0.63	21.57
	0.41	0.64	0.81	2.77	2.94	
	2.04	2.80	1.62	7.60	13.20	
Grassland (70-90	3.26	3.08	33.97	19.48	10.16	208.24
dominant)	0.23	0.21	2.36	1.36	0.71	14.50
	1.56	1.48	16.31	9.35	4.88	
	5.17	4.34	21.82	17.26	14.74	
Shrubs	25.68	63.23	68.63	9.31	8.01	372.31
	1.79	4.40	4.78	0.65	0.56	25.92
	6.90	16.98	18.43	2.50	2.15	
	40.77	89.25	44.08	8.25	11.62	
Coconut	0.00	0.00	0.00	0.00	0.00	4.91
	0.00	0.00	0.00	0.00	0.00	0.34
	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	
Built-up Areas	0.00	0.00	0.93	1.00	1.03	76.89
	0.00	0.00	0.06	0.07	0.07	5.35
	0.00	0.00	1.20	1.30	1.34	
	0.00	0.00	0.59	0.89	1.50	
Grassland (<70%	25.07	0.84	0.87	0.15	1.85	134.31
dominant)	1.74	0.06	0.06	0.01	0.13	9.35
	18.66	0.62	0.65	0.11	1.38	
	39.80	1.18	0.56	0.13	2.69	
Corn (>70%	0.00	0.00	0.00	0.00	0.00	2.96
dominant)	0.00	0.00	0.00	0.00	0.00	0.21
	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	
Fishponds	0.00	0.00	0.00	0.00	0.00	15.66
	0.00	0.00	0.00	0.00	0.00	1.09
	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	

	Burgos	Bagulin	San Gabriel	Santol	Sudipen	Total
Bamboos	0.00	0.00	0.00	0.00	0.00	0.84
	0.00	0.00	0.00	0.00	0.00	0.06
	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	
Ricefield, upland	1.87	0.00	2.57	0.00	0.19	7.22
	0.13	0.00	0.18	0.00	0.01	0.50
	25.88	0.00	35.61	0.00	2.69	
	2.96	0.00	1.65	0.00	0.28	
Beach sands	0.00	0.00	0.00	0.00	0.00	5.18
	0.00	0.00	0.00	0.00	0.00	0.36
	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	
Riverwash	0.00	0.15	0.00	1.12	3.81	19.49
	0.00	0.01	0.00	0.08	0.27	1.36
	0.00	0.77	0.00	5.75	19.54	
	0.00	0.21	0.00	0.99	5.53	
Rice terraces	1.96	0.00	0.00	0.00	0.00	2.84
	0.14	0.00	0.00	0.00	0.00	0.20
	68.95	0.00	0.00	0.00	0.00	
	3.11	0.00	0.00	0.00	0.00	
Grapes	0.00	0.00	0.00	0.00	0.00	0.93
	0.00	0.00	0.00	0.00	0.00	0.06
	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	
Mango	1.25	0.00	0.00	0.00	0.00	2.54
	0.09	0.00	0.00	0.00	0.00	0.18
	49.41	0.00	0.00	0.00	0.00	
	1.99	0.00	0.00	0.00	0.00	
Vegetables, lowland	0.00	0.00	0.00	0.00	0.00	11.64
	0.00	0.00	0.00	0.00	0.00	0.81
	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	
Airport	0.00	0.00	0.00	0.00	0.00	0.25
	0.00	0.00	0.00	0.00	0.00	0.02
	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	
Total	62.98	70.85	155.67	112.83	68.91	1,436.58
	4.38	4.93	10.84	7.85	4.80	

Area cross tabulation of the 1990 landuse map across the N sub-basins of Agno River Basin

Area (km sq)
Total %
Row %
Col %

Legend	N1	N2	N3	N4	N5	N6	N7	N8
Forest with	16.18	4.99	23.77	18.21	37.48	31.43	30.34	34.93
Associated	0.92	0.28	1.35	1.03	2.12	1.78	1.72	1.98
landuse	1.88	0.58	2.76	2.12	4.36	3.66	3.53	4.06
	29.70	58.70	54.39	57.88	57.94	65.32	63.69	46.92
Grassland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(90-100%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Paddy rice	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
irrigated	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grassland	0.45	0.00	4.83	6.23	18.16	15.67	8.41	27.40
(70-90%)	0.03	0.00	0.27	0.35	1.03	0.89	0.48	1.55
	0.08	0.00	0.88	1.14	3.32	2.87	1.54	5.01
	0.82	0.00	11.04	19.80	28.08	32.57	17.65	36.81
Shrubs	0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.32	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.55	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Built-up area	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grassland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(>70%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Riverwash	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Legend	N1	N2	N3	N4	N5	N6	N7	N8
Rice terrace	0.00	0.00	0.00	0.04	2.20	1.02	1.94	10.95
irrigated	0.00	0.00	0.00	0.00	0.12	0.06	0.11	0.62
	0.00	0.00	0.00	0.14	6.91	3.20	6.11	34.46
	0.00	0.00	0.00	0.14	3.39	2.11	4.08	14.71
Vegetable	37.54	3.51	15.10	6.98	6.84	0.00	3.38	0.00
terrace	2.12	0.20	0.85	0.39	0.39	0.00	0.19	0.00
	49.47	4.63	19.90	9.19	9.02	0.00	4.45	0.00
	68.92	41.30	34.56	22.17	10.58	0.00	7.09	0.00
Mines	0.00	0.00	0.00	0.00	0.00	0.00	3.57	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	78.10	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	7.49	0.00
Flilling pond	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Reservoir	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.17
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	17.57
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.57
Total	54.46	8.50	43.69	31.46	64.68	48.12	47.64	74.44
	3.08	0.48	2.47	1.78	3.66	2.72	2.70	4.21

Legend	N9	N10	N11	N12	N13	N14	N15	N16
Forest with	57.69	38.91	112.25	27.28	20.08	40.26	56.39	6.17
Associated	3.27	2.20	6.35	1.54	1.14	2.28	3.19	0.35
landuse	6.71	4.53	13.06	3.17	2.34	4.68	6.56	0.72
	57.53	52.15	78.73	28.50	22.91	38.28	49.26	59.94
Grassland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(90-100%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Paddy rice	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
irrigated	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grassland	35.66	28.32	30.06	35.39	53.55	49.60	47.13	4.12
(70-90%)	2.02	1.60	1.70	2.00	3.03	2.81	2.67	0.23
	6.53	5.18	5.50	6.48	9.80	9.08	8.63	0.75
	35.56	37.96	21.08	36.98	61.11	47.16	41.17	40.06
Shrubs	0.00	0.94	0.00	1.45	4.15	11.11	8.02	0.00
	0.00	0.05	0.00	0.08	0.24	0.63	0.45	0.00
	0.00	1.02	0.00	1.57	4.50	12.03	8.69	0.00
	0.00	1.26	0.00	1.51	4.74	10.57	7.01	0.00
Built-up area	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grassland	0.00	3.93	0.00	27.96	6.93	0.00	1.99	0.00
(>70%)	0.00	0.22	0.00	1.58	0.39	0.00	0.11	0.00
	0.00	8.51	0.00	60.56	15.01	0.00	4.30	0.00
	0.00	5.27	0.00	29.22	7.91	0.00	1.74	0.00
Riverwash	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rice terrace	6.65	0.00	0.27	0.48	2.09	4.14	0.48	0.00
irrigated	0.38	0.00	0.02	0.03	0.12	0.23	0.03	0.00
	20.92	0.00	0.85	1.50	6.58	13.02	1.50	0.00
	6.63	0.00	0.19	0.50	2.39	3.93	0.42	0.00
Vegetable	0.00	0.63	0.00	0.00	0.63	0.00	0.00	0.00
terrace	0.00	0.04	0.00	0.00	0.04	0.00	0.00	0.00
	0.00	0.83	0.00	0.00	0.83	0.00	0.00	0.00
	0.00	0.84	0.00	0.00	0.72	0.00	0.00	0.00

Legend	N9	N10	N11	N12	N13	N14	N15	N16
Mines	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	1.96	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.00
Filling pond	0.00	0.00	0.00	0.00	0.00	0.00	0.46	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	100.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.40	0.00
Reservoir	0.28	1.88	0.00	3.05	0.19	0.06	0.00	0.00
	0.02	0.11	0.00	0.17	0.01	0.00	0.00	0.00
	4.28	28.38	0.00	45.95	2.93	0.90	0.00	0.00
	0.28	2.52	0.00	3.18	0.22	0.06	0.00	0.00
Total	100.28	74.62	142.57	95.69	87.63	105.17	114.47	10.29
	5.68	4.22	8.07	5.42	4.96	5.95	6.48	0.58

Legend	N17	N18	N19	N20	N21	N22	N23	N24
Forest with	23.27	1.43	4.12	0.18	3.23	2.82	0.70	14.85
Associated	1.32	0.08	0.23	0.01	0.18	0.16	0.04	0.84
landuse	2.71	0.17	0.48	0.02	0.38	0.33	0.08	1.73
	42.03	11.55	81.90	0.64	16.00	14.09	20.61	96.88
Grassland	22.51	0.00	0.00	0.57	0.18	3.53	0.00	0.00
(90-100%)	1.27	0.00	0.00	0.03	0.01	0.20	0.00	0.00
	37.50	0.00	0.00	0.95	0.30	5.87	0.00	0.00
	40.65	0.00	0.00	2.03	0.89	17.60	0.00	0.00
Paddy rice	1.73	0.00	0.00	1.72	0.00	2.60	0.00	0.00
irrigated	0.10	0.00	0.00	0.10	0.00	0.15	0.00	0.00
	4.64	0.00	0.00	4.60	0.00	6.96	0.00	0.00
	3.13	0.00	0.00	6.16	0.00	12.98	0.00	0.00
Grassland	7.86	10.98	0.91	25.44	16.76	3.45	0.00	0.00
(70-90%)	0.44	0.62	0.05	1.44	0.95	0.20	0.00	0.00
	1.44	2.01	0.17	4.66	3.07	0.63	0.00	0.00
	14.19	88.45	18.10	91.17	83.11	17.23	0.00	0.00
Shrubs	0.00	0.00	0.00	0.00	0.00	7.50	2.70	0.48
	0.00	0.00	0.00	0.00	0.00	0.42	0.15	0.03
	0.00	0.00	0.00	0.00	0.00	8.12	2.93	0.52
	0.00	0.00	0.00	0.00	0.00	37.43	79.39	3.12
Built-up area	0.00	0.00	0.00	0.00	0.00	0.13	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	3.93	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.67	0.00	0.00
Grassland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(>70%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Riverwash	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rice terrace	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
irrigated	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Vegetable	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
terrace	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Legend	N17	N18	N19	N20	N21	N22	N23	N24
Mines	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Filling pond	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Reservoir	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	55.38	12.41	5.03	27.90	20.17	20.03	3.41	15.33
	3.13	0.70	0.28	1.58	1.14	1.13	0.19	0.87

Legend	N25	N26	N27	N28	N29	N30	N31	N32
Forest with	9.65	21.36	27.13	47.76	4.26	3.05	5.54	8.69
Associated	0.55	1.21	1.54	2.70	0.24	0.17	0.31	0.49
landuse	1.12	2.48	3.16	5.56	0.50	0.35	0.64	1.01
	39.83	100.00	96.54	92.40	65.52	29.82	38.17	66.06
Grassland	0.00	0.00	0.88	0.00	0.00	6.45	0.30	2.76
(90-100%)	0.00	0.00	0.05	0.00	0.00	0.37	0.02	0.16
	0.00	0.00	1.47	0.00	0.00	10.75	0.50	4.60
	0.00	0.00	3.14	0.00	0.00	63.16	2.06	21.00
Paddy rice	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
irrigated	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grassland	0.67	0.00	0.00	3.93	2.24	0.06	8.59	1.06
(70-90%)	0.04	0.00	0.00	0.22	0.13	0.00	0.49	0.06
	0.12	0.00	0.00	0.72	0.41	0.01	1.57	0.19
	2.77	0.00	0.00	7.60	34.48	0.58	59.16	8.06
Shrubs	13.91	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.79	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	15.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	57.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Built-up area	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grassland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(>70%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Riverwash	0.00	0.00	0.09	0.00	0.00	0.66	0.09	0.64
	0.00	0.00	0.01	0.00	0.00	0.04	0.01	0.04
	0.00	0.00	4.35	0.00	0.00	31.88	4.35	31.16
	0.00	0.00	0.32	0.00	0.00	6.43	0.62	4.88
Rice terrace	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
irrigated	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Vegetable	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
terrace	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Legend	N25	N26	N27	N28	N29	N30	N31	N32
Mines	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Filling pond	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Reservoir	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	24.23	21.36	28.10	51.69	6.50	10.22	14.52	13.16
	1.37	1.21	1.59	2.93	0.37	0.58	0.82	0.74

Legend	N33	N34	N35	N36	N37	Total
Forest with	17.42	38.18	28.92	40.77	0.03	859.71
Associated	0.99	2.16	1.64	2.31	0.00	48.66
landuse	2.03	4.44	3.36	4.74	0.00	
	55.44	62.16	38.27	41.08	0.05	
Grassland	0.00	5.60	0.00	0.00	17.25	60.04
(90-100%)	0.00	0.32	0.00	0.00	0.98	3.40
	0.00	9.33	0.00	0.00	28.74	
	0.00	9.12	0.00	0.00	26.15	
Paddy rice	0.00	0.97	0.00	0.34	29.98	37.35
irrigated	0.00	0.05	0.00	0.02	1.70	2.11
	0.00	2.60	0.00	0.92	80.28	
	0.00	1.58	0.00	0.35	45.45	
Grassland	12.25	14.53	42.99	24.33	5.29	546.32
(70-90%)	0.69	0.82	2.43	1.38	0.30	30.92
	2.24	2.66	7.87	4.45	0.97	
	38.99	23.66	56.89	24.52	8.02	
Shrubs	1.52	0.10	0.18	29.77	10.22	92.36
	0.09	0.01	0.01	1.69	0.58	5.23
	1.65	0.11	0.19	32.23	11.06	
	4.85	0.17	0.24	30.00	15.49	
Built-up area	0.00	0.00	0.00	0.25	3.03	3.42
	0.00	0.00	0.00	0.01	0.17	0.19
	0.00	0.00	0.00	7.42	88.65	
	0.00	0.00	0.00	0.26	4.60	
Grassland	0.00	1.61	0.67	3.08	0.00	46.17
(>70%)	0.00	0.09	0.04	0.17	0.00	2.61
	0.00	3.49	1.46	6.66	0.00	
	0.00	2.63	0.89	3.10	0.00	
Riverwash	0.00	0.42	0.00	0.00	0.16	2.06
	0.00	0.02	0.00	0.00	0.01	0.12
	0.00	20.29	0.00	0.00	7.97	
	0.00	0.68	0.00	0.00	0.25	
Rice terrace	0.00	0.00	1.52	0.00	0.00	31.77
irrigated	0.00	0.00	0.09	0.00	0.00	1.80
	0.00	0.00	4.80	0.00	0.00	
	0.00	0.00	2.02	0.00	0.00	
Vegetable	0.00	0.00	1.28	0.00	0.00	75.89
terrace	0.00	0.00	0.07	0.00	0.00	4.30
	0.00	0.00	1.69	0.00	0.00	
	0.00	0.00	1.70	0.00	0.00	

Legend	N33	N34	N35	N36	N37	Total
Mines	0.22	0.00	0.00	0.69	0.00	4.57
	0.01	0.00	0.00	0.04	0.00	0.26
	4.90	0.00	0.00	15.03	0.00	
	0.71	0.00	0.00	0.69	0.00	
Filling pond	0.00	0.00	0.00	0.00	0.00	0.46
	0.00	0.00	0.00	0.00	0.00	0.03
	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	
Reservoir	0.00	0.00	0.00	0.00	0.00	6.63
	0.00	0.00	0.00	0.00	0.00	0.38
	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	
Total	31.42	61.43	75.57	99.23	65.97	1,766.76
	1.78	3.48	4.28	5.62	3.73	

Area cross tabulation of the 1990 landuse map across the Central Plain and S sub-basins of the Agno River Basin

Area (km sq)
Total %
Row %
Col %

Legend	Central Plain	S1	S2	S3	S4	S5	S6	S7
Forest	3.60	24.63	16.87	4.53	0.00	183.64	91.86	0.00
	0.06	0.41	0.28	0.08	0.00	3.05	1.52	0.00
	0.70	4.79	3.28	0.88	0.00	35.73	17.87	0.00
	0.09	23.63	44.54	3.82	0.00	82.18	34.51	0.00
Forest with	44.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Associated	0.74	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Landuse	35.88	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grassland	192.23	19.67	0.00	8.34	0.00	0.00	34.18	10.28
(90-100%)	3.19	0.33	0.00	0.14	0.00	0.00	0.57	0.17
	43.45	4.45	0.00	1.88	0.00	0.00	7.73	2.32
	4.71	18.88	0.00	7.04	0.00	0.00	12.84	29.50
Mangrove/	20.38	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nipa	0.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	78.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Paddy rice	2,428.93	0.78	0.00	36.79	16.49	0.00	37.79	4.45
irrigated	40.31	0.01	0.00	0.61	0.27	0.00	0.63	0.07
	86.49	0.03	0.00	1.31	0.59	0.00	1.35	0.16
	59.47	0.75	0.00	31.09	40.20	0.00	14.20	12.78
Grassland	5.95	0.00	0.00	5.24	14.77	0.00	50.03	17.34
(70-90%)	0.10	0.00	0.00	0.09	0.25	0.00	0.83	0.29
	4.58	0.00	0.00	4.04	11.39	0.00	38.58	13.37
	0.15	0.00	0.00	4.43	36.02	0.00	18.79	49.79
Shrubs	38.93	0.00	0.00	0.00	0.00	17.25	0.00	0.00
	0.65	0.00	0.00	0.00	0.00	0.29	0.00	0.00
	67.37	0.00	0.00	0.00	0.00	29.86	0.00	0.00
	0.95	0.00	0.00	0.00	0.00	7.72	0.00	0.00
Coconut	88.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1.47	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	97.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Legend	Central Plain	S1	S2	S3	S4	S5	S6	S7
Built-up	303.08	0.00	0.00	0.46	0.00	0.00	0.00	0.00
	5.03	0.00	0.00	0.01	0.00	0.00	0.00	0.00
	92.80	0.00	0.00	0.14	0.00	0.00	0.00	0.00
	7.42	0.00	0.00	0.39	0.00	0.00	0.00	0.00
Coffee	2.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cassava	83.86	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1.39	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sugarcane	322.47	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	99.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	7.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grassland	298.41	53.12	21.00	56.06	3.08	14.71	40.90	0.00
(>70%)	4.95	0.88	0.35	0.93	0.05	0.24	0.68	0.00
	38.24	6.81	2.69	7.18	0.39	1.89	5.24	0.00
	7.31	50.97	55.46	47.37	7.50	6.58	15.36	0.00
Corn (>70%)	13.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fishpond	87.79	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	97.88	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Beachsand	4.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Riverwash	127.59	6.02	0.00	6.92	6.68	7.86	11.44	2.76
	2.12	0.10	0.00	0.11	0.11	0.13	0.19	0.05
	67.87	3.20	0.00	3.68	3.55	4.18	6.09	1.47
	3.12	5.78	0.00	5.84	16.28	3.52	4.30	7.93

Legend	Central Plain	S1	S2	S3	S4	S5	S6	S7
Mango	2.55	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Swamp	14.71	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.36	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	4,084.21	104.22	37.87	118.34	41.02	223.46	266.20	34.84
	67.79	1.73	0.63	1.96	0.68	3.71	4.42	0.58

Legend	S8	S9	S10	S11	S12	S13	S14	S15
Forest	0.00	148.50	12.95	0.66	0.04	22.14	4.57	0.00
	0.00	2.46	0.21	0.01	0.00	0.37	0.08	0.00
	0.00	28.89	2.52	0.13	0.01	4.31	0.89	0.00
	0.00	97.07	42.29	1.21	0.03	20.09	12.36	0.00
Forest with	0.00	0.00	0.00	0.00	0.00	0.00	18.43	12.20
Associated	0.00	0.00	0.00	0.00	0.00	0.00	0.31	0.20
Landuse	0.00	0.00	0.00	0.00	0.00	0.00	14.82	9.81
	0.00	0.00	0.00	0.00	0.00	0.00	49.84	23.06
Grassland	13.18	1.42	14.36	21.27	70.11	52.97	4.42	0.00
(90-100%)	0.22	0.02	0.24	0.35	1.16	0.88	0.07	0.00
	2.98	0.32	3.24	4.81	15.80	11.97	1.00	0.00
	11.39	0.93	46.88	39.05	54.41	48.08	11.95	0.00
Mangrove/	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nipa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Paddy rice	57.45	0.00	0.00	29.11	47.70	34.07	2.12	0.00
irrigated	0.95	0.00	0.00	0.48	0.79	0.57	0.04	0.00
	2.05	0.00	0.00	1.04	1.70	1.21	0.08	0.00
	49.65	0.00	0.00	53.44	37.02	30.93	5.74	0.00
Grassland	36.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(70-90%)	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	28.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	31.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Shrubs	0.00	1.60	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	2.77	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	1.04	0.00	0.00	0.00	0.00	0.00	0.00
Coconut	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Built-up	2.67	0.00	0.00	0.06	8.78	0.24	0.00	0.00
	0.04	0.00	0.00	0.00	0.15	0.00	0.00	0.00
	0.82	0.00	0.00	0.02	2.69	0.07	0.00	0.00
	2.31	0.00	0.00	0.11	6.82	0.22	0.00	0.00

Legend	S8	S9	S10	S11	S12	S13	S14	S15
Coffee	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cassava	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sugarcane	0.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grassland	0.00	0.00	0.00	0.00	0.00	0.04	7.44	40.72
(>70%)	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.68
	0.00	0.00	0.00	0.00	0.00	0.01	0.95	5.22
	0.00	0.00	0.00	0.00	0.00	0.04	20.11	76.94
Corn (>70%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fishpond	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Beachsand	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Riverwash	5.80	1.46	3.32	3.38	2.21	0.70	0.00	0.00
	0.10	0.02	0.06	0.06	0.04	0.01	0.00	0.00
	3.08	0.78	1.76	1.80	1.18	0.37	0.00	0.00
	5.01	0.96	10.83	6.20	1.72	0.64	0.00	0.00
Mango	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Legend	S8	S9	S10	S11	S12	S13	S14	S15
Swamp	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	115.71	152.98	30.62	54.48	128.84	110.17	36.99	52.93
	1.92	2.54	0.51	0.90	2.14	1.83	0.61	0.88

Legend	S16	S17	S18	S19	S20	S21	S22	Total
Forest	0.00	0.00	0.00	0.00	0.00	0.00	0.00	513.98
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.53
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Forest with	15.88	0.00	9.98	2.33	3.48	11.19	6.23	124.35
Associated	0.26	0.00	0.17	0.04	0.06	0.19	0.10	2.06
Landuse	12.77	0.00	8.02	1.87	2.80	9.00	5.01	
	39.56	0.00	23.12	4.28	2.81	11.12	10.71	
Grassland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	442.41
(90-100%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.34
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Mangrove/	0.00	0.00	0.00	0.00	0.30	5.11	0.28	26.07
Nipa	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.43
	0.00	0.00	0.00	0.00	1.15	19.60	0.09	
	0.00	0.00	0.00	0.00	0.24	5.08	0.49	
Paddy rice	5.95	0.00	0.24	24.02	38.65	29.65	14.21	2,808.41
Irrigated	0.10	0.00	0.00	0.40	0.64	0.49	0.24	46.61
	0.21	0.00	0.01	0.86	1.38	1.06	0.51	
	14.81	0.00	0.55	44.08	31.21	29.47	24.42	
Grassland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	129.68
(70-90%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.15
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Shrubs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	57.78
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.96
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Coconut	0.00	0.00	0.00	0.00	0.67	0.87	0.63	90.88
	0.00	0.00	0.00	0.00	0.01	0.01	0.01	1.51
	0.00	0.00	0.00	0.00	0.74	0.95	0.69	
	0.00	0.00	0.00	0.00	0.54	0.86	1.08	
Built-up	0.81	0.00	0.00	1.90	3.23	3.76	1.61	326.61
	0.01	0.00	0.00	0.03	0.05	0.06	0.03	5.42
	0.25	0.00	0.00	0.58	0.99	1.15	0.49	
	2.01	0.00	0.00	3.48	2.61	3.74	2.77	

Legend	S16	S17	S18	S19	S20	S21	S22	Total
Coffee	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.29
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Cassava	0.00	0.00	0.00	0.00	0.00	0.00	0.00	83.86
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.39
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Sugarcane	0.00	0.00	0.00	0.00	0.00	0.09	2.30	325.13
	0.00	0.00	0.00	0.00	0.00	0.00	0.04	5.40
	0.00	0.00	0.00	0.00	0.00	0.03	0.71	
	0.00	0.00	0.00	0.00	0.00	0.09	3.95	
Grassland	16.45	11.43	32.94	25.68	77.47	49.95	31.03	780.44
(>70%)	0.27	0.19	0.55	0.43	1.29	0.83	0.51	12.95
	2.11	1.46	4.22	3.29	9.93	6.40	3.98	
	40.98	98.20	76.32	47.12	62.57	49.64	53.32	
Corn (>70%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.80
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.23
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Fishpond	0.00	0.00	0.00	0.00	0.00	0.00	1.90	89.69
	0.00	0.00	0.00	0.00	0.00	0.00	0.03	1.49
	0.00	0.00	0.00	0.00	0.00	0.00	2.12	
	0.00	0.00	0.00	0.00	0.00	0.00	3.26	
Beachsand	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.30
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Riverwash	1.06	0.21	0.00	0.57	0.01	0.00	0.00	187.98
	0.02	0.00	0.00	0.01	0.00	0.00	0.00	3.12
	0.56	0.11	0.00	0.30	0.01	0.00	0.00	
	2.64	1.80	0.00	1.04	0.01	0.00	0.00	
Mango	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.55
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

Legend	S16	S17	S18	S19	S20	S21	S22	Total
Swamp	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.71
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.24
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Total	40.14	11.64	43.16	54.49	123.81	100.62	58.18	6,024.93
	0.67	0.19	0.72	0.90	2.05	1.67	0.97	

Tables on single area and area cross tabulation analysis 1981-1990 landuse change for (old growth dipterocarp) virgin forests

Area analysis on land use changes within virgin forest areas (dipterocarp) between 1981-1990.

Class	Land Use Change	Area (%)	Cumm (%)	Area (km sq.)
1	Virgin to Forest	25.460	25.460	114.681
2	Virgin to Forest w/ associated landuses	39.050	64.510	175.913
3	Virgin to Agricultural areas	4.370	68.880	19.674
5	Virgin to Riverwash	0.070	68.940	0.299
11	Virgin to Brushland/Grassland	31.060	100.000	139.897
Total of 5 classes		100.000		450.464

Area cross tabulation of the 1981-1990 landuse change for virgin (dipterocarp) forest across the N sub-basins of the Agno River Basin

Area (km sq)
Total %
Row %
Col %

Legend	N1	N3	N4	N5	N6	N9	N11	N17	N18
Virgin to	4.511	10.382	5.871	7.633	9.740	5.856	1.643	1.658	0.493
Forest with	3.850	8.860	5.010	6.510	8.310	5.000	1.400	1.410	0.420
Associated	4.760	10.940	6.190	8.050	10.270	6.170	1.730	1.750	0.520
Landuse	63.710	92.300	86.750	90.760	91.190	97.270	62.860	80.430	42.860
Virgin to	2.569	0.866	0.045	0.777	0.000	0.015	0.000	0.000	0.000
Agriculture	2.190	0.740	0.040	0.660	0.000	0.010	0.000	0.000	0.000
	60.140	20.280	1.050	18.180	0.000	0.350	0.000	0.000	0.000
	36.290	7.700	0.660	9.240	0.000	0.250	0.000	0.000	0.000
Virgin to	0.000	0.000	0.851	0.000	0.941	0.149	0.971	0.403	0.657
Brushland	0.000	0.000	0.730	0.000	0.800	0.130	0.830	0.340	0.560
	0.000	0.000	4.720	0.000	5.220	0.830	5.380	2.240	3.640
	0.000	0.000	12.580	0.000	8.810	2.480	37.140	19.570	57.140
Total	7.081	11.249	6.767	8.410	10.681	6.020	2.614	2.061	1.150
	6.040	9.600	5.770	7.180	9.110	5.140	2.230	1.760	0.980

Legend	N21	N22	N23	N24	N25	N26	N27	N34	Total
Virgin to	0.538	0.000	0.702	14.849	7.200	19.375	4.198	0.224	94.873
Forest with	0.460	0.000	0.600	12.670	6.140	16.530	3.580	0.190	80.960
Associated	0.570	0.000	0.740	15.650	7.590	20.420	4.420	0.240	
Landuse	12.810	0.000	20.610	96.880	69.450	100.000	100.000	9.490	
Virgin to	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	4.272
Agriculture	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	3.650
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Virgin to	3.660	1.927	2.704	0.478	3.167	0.000	0.000	2.136	18.045
Brushland	3.120	1.640	2.310	0.410	2.700	0.000	0.000	1.820	15.400
	20.280	10.680	14.980	2.650	17.550	0.000	0.000	11.840	
	87.190	100.000	79.390	3.120	30.550	0.000	0.000	90.510	
Total	4.198	1.927	3.406	15.327	10.367	19.375	4.198	2.360	117.191
	3.580	1.640	2.910	13.080	8.850	16.530	3.580	2.010	

Area cross tabulation of the 1981-1990 landuse change for virgin (dipterocarp) forest across the Central Plain and S sub-basins of the Agno River Basin

Area (km sq)
Total %
Row %
Col %

Legend	Central Plain	S1	S5	S6	S9	S13	S14	S15	S6	S17	S18	Total
Forest	0.000	0.060	43.157	2.241	38.242	7.424	1.434	0.000	0.000	0.000	0.000	92.558
	0.000	0.040	25.790	1.340	22.860	4.440	0.860	0.000	0.000	0.000	0.000	55.320
	0.000	0.060	46.630	2.420	41.320	8.020	1.550	0.000	0.000	0.000	0.000	
	0.000	100.000	72.080	96.770	97.340	100.000	16.130	0.000	0.000	0.000	0.000	
Forest with	15.610	0.000	0.000	0.000	0.000	0.000	7.380	6.558	5.677	0.000	0.732	35.956
Associated	9.330	0.000	0.000	0.000	0.000	0.000	4.410	3.920	3.390	0.000	0.440	21.490
Landuse	43.420	0.000	0.000	0.000	0.000	0.000	20.520	18.240	15.790	0.000	2.040	
	55.790	0.000	0.000	0.000	0.000	0.000	83.030	43.990	99.220	0.000	100.000	
Riverwash	0.000	0.000	0.299	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.299
	0.000	0.000	0.180	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.180
	0.000	0.000	100.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
	0.000	0.000	0.500	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Brushland	12.369	0.000	16.417	0.075	1.046	0.000	0.075	8.350	0.045	0.134	0.000	38.511
	7.390	0.000	9.810	0.040	0.620	0.000	0.040	4.990	0.030	0.080	0.000	23.020
	32.120	0.000	42.630	0.190	2.720	0.000	0.190	21.680	0.120	0.350	0.000	
	44.210	0.000	27.420	3.230	2.660	0.000	0.840	56.010	0.780	100.000	0.000	
Total	27.979	0.060	59.873	2.315	39.288	7.424	8.888	14.908	5.721	0.134	0.732	167.324
	16.720	0.040	35.780	1.380	23.480	4.440	5.310	8.910	3.420	0.080	0.440	

Area cross tabulation of the 1981-1990 landuse change for virgin (old growth dipterocarp) forest within the municipalities of Pangasinan.

Area (km sq)
Total %
Row %
Col %

Municipality	Forest	Forest w/ Associated Landuses	Brushland	Total
Labrador	0.000	0.060	0.164	0.224
	0.000	0.040	0.120	0.170
	0.000	26.670	73.330	
	0.000	0.070	0.390	
Mabini	0.000	0.000	6.543	6.543
	0.000	0.000	4.880	4.880
	0.000	0.000	100.000	
	0.000	0.000	15.610	
Aguilar	0.000	0.717	0.000	0.717
	0.000	0.530	0.000	0.530
	0.000	100.000	0.000	
	0.000	0.850	0.000	
Mangatarem	7.394	19.614	8.604	35.613
	5.520	14.630	6.420	26.570
	20.760	55.080	24.160	
	100.000	23.140	20.530	
Sison	0.000	0.164	1.808	1.972
	0.000	0.120	1.350	1.470
	0.000	8.330	91.670	
	0.000	0.190	4.310	
San Manuel	0.000	0.015	0.090	0.105
	0.000	0.010	0.070	0.080
	0.000	14.290	85.710	
	0.000	0.020	0.210	
San Nicolas	0.000	2.211	5.901	8.111
	0.000	1.650	4.400	6.050
	0.000	27.260	72.740	
	0.000	2.610	14.080	
Natividad	0.000	23.468	13.146	36.614
	0.000	17.510	9.810	27.320
	0.000	64.100	35.900	
	0.000	27.690	31.370	

Municipality	Forest	Forest w/ Associated Landuses	Brushland	Total
San Quintin	0.000	37.107	5.647	42.753
	0.000	27.680	4.210	31.900
	0.000	86.790	13.210	
	0.000	43.790	13.480	
Umingan	0.000	1.389	0.000	1.389
	0.000	1.040	0.000	1.040
	0.000	100.000	0.000	
	0.000	1.640	0.000	
Total	7.394	84.745	41.902	134.041
	5.520	63.220	31.260	

Area cross tabulation of the 1981-1990 landuse change for virgin (old growth dipterocarp) forest within the municipalities of Benguet.

Area (km sq)
Total %
Row %
Col %

Municipality	Forest w/ Associated Landuses	Agricultural Areas	Brushland	Total
Bakun	11.951	0.359	7.678	19.987
	8.450	0.250	5.430	14.130
	59.790	1.790	38.420	
	14.350	2.070	18.810	
Mankayan	13.056	8.111	0.448	21.616
	9.230	5.740	0.320	15.280
	60.400	37.530	2.070	
	15.680	46.770	1.100	
Buguias	10.263	3.286	0.284	13.833
	7.260	2.320	0.200	9.780
	74.190	23.760	2.050	
	12.330	18.950	0.700	
Kibungan	12.653	3.406	1.150	17.209
	8.950	2.410	0.810	12.170
	73.520	19.790	6.680	
	15.200	19.640	2.820	
Kabayan	27.412	1.001	1.225	29.638
	19.380	0.710	0.870	20.950
	92.490	3.380	4.130	
	32.920	5.770	3.000	
Atok	0.762	1.165	0.373	2.300
	0.540	0.820	0.260	1.630
	33.120	50.650	16.230	
	0.910	6.720	0.910	
Kapangan	0.000	0.000	21.138	21.138
	0.000	0.000	14.950	14.950
	0.000	0.000	100.000	
	0.000	0.000	51.770	
Tublay	0.000	0.000	3.361	3.361
	0.000	0.000	2.380	2.380
	0.000	0.000	100.000	
	0.000	0.000	8.230	

Municipality	Forest w/ Associated Landuses	Agricultural Areas	Brushland	Total
Sablan	0.000	0.000	2.853	2.853
	0.000	0.000	2.020	2.020
	0.000	0.000	100.000	
	0.000	0.000	6.990	
Tuba	0.060	0.000	0.538	0.598
	0.040	0.000	0.380	0.420
	10.000	0.000	90.000	
	0.070	0.000	1.320	
Itogon	2.136	0.000	1.628	3.764
	1.510	0.000	1.150	2.660
	56.750	0.000	43.250	
	2.570	0.000	3.990	
Bokod	4.974	0.015	0.149	5.139
	3.520	0.010	0.110	3.630
	96.800	0.290	2.910	
	5.970	0.090	0.370	
Total	83.266	17.343	40.826	141.436
	58.870	12.260	28.870	

Area cross tabulation of the 1981-1990 landuse change for virgin (old growth dipterocarp) forest within the municipalities of Tarlac.

Area (km sq)
Total %
Row %
Col %

Municipality	Forest	Riverwash	Brushland	Total
Camp O'Donnel	6.603	0.000	0.284	6.887
	4.550	0.000	0.200	4.740
	95.880	0.000	4.120	
	5.960	0.000	0.830	
Tarlac	75.140	0.299	33.970	109.408
	51.730	0.210	23.390	75.320
	68.680	0.270	31.050	
	67.870	100.000	99.170	
Mayantoc	26.829	0.000	0.000	26.829
	18.470	0.000	0.000	18.470
	100.000	0.000	0.000	
	24.230	0.000	0.000	
San Clemente	2.136	0.000	0.000	2.136
	1.470	0.000	0.000	1.470
	100.000	0.000	0.000	
	1.930	0.000	0.000	
Total	110.708	0.299	34.253	145.260
	76.210	0.210	23.580	

Area cross tabulation of the 1981-1990 landuse change for virgin (old growth dipterocar forest within the municipalities of La Union.

Area (km sq)
Total %
Row %
Col %

Municipality	Forest w/ Associated Landuses	Agricultural Areas	Brushland	Total
Burgos	0.0000	1.0009	5.6317	6.6326
	0.0000	2.7800	15.6700	18.4500
	0.0000	15.0900	84.9100	
	0.0000	42.9500	21.8800	
Bagulin	0.0000	0.0000	3.0922	3.0922
	0.0000	0.0000	8.6000	8.6000
	0.0000	0.0000	100.0000	
	0.0000	0.0000	12.0100	
San Gabriel	0.2689	1.0307	12.7872	14.0868
	0.7500	2.8700	35.5800	39.1900
	1.9100	7.3200	90.7700	
	3.4200	44.2300	49.6800	
Santol	1.6731	0.0000	2.1660	3.8391
	4.6600	0.0000	6.0300	10.6800
	43.5800	0.0000	56.4200	
	21.2500	0.0000	8.4200	
Sudipen	5.9305	0.2988	2.0615	8.2907
	16.5000	0.8300	5.7400	23.0700
	71.5300	3.6000	24.8600	
	75.3300	12.8200	8.0100	
Total	7.8725	2.3304	25.7386	35.9415
	21.9000	6.4800	71.6100	

Tables on single area and area cross tabulation analysis for 1981-1990 landuse change for (old growth dipterocarp) residual forests

Area analysis on land use changes within residual forest areas (dipterocarp) between 1981-1990.

Class	Land Use Change	Area (%)	Cumm (%)	Area (km sq.)
1	Residual to Forest area	32.160	32.160	276.059
2	Residual to Forest w/ associated landuses	21.920	54.080	188.207
3	Residual to Agricultural areas	2.300	56.380	19.719
5	Residual to Riverwash	0.690	57.060	5.901
8	Residual to Mines	0.000	57.070	0.015
11	Residual to Brush/Grassland	42.930	100.000	368.587
	Total of 6 classes	100.000		858.488

Area cross tabulation of the 1981-1990 landuse change for residual (dipterocarp) forest across the N sub-basins of the Agno River System

Area (km sq)
Total %
Row %
Col %

Legend	N1	N3	N4	N5	N6	N9	N10	N11	N13	N14	N15	N17
Forest with	0.4631	0.9262	0.2689	0.5378	5.4077	1.9569	0.0000	3.2416	0.0149	0.0000	2.1212	7.9023
Associated	0.5400	1.0900	0.3200	0.6300	6.3600	2.3000	0.0000	3.8100	0.0200	0.0000	2.4900	9.2900
Landuse	0.9500	1.9000	0.5500	1.1000	11.1000	4.0200	0.0000	6.6600	0.0300	0.0000	4.3600	16.2300
	48.4400	74.7000	21.9500	51.4300	87.8600	72.3800	0.0000	100.0000	4.5500	0.0000	81.1400	39.8600
Agriculture	0.4930	0.3137	0.8963	0.0448	0.1195	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1344
	0.5800	0.3700	1.0500	0.0500	0.1400	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1600
	22.6000	14.3800	41.1000	2.0500	5.4800	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	6.1600
	51.5600	25.3000	73.1700	4.2900	1.9400	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.6800
Brushland	0.0000	0.0000	0.0598	0.4631	0.6274	0.7469	1.0756	0.0000	0.3137	1.5237	0.4930	11.7863
	0.0000	0.0000	0.0700	0.5400	0.7400	0.8800	1.2600	0.0000	0.3700	1.7900	0.5800	13.8600
	0.0000	0.0000	0.1700	1.3600	1.8400	2.1900	3.1500	0.0000	0.9200	4.4600	1.4400	34.5100
	0.0000	0.0000	4.8800	44.2900	10.1900	27.6200	100.0000	0.0000	95.4500	100.0000	18.8600	59.4600
Total	0.9560	1.2399	1.2249	1.0457	6.1546	2.7038	1.0756	3.2416	0.3286	1.5237	2.6142	19.8231
	1.1200	1.4600	1.4400	1.2300	7.2400	3.1800	1.2600	3.8100	0.3900	1.7900	3.0700	23.3100

Legend	N18	N20	N21	N22	N25	N26	N27	N28	N33	N34	N35	Total
Forest with	0.0299	0.1046	0.6125	2.0914	1.2548	0.1942	12.7125	0.1494	0.4033	4.1528	4.1528	48.6988
Associated	0.0400	0.1200	0.7200	2.4600	1.4800	0.2300	14.9500	0.1800	0.4700	4.8800	4.8800	57.2700
Landuse	0.0600	0.2100	1.2600	4.2900	2.5800	0.4000	26.1000	0.3100	0.8300	8.5300	8.5300	
	1.8500	3.4700	16.7300	43.8900	38.5300	100.0000	100.0000	100.0000	62.7900	54.1900	76.5800	
Agriculture	0.0000	0.0299	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1494	2.1810
	0.0000	0.0400	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1800	2.5700
	0.0000	1.3700	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	6.8500	
	0.0000	0.9900	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	2.7500	
Brushland	1.5835	2.8831	3.0474	2.6740	2.0017	0.0000	0.0000	0.0000	0.2390	3.5105	1.1204	34.1489
	1.8600	3.3900	3.5800	3.1400	2.3500	0.0000	0.0000	0.0000	0.2800	4.1300	1.3200	40.1600
	4.6400	8.4400	8.9200	7.8300	5.8600	0.0000	0.0000	0.0000	0.7000	10.2800	3.2800	
	98.1500	95.5400	83.2700	56.1100	61.4700	0.0000	0.0000	0.0000	37.2100	45.8100	20.6600	
Total	1.6133	3.0175	3.6599	4.7653	3.2565	0.1942	12.7125	0.1494	0.6423	7.6633	5.4226	85.0286
	1.9000	3.5500	4.3000	5.6000	3.8300	0.2300	14.9500	0.1800	0.7600	9.0100	6.3800	

Area cross tabulation of the 1981-1990 landuse change for residual (dipterocarp) forest across the Central Plain and S sub-basins of the Agno River Basin

Area (km sq)
Total %
Row %
Col %

Legend	Central Plain	S1	S2	S3	S5
Forest	0.866	14.998	11.024	1.688	85.746
	0.220	3.760	2.760	0.420	21.490
	0.340	5.940	4.370	0.670	33.970
	5.510	75.380	81.640	96.580	89.790
Forest with	2.076	0.000	0.000	0.000	0.000
Associated	0.520	0.000	0.000	0.000	0.000
Landuse	6.170	0.000	0.000	0.000	0.000
	13.200	0.000	0.000	0.000	0.000
Agriculture	0.463	0.000	0.000	0.000	0.000
	0.120	0.000	0.000	0.000	0.000
	18.790	0.000	0.000	0.000	0.000
	2.940	0.000	0.000	0.000	0.000
Riverwash	0.911	0.000	0.000	0.000	3.077
	0.230	0.000	0.000	0.000	0.770
	16.140	0.000	0.000	0.000	54.500
	5.790	0.000	0.000	0.000	3.220
Brushland	11.413	4.900	2.480	0.060	6.677
	2.860	1.230	0.620	0.010	1.670
	10.880	4.670	2.360	0.060	6.370
	72.550	24.620	18.360	3.420	6.990
Total	15.730	19.898	13.504	1.748	95.500
	3.940	4.990	3.380	0.440	23.930

Legend	S6	S9	S10	S11	S12
Forest	71.838	53.494	4.750	0.254	0.045
	18.000	13.410	1.190	0.060	0.010
	28.460	21.190	1.880	0.100	0.020
	78.270	99.030	43.860	2.540	1.690
Forest with	0.000	0.000	0.000	0.000	0.000
Associated	0.000	0.000	0.000	0.000	0.000
Landuse	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000
Agriculture	0.000	0.000	0.000	0.881	0.284
	0.000	0.000	0.000	0.220	0.070
	0.000	0.000	0.000	35.760	11.520
	0.000	0.000	0.000	8.830	10.730
Riverwash	0.956	0.060	0.642	0.000	0.000
	0.240	0.010	0.160	0.000	0.000
	16.930	1.060	11.380	0.000	0.000
	1.040	0.110	5.930	0.000	0.000
Brushland	18.987	0.463	5.438	8.843	2.315
	4.760	0.120	1.360	2.220	0.580
	18.100	0.440	5.180	8.430	2.210
	20.690	0.860	50.210	88.620	87.570
Total	91.781	54.017	10.830	9.979	2.644
	23.000	13.540	2.710	2.500	0.660

Legend	S13	S14	S15	S16	S18
Forest	5.691	2.002	0.000	0.000	0.000
	1.430	0.500	0.000	0.000	0.000
	2.250	0.790	0.000	0.000	0.000
	27.040	19.620	0.000	0.000	0.000
Forest with	0.000	6.214	4.706	7.858	6.588
Associated	0.000	1.560	1.180	1.970	1.650
Landuse	0.000	18.470	13.990	23.360	19.580
	0.000	60.910	100.000	66.670	55.540
Agriculture	0.209	0.000	0.000	0.627	0.000
	0.050	0.000	0.000	0.160	0.000
	8.480	0.000	0.000	25.450	0.000
	0.990	0.000	0.000	5.320	0.000
Riverwash	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000
Brushland	15.147	1.987	0.000	3.301	5.273
	3.800	0.500	0.000	0.830	1.320
	14.440	1.890	0.000	3.150	5.030
	71.970	19.470	0.000	28.010	44.460
Total	21.048	10.203	4.706	11.786	11.861
	5.270	2.560	1.180	2.950	2.970

Legend	S19	S20	S21	S22	Total
Forest	0.000	0.000	0.000	0.000	252.397
	0.000	0.000	0.000	0.000	63.250
	0.000	0.000	0.000	0.000	
	0.000	0.000	0.000	0.000	
Forest with	1.882	0.373	1.897	2.047	33.641
Associated	0.470	0.090	0.480	0.510	8.430
Landuse	5.600	1.110	5.640	6.080	
	46.490	6.100	33.420	25.700	
Agriculture	0.000	0.000	0.000	0.000	2.465
	0.000	0.000	0.000	0.000	0.620
	0.000	0.000	0.000	0.000	
	0.000	0.000	0.000	0.000	
Riverwash	0.000	0.000	0.000	0.000	5.647
	0.000	0.000	0.000	0.000	1.420
	0.000	0.000	0.000	0.000	
	0.000	0.000	0.000	0.000	
Brushland	2.166	5.751	3.779	5.916	104.897
	0.540	1.440	0.950	1.480	26.290
	2.060	5.480	3.600	5.640	
	53.510	93.900	66.580	74.300	
Total	4.048	6.125	5.677	7.962	399.046
	1.010	1.530	1.420	2.000	

Area cross tabulation of the 1981-1990 landuse change for residual (dipterocarp) forest within the municipalities of Pangasinan.

Area (km sq)
Total %
Row %
Col%

Municipality	Forest	Forest w/ Associated Landuse	Agricultural Areas	Riverwash	Brushland	Total
Labrador	0.000	18.270	0.075	0.000	6.707	25.051
	0.000	9.800	0.040	0.000	3.600	13.440
	0.000	72.930	0.300	0.000	26.770	
	0.000	17.410	2.380	0.000	9.080	
Sual	0.000	0.000	1.793	0.000	4.870	6.662
	0.000	0.000	0.960	0.000	2.610	3.580
	0.000	0.000	26.910	0.000	73.090	
	0.000	0.000	57.140	0.000	6.600	
Mabini	0.000	2.211	0.000	0.000	0.015	2.226
	0.000	1.190	0.000	0.000	0.010	1.190
	0.000	99.330	0.000	0.000	0.670	
	0.000	2.110	0.000	0.000	0.020	
Infanta	0.000	27.875	0.000	0.000	4.272	32.147
	0.000	14.960	0.000	0.000	2.290	17.250
	0.000	86.710	0.000	0.000	13.290	
	0.000	26.570	0.000	0.000	5.790	
Bugallon	0.000	3.018	0.000	0.000	8.111	11.129
	0.000	1.620	0.000	0.000	4.350	5.970
	0.000	27.110	0.000	0.000	72.890	
	0.000	2.880	0.000	0.000	10.990	
Aguilar	0.000	11.099	0.000	0.000	7.992	19.091
	0.000	5.960	0.000	0.000	4.290	10.250
	0.000	58.140	0.000	0.000	41.860	
	0.000	10.580	0.000	0.000	10.820	
Mangatarem	3.540	14.460	0.777	0.000	5.990	24.768
	1.900	7.760	0.420	0.000	3.210	13.290
	14.290	58.380	3.140	0.000	24.190	
	100.000	13.780	24.760	0.000	8.110	
Sison	0.000	0.926	0.269	0.000	7.215	8.410
	0.000	0.500	0.140	0.000	3.870	4.510
	0.000	11.010	3.200	0.000	85.790	
	0.000	0.880	8.570	0.000	9.770	

Municipality	Forest	Forest w/ Associated Landuse	Agricultural Areas	Riverwash	Brushland	Total
San Manuel	0.000	1.598	0.000	0.105	2.241	3.944
	0.000	0.860	0.000	0.060	1.200	2.120
	0.000	40.530	0.000	2.650	56.820	
	0.000	1.520	0.000	11.480	3.030	
San Nicolas	0.000	12.264	0.224	0.807	24.454	37.749
	0.000	6.580	0.120	0.430	13.120	20.260
	0.000	32.490	0.590	2.140	64.780	
	0.000	11.690	7.140	88.520	33.120	
Natividad	0.000	0.030	0.000	0.000	1.583	1.613
	0.000	0.020	0.000	0.000	0.850	0.870
	0.000	1.850	0.000	0.000	98.150	
	0.000	0.030	0.000	0.000	2.140	
San Quintin	0.000	4.974	0.000	0.000	0.000	4.974
	0.000	2.670	0.000	0.000	0.000	2.670
	0.000	100.000	0.000	0.000	0.000	
	0.000	4.740	0.000	0.000	0.000	
Umingan	0.000	8.186	0.000	0.000	0.388	8.575
	0.000	4.390	0.000	0.000	0.210	4.600
	0.000	95.470	0.000	0.000	4.530	
	0.000	7.800	0.000	0.000	0.530	
Total	3.540	104.911	3.137	0.911	73.840	186.340
	1.900	56.300	1.680	0.490	39.630	

Area cross tabulation of the 1981-1990 landuse change for residual (dipterocarp) forest within the municipalities of Benguet.

Area (km sq)
Total %
Row %
Col %

Municipality	Forest w/ Associated Landuses	Agricultural Areas	Mines	Brushland	Total
Bakun	7.75	0.00	0.00	1.73	9.49
	3.94	0.00	0.00	0.88	4.82
	81.73	0.00	0.00	18.27	
	15.51	0.00	0.00	1.29	
Mankayan	0.63	0.15	0.00	0.43	1.21
	0.32	0.08	0.00	0.22	0.62
	51.85	12.35	0.00	35.80	
	1.26	1.20	0.00	0.32	
Buguias	1.60	1.84	0.00	0.06	3.50
	0.81	0.93	0.00	0.03	1.78
	45.73	52.56	0.00	1.71	
	3.20	14.78	0.00	0.04	
Kibungan	5.63	1.24	0.00	7.35	14.22
	2.86	0.63	0.00	3.74	7.23
	39.60	8.72	0.00	51.68	
	11.27	9.98	0.00	5.48	
Kabayan	5.90	0.48	0.00	1.03	7.41
	3.00	0.24	0.00	0.52	3.77
	79.64	6.45	0.00	13.91	
	11.81	3.85	0.00	0.77	
Atok	10.26	0.69	0.02	5.92	16.88
	5.22	0.35	0.01	3.01	8.58
	60.80	4.07	0.09	35.04	
	20.53	5.53	100.00	4.41	
Kapangan	0.13	1.60	0.00	39.14	40.87
	0.07	0.81	0.00	19.90	20.78
	0.33	3.91	0.00	95.76	
	0.27	12.86	0.00	29.16	
Tublay	0.00	6.01	0.00	11.91	17.91
	0.00	3.05	0.00	6.05	9.11
	0.00	33.53	0.00	66.47	
	0.00	48.32	0.00	8.87	

Municipality	Forest w/ Associated Landuses	Agricultural Areas	Mines	Brushland	Total
Sablan	1.17	0.00	0.00	42.57	43.74
	0.59	0.00	0.00	21.65	22.24
	2.66	0.00	0.00	97.34	
	2.33	0.00	0.00	31.72	
La Trinidad	0.00	0.22	0.00	3.85	4.08
	0.00	0.11	0.00	1.96	2.07
	0.00	5.49	0.00	94.51	
	0.00	1.80	0.00	2.87	
Tuba	3.91	0.06	0.00	13.68	17.66
	1.99	0.03	0.00	6.96	8.98
	22.17	0.34	0.00	77.50	
	7.83	0.48	0.00	10.19	
Baguio	5.11	0.15	0.00	1.00	6.26
	2.60	0.08	0.00	0.51	3.18
	81.62	2.39	0.00	15.99	
	10.22	1.20	0.00	0.75	
Itogon	2.39	0.00	0.00	3.68	6.07
	1.22	0.00	0.00	1.87	3.08
	39.41	0.00	0.00	60.59	
	4.78	0.00	0.00	2.74	
Bokod	5.50	0.00	0.00	1.88	7.38
	2.80	0.00	0.00	0.96	3.75
	74.49	0.00	0.00	25.51	
	11.00	0.00	0.00	1.40	
Total	49.98	12.43	0.02	134.24	196.66
	25.42	6.32	0.01	68.26	

Area cross tabulation of the 1981-1990 landuse change for residual (dipterocarp) forest within the municipalities of Tarlac.

Area (km sq)
Total %
Row %
Col %

Municipality	Forest	Forest w/ Associated Landuses	Agricultural Areas	Riverwash	Brushland	Total
Bamban	26.680	0.000	0.000	0.000	2.480	29.160
	7.690	0.000	0.000	0.000	0.720	8.410
	91.500	0.000	0.000	0.000	8.500	
	9.730	0.000	0.000	0.000	3.750	
O'Donnel	57.886	0.000	0.000	0.000	9.426	67.312
	16.690	0.000	0.000	0.000	2.720	19.410
	86.000	0.000	0.000	0.000	14.000	
	21.120	0.000	0.000	0.000	14.260	
Tarlac	109.020	0.000	0.000	4.033	19.898	132.951
	31.440	0.000	0.000	1.160	5.740	38.340
	82.000	0.000	0.000	3.030	14.970	
	39.770	0.000	0.000	85.170	30.110	
Mayantoc	80.009	0.000	1.165	0.702	32.595	114.472
	23.070	0.000	0.340	0.200	9.400	33.010
	69.890	0.000	1.020	0.610	28.470	
	29.190	0.000	84.780	14.830	49.320	
Camiling	0.000	0.000	0.000	0.000	0.045	0.045
	0.000	0.000	0.000	0.000	0.010	0.010
	0.000	0.000	0.000	0.000	100.000	
	0.000	0.000	0.000	0.000	0.070	
San Clemente	0.508	0.448	0.209	0.000	1.643	2.808
	0.150	0.130	0.060	0.000	0.470	0.810
	18.090	15.960	7.450	0.000	58.510	
	0.190	100.000	15.220	0.000	2.490	
Total	274.102	0.448	1.374	4.735	66.087	346.747
	79.050	0.130	0.400	1.370	19.060	

Area cross tabulation of the 1981-1990 landuse change for residual (dipterocarp) forest within the municipalities of La Union.

Area (km sq)
Total %
Row %
Col %

Municipality	Forest w/ Associated Landuse	Agricultural Areas	Riverwash	Brushland	Total
San Juan	0.000	0.299	0.000	0.478	0.777
	0.000	0.220	0.000	0.350	0.560
	0.000	38.460	0.000	61.540	
	0.000	10.470	0.000	0.470	
San Fernando	0.000	0.000	0.000	1.031	1.031
	0.000	0.000	0.000	0.750	0.750
	0.000	0.000	0.000	100.000	
	0.000	0.000	0.000	1.020	
Aringay	0.000	0.149	0.000	1.031	1.180
	0.000	0.110	0.000	0.750	0.860
	0.000	12.660	0.000	87.340	
	0.000	5.240	0.000	1.020	
Pugo	0.000	0.000	0.000	2.480	2.480
	0.000	0.000	0.000	1.800	1.800
	0.000	0.000	0.000	100.000	
	0.000	0.000	0.000	2.440	
Naguilian	0.000	0.000	0.000	0.657	0.657
	0.000	0.000	0.000	0.480	0.480
	0.000	0.000	0.000	100.000	
	0.000	0.000	0.000	0.650	
Burgos	0.000	1.016	0.000	23.199	24.215
	0.000	0.740	0.000	16.820	17.560
	0.000	4.190	0.000	95.810	
	0.000	35.600	0.000	22.850	
Bagulin	0.000	0.254	0.000	29.339	29.593
	0.000	0.180	0.000	21.280	21.460
	0.000	0.860	0.000	99.140	
	0.000	8.900	0.000	28.900	
San Gabriel	26.426	0.583	0.000	41.065	68.074
	19.160	0.420	0.000	29.780	49.370
	38.820	0.860	0.000	60.320	
	79.430	20.420	0.000	40.440	

Municipality	Forest w/ Associated Landuse	Agricultural Areas	Riverwash	Brushland	Total
Santol	6.364	0.000	0.075	0.971	7.409
	4.610	0.000	0.050	0.700	5.370
	85.890	0.000	1.010	13.100	
	19.130	0.000	31.250	0.960	
Sudipen	0.478	0.553	0.164	1.285	2.480
	0.350	0.400	0.120	0.930	1.800
	19.280	22.290	6.630	51.810	
	1.440	19.370	68.750	1.270	
Total	33.268	2.853	0.239	101.535	137.895
	24.130	2.070	0.170	73.630	

Tables on single area and area cross tabulation analysis for 1981-1990 landuse change for pine forests

Area analysis on land use change within pine forest areas from 1981 to 1990.

Class	Land Use Change	Area (%)	Cumm (%)	Area (km sq.)
2	Pine to Forest w/ associated landuses	62.140	62.140	575.482
3	Pine to Agricultural area	3.770	65.900	34.881
4	Pine to Built-up area	0.020	65.930	0.224
5	Pine to Riverwash	0.170	66.100	1.598
6	Pine to Reservoir	0.190	66.290	1.763
8	Pine to Mines	0.260	66.550	2.420
11	Pine to Brushland/Grassland	33.450	100.000	309.790
Total of 7 classes		100.000		926.158

Area cross tabulation of the 1981-1990 landuse change
for pine forest across the N sub-basins of the Agno River Basin

Area (km sq)
Total %
Row %
Col %

Legend	N1	N2	N3	N4	N5	N6	N7	N8
Forest with	1.897	2.614	2.450	1.554	19.240	11.443	18.628	27.979
Associated	0.280	0.380	0.360	0.230	2.800	1.670	2.710	4.080
Landuse	0.450	0.610	0.570	0.360	4.510	2.680	4.370	6.560
	37.130	86.630	50.930	47.490	83.850	78.000	71.750	50.130
Agriculture	3.062	0.403	1.464	1.374	0.179	0.239	2.435	8.649
	0.450	0.060	0.210	0.200	0.030	0.030	0.350	1.260
	14.540	1.910	6.950	6.520	0.850	1.130	11.560	41.060
	59.940	13.370	30.430	42.010	0.780	1.630	9.380	15.500
Riverwash	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Reservoir	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.031
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.150
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	58.470
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.850
Mines	0.000	0.000	0.000	0.000	0.000	0.000	0.971	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.140	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	51.180	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	3.740	0.000
Brushland	0.149	0.000	0.896	0.344	3.525	2.988	3.929	18.150
	0.020	0.000	0.130	0.050	0.510	0.440	0.570	2.640
	0.060	0.000	0.380	0.150	1.500	1.270	1.670	7.720
	2.920	0.000	18.630	10.500	15.360	20.370	15.130	32.520
Total	5.109	3.018	4.810	3.271	22.945	14.669	25.963	55.809
	0.740	0.440	0.700	0.480	3.340	2.140	3.780	8.130

Legend	N9	N10	N11	N12	N13	N14	N15	N16
Forest with	29.518	32.550	90.840	18.284	13.878	27.651	38.063	1.927
Associated	4.300	4.740	13.230	2.660	2.020	4.030	5.540	0.280
Landuse	6.930	7.640	21.310	4.290	3.260	6.490	8.930	0.450
	60.320	58.800	88.810	39.190	41.230	84.020	50.340	77.710
Agriculture	0.822	0.627	0.120	0.478	0.284	0.538	0.194	0.000
	0.120	0.090	0.020	0.070	0.040	0.080	0.030	0.000
	3.900	2.980	0.570	2.270	1.350	2.550	0.920	0.000
	1.680	1.130	0.120	1.020	0.840	1.630	0.260	0.000
Riverwash	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Reservoir	0.194	0.538	0.000	0.000	0.000	0.000	0.000	0.000
	0.030	0.080	0.000	0.000	0.000	0.000	0.000	0.000
	11.020	30.510	0.000	0.000	0.000	0.000	0.000	0.000
	0.400	0.970	0.000	0.000	0.000	0.000	0.000	0.000
Mines	0.000	0.000	0.000	0.090	0.000	0.000	0.105	0.000
	0.000	0.000	0.000	0.010	0.000	0.000	0.020	0.000
	0.000	0.000	0.000	4.720	0.000	0.000	5.510	0.000
	0.000	0.000	0.000	0.190	0.000	0.000	0.140	0.000
Brushland	18.404	21.646	11.323	27.800	19.494	4.720	37.256	0.553
	2.680	3.150	1.650	4.050	2.840	0.690	5.430	0.080
	7.830	9.210	4.820	11.820	8.290	2.010	15.850	0.240
	37.610	39.100	11.070	59.590	57.920	14.340	49.270	22.290
Total	48.938	55.361	102.282	46.652	33.656	32.909	75.618	2.480
	7.130	8.060	14.900	6.790	4.900	4.790	11.010	0.360

Legend	N17	N18	N19	N20	N21	N28	N29	N30
Forest with	4.586	0.553	1.912	0.000	0.000	30.997	2.286	0.508
Associated	0.670	0.080	0.280	0.000	0.000	4.510	0.330	0.070
Landuse	1.080	0.130	0.450	0.000	0.000	7.270	0.540	0.120
	82.750	18.500	67.720	0.000	0.000	92.220	68.300	18.890
Agriculture	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Riverwash	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Reservoir	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Mines	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Brushland	0.956	2.435	0.911	7.096	0.164	2.614	1.061	2.181
	0.140	0.350	0.130	1.030	0.020	0.380	0.150	0.320
	0.410	1.040	0.390	3.020	0.070	1.110	0.450	0.930
	17.250	81.500	32.280	100.000	100.000	7.780	31.700	81.110
Total	5.542	2.988	2.823	7.096	0.164	33.611	3.346	2.689
	0.810	0.440	0.410	1.030	0.020	4.900	0.490	0.390

Legend	N31	N32	N33	N34	N35	N36	Total
Forest with	3.137	6.259	9.157	3.257	11.771	13.265	426.204
Associated	0.460	0.910	1.330	0.470	1.710	1.930	62.080
Landuse	0.740	1.470	2.150	0.760	2.760	3.110	
	32.860	65.880	47.820	75.430	40.180	57.590	
Agriculture	0.000	0.000	0.000	0.000	0.194	0.000	21.063
	0.000	0.000	0.000	0.000	0.030	0.000	3.070
	0.000	0.000	0.000	0.000	0.920	0.000	
	0.000	0.000	0.000	0.000	0.660	0.000	
Riverwash	0.090	0.478	0.000	0.000	0.000	0.000	0.568
	0.010	0.070	0.000	0.000	0.000	0.000	0.080
	15.790	84.210	0.000	0.000	0.000	0.000	
	0.940	5.030	0.000	0.000	0.000	0.000	
Reservoir	0.000	0.000	0.000	0.000	0.000	0.000	1.763
	0.000	0.000	0.000	0.000	0.000	0.000	0.260
	0.000	0.000	0.000	0.000	0.000	0.000	
	0.000	0.000	0.000	0.000	0.000	0.000	
Mines	0.000	0.000	0.224	0.000	0.000	0.508	1.897
	0.000	0.000	0.030	0.000	0.000	0.070	0.280
	0.000	0.000	11.810	0.000	0.000	26.770	
	0.000	0.000	1.170	0.000	0.000	2.200	
Brushland	6.319	2.764	9.770	1.061	17.328	9.262	235.099
	0.920	0.400	1.420	0.150	2.520	1.350	34.240
	2.690	1.180	4.160	0.450	7.370	3.940	
	66.200	29.090	51.010	24.570	59.150	40.210	
Total	9.546	9.501	19.151	4.317	29.294	23.035	686.593
	1.390	1.380	2.790	0.630	4.270	3.350	

Area cross tabulation of the 1981-1990 landuse change for pine forest across the Central Plain and S sub-basins of the Agno River Basin

Area (km sq)
Total %
Row %
Col %

Legend	Central Plain	Total
Forest with Associated Landuse	7.4094 53.2200 100.0000 53.2200	7.4094 53.2200
Agriculture	0.0747 0.5400 100.0000 0.5400	0.0747 0.5400
Riverwash	1.0307 7.4000 100.0000 7.4000	1.0307 7.4000
Brushland	5.4077 38.8400 100.0000 38.8400	5.4077 38.8400
Total	13.9225 100.0000	13.9225

Area cross tabulation of the 1981-1990 landuse change for pine forest within the municipalities of Pangasinan

Area (km sq)
Total %
Row %
Col %

Municipality	Forest with Associate Landuse	Agricultural Areas	Riverwas	Brushland	Total
San Manuel	5.1686	0.0149	0.9262	6.6774	12.7872
	14.3200	0.0400	2.5700	18.5000	35.4300
	40.4200	0.1200	7.2400	52.2200	
	37.8100	20.0000	57.9400	32.1800	
San Nicolas	8.4999	0.0598	0.6722	14.0719	23.3037
	23.5500	0.1700	1.8600	38.9900	64.5700
	36.4700	0.2600	2.8800	60.3800	
	62.1900	80.0000	42.0600	67.8200	
Total	13.6685	0.0747	1.5984	20.7493	36.0909
	37.8700	0.2100	4.4300	57.4900	

Area cross tabulation of the 1981-1990 landuse change for pine forest within the municipalities of Benguet

Area (km sq)
Total %
Row %
Col %

Municipality	Forest w/ Associated Landuse	Agricultural Areas	Built-up Areas	Reservoir	Mines	Brushland	Total
Bakun	24.917	0.239	0.000	0.000	0.000	4.437	29.593
	2.780	0.030	0.000	0.000	0.000	0.490	3.300
	84.200	0.810	0.000	0.000	0.000	14.990	
	4.390	0.690	0.000	0.000	0.000	1.530	
Mankayan	24.155	4.332	0.000	0.000	0.000	13.205	41.693
	2.690	0.480	0.000	0.000	0.000	1.470	4.650
	57.940	10.390	0.000	0.000	0.000	31.670	
	4.250	12.450	0.000	0.000	0.000	4.560	
Buguias	9.501	7.544	0.000	0.000	0.000	1.165	18.210
	1.060	0.840	0.000	0.000	0.000	0.130	2.030
	52.170	41.430	0.000	0.000	0.000	6.400	
	1.670	21.670	0.000	0.000	0.000	0.400	
Kibungan	24.514	4.765	0.000	0.000	0.000	5.662	34.941
	2.730	0.530	0.000	0.000	0.000	0.630	3.900
	70.160	13.640	0.000	0.000	0.000	16.200	
	4.320	13.690	0.000	0.000	0.000	1.950	
Kabayan	43.396	0.807	0.000	0.000	0.493	8.037	52.732
	4.840	0.090	0.000	0.000	0.050	0.900	5.880
	82.290	1.530	0.000	0.000	0.930	15.240	
	7.640	2.320	0.000	0.000	20.370	2.770	
Atok	28.069	3.809	0.000	0.000	0.000	9.456	41.334
	3.130	0.420	0.000	0.000	0.000	1.050	4.610
	67.910	9.220	0.000	0.000	0.000	22.880	
	4.940	10.940	0.000	0.000	0.000	3.260	
Kapangan	0.149	0.149	0.000	0.000	0.000	11.622	11.921
	0.020	0.020	0.000	0.000	0.000	1.300	1.330
	1.250	1.250	0.000	0.000	0.000	97.490	
	0.030	0.430	0.000	0.000	0.000	4.010	
Tublay	7.783	0.329	0.000	0.000	0.000	9.202	17.313
	0.870	0.040	0.000	0.000	0.000	1.030	1.930
	44.950	1.900	0.000	0.000	0.000	53.150	
	1.370	0.940	0.000	0.000	0.000	3.170	

Municipality	Forest w/ Associated Landuse	Agricultural Areas	Built-up Areas	Reservoir	Mines	Brushland	Total
Sablan	4.168	0.000	0.000	0.000	0.000	0.090	4.257
	0.460	0.000	0.000	0.000	0.000	0.010	0.470
	97.890	0.000	0.000	0.000	0.000	2.110	
	0.730	0.000	0.000	0.000	0.000	0.030	
La Trinidad	3.869	0.493	0.224	0.000	0.612	8.754	13.952
	0.430	0.050	0.020	0.000	0.070	0.980	1.560
	27.730	3.530	1.610	0.000	4.390	62.740	
	0.680	1.420	100.000	0.000	25.310	3.020	
Tuba	48.818	0.194	0.000	0.000	0.732	40.871	90.616
	5.440	0.020	0.000	0.000	0.080	4.560	10.100
	53.870	0.210	0.000	0.000	0.810	45.100	
	8.600	0.560	0.000	0.000	30.250	14.100	
Baguio City	3.720	0.194	0.000	0.000	0.000	6.304	10.218
	0.410	0.020	0.000	0.000	0.000	0.700	1.140
	36.400	1.900	0.000	0.000	0.000	61.700	
	0.660	0.560	0.000	0.000	0.000	2.170	
Itogon	176.854	1.613	0.000	0.000	0.105	106.868	285.441
	19.720	0.180	0.000	0.000	0.010	11.910	31.820
	61.960	0.570	0.000	0.000	0.040	37.440	
	31.140	4.640	0.000	0.000	4.320	36.870	
Bokod	167.936	10.337	0.000	1.763	0.478	64.205	244.719
	18.720	1.150	0.000	0.200	0.050	7.160	27.280
	68.620	4.220	0.000	0.720	0.200	26.240	
	29.570	29.700	0.000	100.000	19.750	22.150	
Total	567.849	34.806	0.224	1.763	2.420	289.877	896.939
	63.310	3.880	0.020	0.200	0.270	32.320	

Tables on single area and area cross tabulation analysis for 1981-1990 landuse change for brushland area

Area analysis on the land use/cover change within brushland areas.

Class	Land Use Change	Area (%)	Cumm (%)	Area (km sq.)
1	Brushland to Forest	6.23	6.23	74.99
2	Brushland to Forest w/ associated landuses	21.62	27.85	260.15
3	Brushland to Agricultural area	7.29	35.14	87.79
4	Brushland to Built-up areas	0.23	35.37	2.81
5	Brushland to Riverwash	0.36	35.73	4.35
6	Brushland to Reservoir	0.01	35.75	0.13
7	Brushland to Fishpond	0.08	35.82	0.91
8	Brushland to Mines	0.22	36.04	2.69
9	Brushland to Swamps	0.02	36.06	0.19
11	Brushland to Brush/Grassland	63.94	100.00	769.55
Total of	10 classes	100.00		1,203.56

Area cross tabulation of the 1981-1990 landuse change for brushland area acroos the N sub-basins of the Agno River Basin

Area (km sq)
Total %
Row %
Col %

Legend	N1	N2	N3	N4	N5	N6	N7
Forest with	1.344	0.433	1.628	0.015	1.703	2.599	1.972
Associated	0.510	0.160	0.610	0.010	0.640	0.980	0.740
landuse	1.080	0.350	1.310	0.010	1.370	2.090	1.580
	67.670	25.660	46.380	2.380	94.210	63.970	36.160
Agriculture	0.642	1.255	1.554	0.000	0.105	0.000	1.120
	0.240	0.470	0.590	0.000	0.040	0.000	0.420
	4.090	7.990	9.900	0.000	0.670	0.000	7.140
	32.330	74.340	44.260	0.000	5.790	0.000	20.550
Riverwash	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Reservoir	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Mines	0.000	0.000	0.000	0.000	0.000	0.000	1.897
	0.000	0.000	0.000	0.000	0.000	0.000	0.720
	0.000	0.000	0.000	0.000	0.000	0.000	84.110
	0.000	0.000	0.000	0.000	0.000	0.000	34.790
Brushland	0.000	0.000	0.329	0.612	0.000	1.464	0.463
	0.000	0.000	0.120	0.230	0.000	0.550	0.170
	0.000	0.000	0.270	0.500	0.000	1.200	0.380
	0.000	0.000	9.360	97.620	0.000	36.030	8.490
Total	1.987	1.688	3.510	0.627	1.808	4.063	5.452
	0.750	0.640	1.320	0.240	0.680	1.530	2.060

Legend	N8	N9	N10	N11	N12	N13	N14
Forest with	5.273	4.191	2.315	8.186	3.525	0.015	2.868
Associated	1.990	5.350	0.870	3.090	1.330	0.010	1.080
landuse	4.230	11.390	1.860	6.570	2.830	0.010	2.300
	36.020	45.637	0.520	68.240	37.460	3.330	25.160
Agriculture	2.047	5.497	0.000	0.000	0.000	0.000	0.239
	0.770	2.070	0.000	0.000	0.000	0.000	0.090
	13.040	35.010	0.000	0.000	0.000	0.000	1.520
	13.980	17.680	0.000	0.000	0.000	0.000	2.100
Riverwash	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Reservoir	0.134	0.000	0.000	0.000	0.000	0.000	0.000
	0.050	0.000	0.000	0.000	0.000	0.000	0.000
	100.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.920	0.000	0.000	0.000	0.000	0.000	0.000
Mines	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Brushland	7.185	11.413	1.165	3.809	5.886	0.433	8.290
	2.710	4.310	0.440	1.440	2.220	0.160	3.130
	5.880	9.330	0.950	3.120	4.810	0.350	6.780
	49.080	36.700	33.480	31.760	62.540	96.670	72.740
Total	14.640	31.101	3.481	11.995	9.411	0.448	11.398
	5.520	11.740	1.310	4.530	3.550	0.170	4.300

Legend	N15	N16	N17	N18	N19	N20	N21
Forest with	5.826	0.493	5.408	0.359	2.136	0.000	1.359
Associated	2.200	0.190	2.040	0.140	0.810	0.000	0.510
landuse	4.680	0.400	4.340	0.290	1.710	0.000	1.090
	42.390	34.020	56.470	18.900	100.000	0.000	24.200
Agriculture	0.075	0.000	0.538	0.000	0.000	0.030	0.000
	0.030	0.000	0.200	0.000	0.000	0.010	0.000
	0.480	0.000	3.430	0.000	0.000	0.190	0.000
	0.540	0.000	5.620	0.000	0.000	0.620	0.000
Riverwash	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Reservoir	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Mines	0.359	0.000	0.000	0.000	0.000	0.000	0.000
	0.140	0.000	0.000	0.000	0.000	0.000	0.000
	15.890	0.000	0.000	0.000	0.000	0.000	0.000
	2.610	0.000	0.000	0.000	0.000	0.000	0.000
Brushland	17.484	0.956	3.630	0.539	0.000	4.825	4.257
	2.820	0.360	1.370	0.580	0.000	1.820	1.610
	6.120	0.780	2.970	1.260	0.000	3.950	3.480
	54.460	65.980	37.910	81.100	0.000	99.380	75.800
Total	13.743	1.449	9.575	1.897	2.136	4.855	5.617
	5.190	0.550	3.610	0.720	0.810	1.830	2.120

Legend	N22	N26	N27	N28	N29	N30	N31
Forest with	0.000	1.793	6.767	3.421	1.150	2.226	2.300
Associated	0.000	0.680	2.550	1.290	0.430	0.840	0.870
landuse	0.000	1.440	5.430	2.750	0.920	1.790	1.850
	0.000	100.000	100.000	97.030	66.380	70.950	51.160
Agriculture	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Riverwash	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Reservoir	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Mines	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Brushland	0.344	0.000	0.000	0.150	0.583	0.911	2.196
	0.130	0.000	0.000	0.040	0.220	0.340	0.830
	0.280	0.000	0.000	0.090	0.480	0.750	1.800
	100.000	0.000	0.000	2.970	33.620	29.050	48.840
Total	0.344	1.793	6.767	3.525	1.733	3.137	4.496
	0.130	0.680	2.550	1.330	0.650	1.180	1.700

Legend	N32	N33	N34	N35	N36	N37	Total
Forest with	0.314	0.448	17.791	4.750	21.974	0.030	124.615
Associated	0.120	0.170	6.710	1.790	8.290	0.014	7.020
landuse	0.250	0.360	14.280	3.810	17.630	0.020	
	72.410	19.480	79.080	25.670	43.430	0.370	
Agriculture	0.000	0.000	0.179	0.000	0.000	2.420	15.700
	0.000	0.000	0.070	0.000	0.000	0.910	5.920
	0.000	0.000	1.140	0.000	0.000	15.410	
	0.000	0.000	0.800	0.000	0.000	30.220	
Riverwash	0.000	0.000	0.000	0.030	0.000	0.000	0.030
	0.000	0.000	0.010	0.000	0.000	0.000	0.010
	0.000	0.000	100.000	0.000	0.000	0.000	
	0.000	0.000	0.130	0.000	0.000	0.000	
Reservoir	0.000	0.000	0.000	0.000	0.000	0.000	0.134
	0.000	0.000	0.000	0.000	0.000	0.000	0.050
	0.000	0.000	0.000	0.000	0.000	0.000	
	0.000	0.000	0.000	0.000	0.000	0.000	
Mines	0.000	0.000	0.000	0.000	0.000	0.000	2.256
	0.000	0.000	0.000	0.000	0.000	0.000	0.850
	0.000	0.000	0.000	0.000	0.000	0.000	
	0.000	0.000	0.000	0.000	0.000	0.000	
Brushland	0.120	1.852	4.496	13.758	28.622	5.557	122.285
	0.050	0.700	1.700	5.190	10.800	2.100	46.140
	0.100	1.510	3.680	11.250	23.410	4.540	
	27.590	80.520	19.990	74.330	56.570	69.400	
Total	0.433	2.300	22.497	18.509	50.596	8.007	265.020
	0.160	0.870	8.490	6.980	19.090	3.020	

Area cross tabulation of the 1981-1990 landuse change
for brushland area across the Central Plain and S sub-basins
of the Agno River Basin

Area (km sq)
Total %
Row %
Col %

Legend	Central Plain	S1	S2	S3	S5	S6	S8
Forest	2.002	0.523	0.015	0.164	17.343	3.884	0.000
	0.810	0.210	0.010	0.070	7.040	1.580	0.000
	2.730	0.710	0.020	0.220	23.640	5.290	0.000
	2.560	5.430	0.380	2.290	87.560	11.110	0.000
Forest with	7.544	0.000	0.000	0.000	0.000	0.000	0.000
Associated	3.060	0.000	0.000	0.000	0.000	0.000	0.000
Landuse	77.570	0.000	0.000	0.000	0.000	0.000	0.000
	9.640	0.000	0.000	0.000	0.000	0.000	0.000
Agriculture	8.306	0.000	0.000	0.000	0.000	0.941	0.568
	3.370	0.000	0.000	0.000	0.000	0.380	0.230
	58.280	0.000	0.000	0.000	0.000	6.600	3.980
	10.620	0.000	0.000	0.000	0.000	2.690	29.690
Built-up	0.149	0.000	0.000	0.000	0.000	0.000	0.000
	0.060	0.000	0.000	0.000	0.000	0.000	0.000
	100.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.190	0.000	0.000	0.000	0.000	0.000	0.000
Riverwash	0.837	0.254	0.000	0.000	0.493	0.657	0.000
	0.340	0.100	0.000	0.000	0.200	0.270	0.000
	37.330	11.330	0.000	0.000	22.000	29.330	0.000
	1.070	2.640	0.000	0.000	2.490	1.880	0.000
Brushland	59.380	8.858	3.944	7.021	1.972	29.488	1.344
	24.110	3.600	1.600	2.850	0.800	11.970	0.550
	40.520	6.040	2.690	4.790	1.350	20.120	0.920
	75.920	91.940	99.620	97.710	9.950	84.320	70.310
Total	78.217	9.635	3.959	7.185	19.808	34.970	1.912
	31.760	3.910	1.610	2.920	8.040	14.200	0.780

Legend	S9	S10	S11	S12	S13	S14	S15
Forest	39.034	7.036	0.403	0.000	2.958	0.000	0.000
	15.850	2.860	0.160	0.000	1.200	0.000	0.000
	53.210	9.590	0.550	0.000	4.030	0.000	0.000
	98.600	74.060	28.720	0.000	29.120	0.000	0.000
Forest with	0.000	0.000	0.000	0.000	0.000	1.105	0.015
Associated	0.000	0.000	0.000	0.000	0.000	0.450	0.010
Landuse	0.000	0.000	0.000	0.000	0.000	11.370	0.150
	0.000	0.000	0.000	0.000	0.000	54.010	0.280
Agriculture	0.000	0.000	0.000	0.732	2.958	0.254	0.000
	0.000	0.000	0.000	0.300	1.200	0.100	0.000
	0.000	0.000	0.000	5.140	20.750	1.780	0.000
	0.000	0.000	0.000	18.850	29.120	12.410	0.000
Built-up	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Riverwash	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Brushland	0.553	2.465	1.001	3.152	4.242	0.687	5.393
	0.220	1.000	0.410	1.280	1.720	0.280	2.190
	0.380	1.680	0.680	2.150	2.900	0.470	3.680
	1.400	25.940	71.280	81.150	41.760	33.580	99.720
Total	39.586	9.501	1.404	3.884	10.158	2.047	5.408
	16.070	3.860	0.570	1.580	4.120	0.830	2.200

Legend	S16	S17	S18	S19	S20	S21	S22	Total
Forest	0.000	0.000	0.000	0.000	0.000	0.000	0.000	73.362
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	29.790
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Forest with Associated Landuse	0.105	0.000	0.045	0.000	0.000	0.015	0.896	9.725
	0.040	0.000	0.020	0.000	0.000	0.010	0.360	3.950
	1.080	0.000	0.460	0.000	0.000	0.150	9.220	
	4.430	0.000	1.480	0.000	0.000	3.230	11.520	
Agriculture	0.224	0.000	0.000	0.000	0.000	0.000	0.269	14.251
	0.090	0.000	0.000	0.000	0.000	0.000	0.110	5.790
	1.570	0.000	0.000	0.000	0.000	0.000	1.890	
	9.490	0.000	0.000	0.000	0.000	0.000	3.450	
Built-up	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.149
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.060
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Riverwash	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.241
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.910
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Brushland	2.032	1.942	2.988	1.001	2.017	0.448	6.618	146.544
	0.820	0.790	1.210	0.410	0.820	0.180	2.690	59.510
	1.390	1.330	2.040	0.680	1.380	0.310	4.520	
	86.080	100.000	98.520	100.000	100.000	96.770	85.030	
Total	2.360	1.942	3.032	1.001	2.017	0.463	7.783	246.272
	0.960	0.790	1.230	0.410	0.820	0.190	3.160	

Area cross tabulation of the 1981-1990 landuse change for brushland within the municipalities of Pangasinan.

Area (km sq.)
Total %
Row %
Col %

Municipality	Forest w/ Associated Landuses	Agricultural Areas	Built-up Areas	Riverwash	Fishpond	Freshwater Swamp	Brushland	Total
Labrador	3.197	0.359	0.000	0.000	0.000	0.000	7.798	11.353
	1.030	0.120	0.000	0.000	0.000	0.000	2.510	3.650
	28.160	3.160	0.000	0.000	0.000	0.000	68.680	
	8.350	0.990	0.000	0.000	0.000	0.000	3.340	
Sual	0.000	1.180	0.000	0.000	0.388	0.000	4.302	5.871
	0.000	0.380	0.000	0.000	0.130	0.000	1.390	1.890
	0.000	20.100	0.000	0.000	6.620	0.000	73.280	
	0.000	3.260	0.000	0.000	42.620	0.000	1.840	
Alaminos	0.000	1.539	0.000	0.000	0.000	0.000	1.240	2.779
	0.000	0.500	0.000	0.000	0.000	0.000	0.400	0.890
	0.000	55.380	0.000	0.000	0.000	0.000	44.620	
	0.000	4.260	0.000	0.000	0.000	0.000	0.530	
Bani	0.000	3.869	0.000	0.000	0.508	0.000	31.520	35.897
	0.000	1.250	0.000	0.000	0.160	0.000	10.150	11.560
	0.000	10.780	0.000	0.000	1.410	0.000	87.810	
	0.000	10.700	0.000	0.000	55.740	0.000	13.480	
Bolinao	0.000	4.706	0.000	0.000	0.000	0.000	22.422	27.128
	0.000	1.510	0.000	0.000	0.000	0.000	7.220	8.730
	0.000	17.350	0.000	0.000	0.000	0.000	82.650	
	0.000	13.020	0.000	0.000	0.000	0.000	9.590	
Anda	0.000	0.941	0.030	0.000	0.015	0.000	0.538	1.524
	0.000	0.300	0.010	0.000	0.000	0.000	0.170	0.490
	0.000	61.760	1.960	0.000	0.980	0.000	35.290	
	0.000	2.600	8.700	0.000	1.640	0.000	0.230	
Agno	0.000	6.394	0.000	0.120	0.000	0.045	34.731	41.289
	0.000	2.060	0.000	0.040	0.000	0.010	11.180	13.290
	0.000	15.480	0.000	0.290	0.000	0.110	84.120	
	0.000	17.690	0.000	12.120	0.000	23.080	14.860	
Burgos	0.000	2.689	0.015	0.000	0.000	0.149	12.354	15.207
	0.000	0.870	0.000	0.000	0.000	0.050	3.980	4.900
	0.000	17.680	0.100	0.000	0.000	0.980	81.240	
	0.000	7.440	4.350	0.000	0.000	76.920	5.280	

Municipality	Forest w/ Associated Landuses	Agricultural Areas	Built-up Areas	Riverwash	Fishpond	Freshwater Swamp	Brushland	Total
Mabini	0.000	0.762	0.000	0.000	0.000	0.000	14.415	15.177
	0.000	0.250	0.000	0.000	0.000	0.000	4.640	4.890
	0.000	5.020	0.000	0.000	0.000	0.000	94.980	
	0.000	2.110	0.000	0.000	0.000	0.000	6.170	
Dasol	0.000	4.765	0.149	0.000	0.000	0.000	18.075	22.990
	0.000	1.530	0.050	0.000	0.000	0.000	5.820	7.400
	0.000	20.730	0.650	0.000	0.000	0.000	78.620	
	0.000	13.180	43.480	0.000	0.000	0.000	7.730	
Infanta	2.271	0.538	0.000	0.000	0.000	0.000	7.275	10.083
	0.730	0.170	0.000	0.000	0.000	0.000	2.340	3.250
	22.520	5.330	0.000	0.000	0.000	0.000	72.150	
	5.930	1.490	0.000	0.000	0.000	0.000	3.110	
Bugallon	0.015	0.000	0.000	0.000	0.000	0.000	1.374	1.389
	0.000	0.000	0.000	0.000	0.000	0.000	0.440	0.450
	1.080	0.000	0.000	0.000	0.000	0.000	98.920	
	0.040	0.000	0.000	0.000	0.000	0.000	0.590	
Aguilar	0.045	0.000	0.000	0.000	0.000	0.000	5.467	5.512
	0.010	0.000	0.000	0.000	0.000	0.000	1.760	1.770
	0.810	0.000	0.000	0.000	0.000	0.000	99.190	
	0.120	0.000	0.000	0.000	0.000	0.000	2.340	
Mangatarem	1.210	0.807	0.000	0.000	0.000	0.000	9.321	11.338
	0.390	0.260	0.000	0.000	0.000	0.000	3.000	3.650
	10.670	7.110	0.000	0.000	0.000	0.000	82.210	
	3.160	2.230	0.000	0.000	0.000	0.000	3.990	
Sison	6.259	1.150	0.000	0.030	0.000	0.000	7.604	15.043
	2.020	0.370	0.000	0.010	0.000	0.000	2.450	4.840
	41.610	7.650	0.000	0.200	0.000	0.000	50.550	
	16.350	3.180	0.000	3.030	0.000	0.000	3.250	
Binalonan	0.000	0.000	0.000	0.000	0.000	0.000	0.881	0.881
	0.000	0.000	0.000	0.000	0.000	0.000	0.280	0.280
	0.000	0.000	0.000	0.000	0.000	0.000	100.000	
	0.000	0.000	0.000	0.000	0.000	0.000	0.380	
San Manuel	6.199	0.792	0.000	0.329	0.000	0.000	12.817	20.137
	2.000	0.250	0.000	0.110	0.000	0.000	4.130	6.480
	30.790	3.930	0.000	1.630	0.000	0.000	63.650	
	16.200	2.190	0.000	33.330	0.000	0.000	5.480	
San Nicolas	8.978	0.702	0.000	0.493	0.000	0.000	17.284	27.457
	2.890	0.230	0.000	0.160	0.000	0.000	5.560	8.840
	32.700	2.560	0.000	1.800	0.000	0.000	62.950	
	23.460	1.940	0.000	50.000	0.000	0.000	7.390	

Municipality	Forest w/ Associated Landuses	Agricultural Areas	Built-up Areas	Riverwash	Fishpond	Freshwater Swamp	Brushland	Total
Natividad	0.000	0.000	0.000	0.015	0.000	0.000	1.808	1.822
	0.000	0.000	0.000	0.000	0.000	0.000	0.580	0.590
	0.000	0.000	0.000	0.820	0.000	0.000	99.180	
	0.000	0.000	0.000	1.520	0.000	0.000	0.770	
San Quintin	4.915	0.000	0.000	0.000	0.000	0.000	2.032	6.946
	1.580	0.000	0.000	0.000	0.000	0.000	0.650	2.240
	70.750	0.000	0.000	0.000	0.000	0.000	29.250	
	12.840	0.000	0.000	0.000	0.000	0.000	0.870	
Umingan	5.184	3.914	0.000	0.000	0.000	0.000	6.379	15.476
	1.670	1.260	0.000	0.000	0.000	0.000	2.050	4.980
	33.490	25.290	0.000	0.000	0.000	0.000	41.220	
	13.540	10.830	0.000	0.000	0.000	0.000	2.730	
Balungao	0.000	0.971	0.149	0.000	0.000	0.000	13.713	14.834
	0.000	0.310	0.050	0.000	0.000	0.000	4.410	4.780
	0.000	6.550	1.010	0.000	0.000	0.000	92.450	
	0.000	2.690	43.480	0.000	0.000	0.000	5.870	
Rosales	0.000	0.075	0.000	0.000	0.000	0.000	0.418	0.493
	0.000	0.020	0.000	0.000	0.000	0.000	0.130	0.160
	0.000	15.150	0.000	0.000	0.000	0.000	84.850	
	0.000	0.210	0.000	0.000	0.000	0.000	0.180	
Total	38.272	36.151	0.344	0.986	0.911	0.194	233.769	310.626
	12.320	11.640	0.110	0.320	0.290	0.060	75.260	

Area cross tabulation of the 1981-1990 landuse change for brushland within the muncipalities of Benguet.

Area (km sq)
Total %
Row %
Col %

Municipality	Forest w/ Associated Landuses	Agricultural Areas	Built-up Areas	Reservoir	Mines	Brushland	Total
Bakun	3.600	0.075	0.000	0.000	0.000	1.613	5.288
	0.860	0.020	0.000	0.000	0.000	0.390	1.270
	68.080	1.410	0.000	0.000	0.000	30.510	
	2.440	0.320	0.000	0.000	0.000	0.660	
Mankayan	5.034	0.881	0.284	0.000	0.000	2.360	8.560
	1.200	0.210	0.070	0.000	0.000	0.560	2.050
	58.810	10.300	3.320	0.000	0.000	27.570	
	3.410	3.740	100.000	0.000	0.000	0.970	
Buguias	2.898	3.391	0.000	0.000	0.000	0.164	6.453
	0.690	0.810	0.000	0.000	0.000	0.040	1.540
	44.910	52.550	0.000	0.000	0.000	2.550	
	1.960	14.390	0.000	0.000	0.000	0.070	
Kibungan	10.830	0.269	0.000	0.000	0.000	19.898	30.997
	2.590	0.060	0.000	0.000	0.000	4.760	7.420
	34.940	0.870	0.000	0.000	0.000	64.190	
	7.330	1.140	0.000	0.000	0.000	8.170	
Kabayan	4.945	0.777	0.000	0.000	0.687	2.226	8.634
	1.180	0.190	0.000	0.000	0.160	0.530	2.070
	57.270	9.000	0.000	0.000	7.960	25.780	
	3.350	3.300	0.000	0.000	25.560	0.910	
Atok	8.515	0.657	0.000	0.000	0.538	11.966	21.675
	2.040	0.160	0.000	0.000	0.130	2.860	5.190
	39.280	3.030	0.000	0.000	2.480	55.200	
	5.760	2.790	0.000	0.000	20.000	4.910	
Kapangan	3.540	5.393	0.000	0.000	0.000	29.473	38.406
	0.850	1.290	0.000	0.000	0.000	7.050	9.190
	9.220	14.040	0.000	0.000	0.000	76.740	
	2.400	22.890	0.000	0.000	0.000	12.100	
Tublay	2.599	2.091	0.000	0.000	0.000	10.711	15.401
	0.620	0.500	0.000	0.000	0.000	2.560	3.690
	16.880	13.580	0.000	0.000	0.000	69.540	
	1.760	8.880	0.000	0.000	0.000	4.400	

Municipality	Forest w/ Associated Landuses	Agricultural Areas	Built-up Areas	Reservoir	Mines	Brushland	Total
Sablan	2.943	0.000	0.000	0.000	0.000	12.070	15.013
	0.700	0.000	0.000	0.000	0.000	2.890	3.590
	19.600	0.000	0.000	0.000	0.000	80.400	
	1.990	0.000	0.000	0.000	0.000	4.960	
La Trinidad	0.732	0.568	0.000	0.000	0.000	2.644	3.944
	0.180	0.140	0.000	0.000	0.000	0.630	0.940
	18.560	14.390	0.000	0.000	0.000	67.050	
	0.500	2.410	0.000	0.000	0.000	1.090	
Tuba	46.966	0.956	0.000	0.000	0.000	99.564	147.486
	11.240	0.230	0.000	0.000	0.000	23.820	35.290
	31.840	0.650	0.000	0.000	0.000	67.510	
	31.800	4.060	0.000	0.000	0.000	40.880	
Baguio	0.090	0.299	0.000	0.000	0.000	2.644	3.032
	0.020	0.070	0.000	0.000	0.000	0.630	0.730
	2.960	9.850	0.000	0.000	0.000	87.190	
	0.060	1.270	0.000	0.000	0.000	1.090	
Itogon	26.754	0.314	0.000	0.000	0.359	26.635	54.062
	6.400	0.080	0.000	0.000	0.090	6.370	12.940
	49.490	0.580	0.000	0.000	0.660	49.270	
	18.110	1.330	0.000	0.000	13.330	10.940	
Bokod	28.263	7.887	0.000	0.134	1.105	21.556	58.946
	6.760	1.890	0.000	0.030	0.260	5.160	14.110
	47.950	13.380	0.000	0.230	1.880	36.570	
	19.130	33.480	0.000	100.000	41.110	8.850	
Total	147.710	23.558	0.284	0.134	2.689	243.524	417.898
	35.350	5.640	0.070	0.030	0.640	58.270	

Area cross tabulation of the 1981-1990 landuse change for brushland within the municipalities of Tarlac.

Area (km sq)
Total %
Row %
Col %

Municipality	Forest	Forest w/ Associated Landuses	Agricultural Areas	Riverwash	Brushland	Total
Bamban	2.017	0.000	0.000	0.000	9.829	11.846
	1.280	0.000	0.000	0.000	6.230	7.510
	17.020	0.000	0.000	0.000	82.980	
	2.690	0.000	0.000	0.000	13.100	
Camp O'Donnel	12.220	0.000	0.000	0.254	33.193	45.666
	7.750	0.000	0.000	0.160	21.050	28.960
	26.760	0.000	0.000	0.560	72.690	
	16.290	0.000	0.000	18.090	44.240	
Tarlac	14.744	0.000	2.196	1.150	20.630	38.720
	9.350	0.000	1.390	0.730	13.080	24.560
	38.080	0.000	5.670	2.970	53.280	
	19.660	0.000	35.420	81.910	27.490	
Sta. Ignacia	0.000	0.000	1.031	0.000	1.763	2.793
	0.000	0.000	0.650	0.000	1.120	1.770
	0.000	0.000	36.900	0.000	63.100	
	0.000	0.000	16.630	0.000	2.350	
Mayantoc	46.010	0.000	0.015	0.000	6.229	52.254
	29.180	0.000	0.010	0.000	3.950	33.140
	88.050	0.000	0.030	0.000	11.920	
	61.350	0.000	0.240	0.000	8.300	
Camiling	0.000	0.000	2.166	0.000	2.569	4.735
	0.000	0.000	1.370	0.000	1.630	3.000
	0.000	0.000	45.740	0.000	54.260	
	0.000	0.000	34.940	0.000	3.420	
San Clemente	0.000	0.045	0.792	0.000	0.822	1.658
	0.000	0.030	0.500	0.000	0.520	1.050
	0.000	2.700	47.750	0.000	49.550	
	0.000	100.000	12.770	0.000	1.090	
Total	74.990	0.045	6.199	1.404	75.035	157.673
	47.560	0.030	3.930	0.890	47.590	

Area cross tabulation of the 1981-1990 landuse change for brushland within the municipalities of La Union.

Area (km sq)
Total %
Row %
Col %

Municipality	Forest w/ Associated Landuses	Agricultural Areas	Built-up Areas	Riverwash	Brushland	Total
Bangar	0.000	0.030	0.000	0.000	0.359	0.388
	0.000	0.010	0.000	0.000	0.110	0.120
	0.000	7.690	0.000	0.000	92.310	
	0.000	0.140	0.000	0.000	0.160	
Luna	0.000	0.000	0.000	0.000	1.837	1.837
	0.000	0.000	0.000	0.000	0.570	0.570
	0.000	0.000	0.000	0.000	100.000	
	0.000	0.000	0.000	0.000	0.840	
Balaoan	0.000	0.105	0.000	0.000	11.667	11.771
	0.000	0.030	0.000	0.000	3.600	3.640
	0.000	0.890	0.000	0.000	99.110	
	0.000	0.480	0.000	0.000	5.300	
Bacnotan	0.000	2.256	0.149	0.000	14.804	17.209
	0.000	0.700	0.050	0.000	4.570	5.320
	0.000	13.110	0.870	0.000	86.020	
	0.000	10.290	6.850	0.000	6.730	
San Juan	0.000	0.120	0.000	0.000	8.858	8.978
	0.000	0.040	0.000	0.000	2.740	2.770
	0.000	1.330	0.000	0.000	98.670	
	0.000	0.540	0.000	0.000	4.030	
San Fernando	0.000	2.599	0.000	0.000	17.284	19.883
	0.000	0.800	0.000	0.000	5.340	6.140
	0.000	13.070	0.000	0.000	86.930	
	0.000	11.850	0.000	0.000	7.860	
Bauang	0.000	1.195	0.060	0.000	13.340	14.595
	0.000	0.370	0.020	0.000	4.120	4.510
	0.000	8.190	0.410	0.000	91.400	
	0.000	5.450	2.740	0.000	6.060	
Caba	0.000	1.225	0.045	0.000	15.939	17.209
	0.000	0.380	0.010	0.000	4.920	5.320
	0.000	7.120	0.260	0.000	92.620	
	0.000	5.590	2.050	0.000	7.240	

Municipality	Forest w/ Associated Landuses	Agricultural Areas	Built-up Areas	Riverwash	Brushland	Total
Aringay	9.112	0.777	0.672	0.000	18.180	28.741
	2.810	0.240	0.210	0.000	5.620	8.880
	31.700	2.700	2.340	0.000	63.250	
	11.740	3.540	30.820	0.000	8.260	
Agoo	0.000	0.896	0.224	0.000	6.812	7.932
	0.000	0.280	0.070	0.000	2.100	2.450
	0.000	11.300	2.820	0.000	85.880	
	0.000	4.090	10.270	0.000	3.100	
Sto. Tomas	0.000	0.837	0.000	0.000	6.170	7.006
	0.000	0.260	0.000	0.000	1.910	2.160
	0.000	11.940	0.000	0.000	88.060	
	0.000	3.810	0.000	0.000	2.800	
Rosario	0.000	2.226	0.000	0.000	4.183	6.409
	0.000	0.690	0.000	0.000	1.290	1.980
	0.000	34.730	0.000	0.000	65.270	
	0.000	10.150	0.000	0.000	1.900	
Pugo	4.750	1.808	0.000	0.239	6.170	12.966
	1.470	0.560	0.000	0.070	1.910	4.010
	36.640	13.940	0.000	1.840	47.580	
	6.120	8.240	0.000	12.310	2.800	
Tubao	11.473	1.240	0.508	0.000	6.453	19.674
	3.540	0.380	0.160	0.000	1.990	6.080
	58.310	6.300	2.580	0.000	32.800	
	14.770	5.650	23.290	0.000	2.930	
Naguilian	0.000	2.315	0.015	0.583	20.286	23.199
	0.000	0.720	0.000	0.180	6.270	7.170
	0.000.	9.980	0.060	2.510	87.440	
	0.000	10.560	0.680	30.000	9.220	
Burgos	0.000	0.015	0.000	0.000	7.439	7.454
	0.000	0.000	0.000	0.000	2.300	2.300
	0.000	0.200	0.000	0.000	99.800	
	0.000	0.070	0.000	0.000	3.380	
Bagulin	0.000	0.881	0.000	0.075	26.411	27.367
	0.000	0.270	0.000	0.020	8.160	8.450
	0.000	3.220	0.000	0.270	96.510	
	0.000	4.020	0.000	3.850	12.000	
San Gabriel	10.980	1.016	0.090	0.000	25.261	37.346
	3.390	0.310	0.030	0.000	7.800	11.540
	29.400	2.720	0.240	0.000	67.640	
	14.140	4.630	4.110	0.000	11.480	

Municipality	Forest w/ Associated Landuses	Agricultural Areas	Built-up Areas	Riverwash	Brushland	Total
Santol	32.999	0.598	0.000	0.433	7.036	41.065
	10.190	0.180	0.000	0.130	2.170	12.690
	80.360	1.460	0.000	1.050	17.130	
	42.500	2.720	0.000	22.310	3.200	
Sudipen	8.336	1.793	0.418	0.612	1.539	12.698
	2.570	0.550	0.130	0.190	0.480	3.920
	65.650	14.120	3.290	4.820	12.120	
	10.730	8.170	19.180	31.540	0.700	
Total	77.649	21.929	2.181	1.942	220.026	323.727
	23.990	6.770	0.670	0.600	67.970	

Tables on single area and area cross tabulation analysis for Gross soil loss and sediment yield

Summary of the gross soil loss and sediment yield of the Agno River Basin using the Universal Soil Loss Equation.

Class	Sub-basin	Total Gross Soil Loss (t/ha/year) (A)	Sediment Delivery Ratio (B)	Total Sediment Yield (t/ha/year) (C)	Area (%) (D)	Area (km sq.) (E)	Total Sediment Yield (t/year) (F)
1	Central Plain	43,817.25	0.26	11,392.49	52.41	4,084.24	4,652,964,293.64
6	S1	2,012.70	0.61	1,227.75	1.34	104.22	12,795,579.23
7	S2	1,030.19	0.62	638.72	0.49	37.87	2,418,824.31
8	S3	488.81	0.58	283.51	1.52	118.34	3,355,054.97
9	S4	214.05	0.54	115.59	0.53	41.02	474,137.87
10	S5	1,138.81	0.73	831.33	2.87	223.46	18,576,929.23
11	S6	1,395.77	0.64	893.29	3.42	266.20	23,779,454.34
12	S7	99.11	0.57	56.49	0.45	34.84	196,820.57
13	S8	323.33	0.52	168.13	1.48	115.71	1,945,450.74
14	S9	55.13	0.56	30.87	1.96	152.98	472,292.09
15	S10	36.68	0.77	28.24	0.39	30.62	86,481.90
16	S11	149.66	0.69	103.27	0.70	54.48	562,589.90
17	S12	20.39	0.59	12.03	1.65	128.84	154,995.81
18	S13	149.44	0.50	74.72	1.41	110.17	823,190.24
19	S14	459.45	0.66	303.24	0.47	36.99	1,121,673.66

Class	Sub-basin	Total Gross Soil Loss (t/ha/year) (A)	Sediment Delivery Ratio (B)	Total Sediment Yield (t/ha/year) (C)	Area (%) (D)	Area (km sq.) (E)	Total Sediment Yield (t/year) (F)
20	S15	1,636.57	0.33	540.07	0.68	52.93	2,858,580.45
21	S16	373.05	0.67	249.94	0.52	40.14	1,003,273.21
22	S17	158.83	0.72	114.36	0.15	11.64	133,112.25
23	S18	161.27	0.52	83.86	0.55	43.16	361,941.49
24	S19	177.80	0.45	80.01	0.70	54.49	435,974.49
25	S20	651.64	0.47	306.27	1.59	123.81	3,791,938.77
26	S21	186.54	0.60	111.92	1.29	100.62	1,126,179.29
27	S22	83.56	0.60	50.14	0.75	58.18	291,691.25
28	N1	5,143.90	0.01	51.44	0.70	54.46	280,136.79
29	N2	587.96	0.08	47.04	0.11	8.50	39,981.28
30	N3	1,851.63	0.56	1,036.91	0.56	43.69	4,530,272.02
31	N4	1,237.13	0.48	593.82	0.40	31.46	1,868,165.27
32	N5	1,218.14	0.72	877.06	0.83	64.68	5,672,829.25
33	N6	365.72	0.57	208.46	0.62	48.12	1,003,111.44
34	N7	645.09	0.35	225.78	0.61	47.64	1,075,623.07
35	N8	213.14	0.57	121.49	0.96	74.44	904,370.07
36	N9	242.11	0.59	142.84	1.29	100.28	1,432,448.66
37	N10	75.42	0.56	42.24	0.96	74.62	315,159.06
38	N11	412.52	0.72	297.01	1.83	142.57	4,234,534.30

Class	Sub-basin	Total Gross Soil Loss (t/ha/year) (A)	Sediment Delivery Ratio (B)	Total Sediment Yield (t/ha/year) (C)	Area (%) (D)	Area (km sq.) (E)	Total Sediment Yield (t/year) (F)
39	N12	999.97	0.59	589.98	1.23	95.69	5,645,540.63
40	N13	3,027.41	0.20	605.48	1.12	87.63	5,305,838.77
41	N14	640.27	0.73	467.40	1.35	105.17	4,915,615.30
42	N15	10.44	0.75	7.83	1.47	114.47	89,630.01
43	N16	82.77	0.16	13.24	0.13	10.29	13,627.25
44	N17	746.05	0.48	358.10	0.71	55.38	1,983,179.95
45	N18	118.05	0.06	7.08	0.17	13.07	9,257.48
46	N19	9.01	0.04	0.36	0.06	5.03	181.28
47	N20	1,057.17	0.48	507.44	0.36	27.90	1,415,762.06
48	N21	231.34	0.48	111.04	0.26	20.17	223,974.13
49	N22	456.09	0.55	250.85	0.26	20.03	502,451.55
50	N23	311.87	0.09	28.07	0.04	3.41	9,571.29
51	N24	61.21	0.57	34.89	0.20	15.33	53,485.91
52	N25	1,461.78	0.47	687.04	0.31	24.23	1,664,689.68
53	N26	6.62	0.49	3.24	0.27	21.36	6,928.76
54	N27	52.32	0.44	23.02	0.36	28.11	64,711.47
55	N28	118.80	0.58	68.90	0.66	51.69	356,164.78
56	N29	43.64	0.58	25.31	0.08	6.50	16,452.28
57	N30	512.43	0.58	297.21	0.13	10.22	303,748.01

Class	Sub-basin	Total Gross Soil Loss (t/ha/year) (A)	Sediment Delivery Ratio (B)	Total Sediment Yield (t/ha/year) (C)	Area (%) (D)	Area (km sq.) (E)	Total Sediment Yield (t/year) (F)
58	N31	1,012.73	0.58	587.38	0.19	14.52	852,880.70
59	N32	353.57	0.59	208.61	0.17	13.16	274,525.89
60	N33	66.19	0.73	48.32	0.40	31.42	151,817.36
61	N34	2,841.32	0.57	1,619.55	0.79	61.43	9,948,910.39
62	N35	3,426.33	0.31	1,062.16	0.97	75.57	8,026,760.50
63	N36	1,476.59	0.57	841.66	1.27	99.23	8,351,755.46
64	N37	1,802.59	0.64	1,153.66	0.85	65.97	7,610,679.19
	Total	87,739.34			100.00	7,792.40	

Note:

(C) = (A) x (B)

(F) = (C) x (E)

TOTALS OF Gross sediment yield BY AREA

Old Areas : rklscp - Unique conditions
New Areas : pmun - Municipality map of Pangasinan

Window : 00 - Universe

Class	Legend Item of New Area	Total	Area (%)	Area
1	San Fabian	2,502.82	1.48	75.26
2	Mangaldan	456.48	0.90	45.68
3	Dagupan	1,759.36	1.00	50.67
4	Calasiao	12.76	1.05	53.21
5	Binmaley	310.00	0.95	48.06
6	San Carlos	318.51	3.50	177.72
7	Lingayen	1,166.37	1.18	59.72
8	Labrador	686.62	2.24	113.64
9	Sual	3,111.83	2.86	145.23
10	Alaminos	1,954.09	3.16	160.65
11	Bani	4,312.61	4.30	218.28
12	Bolinao	3,395.52	3.20	162.60
13	Anda	4,268.82	1.46	74.11
14	Silaqui Island	133.30	0.00	0.13
15	Santiago Island	1,076.35	0.42	21.51
16	Siapar	658.09	0.04	2.02
17	Hundred Island	172.22	0.02	1.20
18	Cabalitian Island	380.73	0.03	1.69
19	Agno	3,663.04	2.73	138.63
20	Burgos	4,328.13	2.42	123.09
21	Mabini	2,502.90	4.47	226.82
22	Dasol	5,987.99	3.36	170.40
23	Infanta	4,395.63	4.61	233.87
24	Bugallon	1,194.24	3.06	155.55
25	Aguilar	560.56	2.85	144.59
26	Mangatarem	5,568.54	5.64	286.61
27	Urbiztondo	267.85	1.06	53.96
28	Basista	30.02	0.59	29.89
29	Malasiqui	175.54	2.35	119.22
30	Sta. Barbara	43.04	1.37	69.40

Class	Legend Item of New Area	Total	Area (%)	Area
31	Mapandan	195.71	0.43	21.94
32	San Jacinto	60.77	0.60	30.32
33	Manaoag	784.77	0.90	45.91
34	Laoac	938.64	0.62	31.24
35	Pozorrubio	1,912.79	1.57	79.64
36	Sison	4,759.87	2.21	112.02
37	Binalonan	1,294.65	1.28	65.00
38	Urdaneta	14.09	2.53	128.30
39	Asingan	513.77	1.47	74.60
40	San Manuel	5,247.02	2.28	115.94
41	San Nicolas	3,773.36	4.33	219.92
42	Tayug	2.19	0.86	43.44
43	Natividad	1,291.05	1.69	85.75
44	San Quintin	1,504.00	2.25	114.19
45	Sta. Maria	55.51	0.96	48.71
46	Umingan	1,481.49	5.08	257.76
47	Balungao	114.30	1.51	76.63
48	Rosales	72.50	1.30	65.86
49	Villasis	267.06	1.55	78.58
50	Sto. Tomas	270.60	0.25	12.79
51	Alcala	2,179.24	0.89	44.96
52	Bautista	569.12	1.34	68.15
53	Bayambang	1,202.52	1.83	93.10
	Total	83,898.96	100.00	5,078.15

TOTALS OF Gross sediment yield BY AREA

Old Areas : rklscp - Unique conditions
New Areas : bmun - Municipalities of Benguet

Window : 00 - Universe

Class	Legend Item of New Area	Total	Area (%)	Area
1	Bakun	1,267.77	6.05	165.78
2	Mankayan	8,334.69	8.57	234.75
3	Buguias	4,253.01	4.44	121.54
4	Kibungan	1,841.43	5.93	162.35
5	Kabayan	1,253.01	5.78	158.29
6	Atok	2,762.53	5.07	138.85
7	Kapangan	2,647.68	5.34	146.19
8	Tublay	4,815.46	3.49	95.63
9	Sablan	2,282.19	3.86	105.67
10	La Trinidad	6,924.42	2.86	78.26
11	Tuba	5,744.49	12.80	350.50
12	Baguio City	2,178.99	2.09	57.15
13	Itogon	4,236.44	20.25	554.58
14	Bokod	7,231.12	13.48	369.05
	Total	55,773.24	100.00	2,738.60

TOTALS OF Gross sediment yield BY AREA

Old Areas : rklscp - Unique conditions
New Areas : tmun - Municipality map of Tarlac

Window : 00 - Universe

Class	Legend Item of New Area	Total	Area (%)	Area
1	Bamban	7,648.48	4.73	145.14
2	Concepcion	2,177.08	6.98	214.32
3	O'Donnel	7,107.90	16.75	514.38
4	Tarlac	6,015.38	24.66	757.28
5	La Paz	185.24	4.01	123.14
6	Victoria	37.07	3.96	121.52
7	Pura	430.85	1.07	32.74
8	Gerona	563.05	3.88	119.24
9	Santa Ignacia	526.74	3.83	117.73
10	Mayantoc	1,630.85	11.37	349.20
11	Camiling	972.30	5.98	183.52
12	Paniqui	468.10	3.07	94.14
13	Ramos	23.04	1.03	31.67
14	Nampicuan	1.03	0.83	25.37
15	Moncada	134.94	3.91	119.95
16	San Manuel	1.61	1.63	50.01
17	San Clemente	662.09	2.32	71.17
	Total	28,585.74	100.00	3,070.52

TOTALS OF Gross sediment yield BY AREA

Old Areas : rklscp - Unique conditions
New Areas : lmun - Municipality map of La Union

Window : 00 - Universe

Class	Legend Item of New Area	Total	Area (%	Area
1	Bangar	561.35	2.88	41.42
2	Luna	3,371.80	2.81	40.44
3	Balaoan	2,056.54	4.87	69.90
4	Bacnotan	3,479.11	4.54	65.19
5	San Juan	3,445.05	4.19	60.25
6	San Fernando	1,543.04	6.88	98.80
7	Bauang	3,267.62	5.28	75.83
8	Caba	1,413.73	3.44	49.46
9	Aringay	2,493.89	6.85	98.44
10	Agoo	8,091.64	2.72	39.12
11	Sto. Tomas	3,238.12	4.31	61.86
12	Rosario	2,578.64	4.82	69.24
13	Pugo	1,340.35	3.03	43.57
14	Tubao	4,137.36	3.96	56.84
15	Naguilian	4,525.29	6.61	94.98
16	Burgos	781.68	4.38	62.98
17	Bagulin	755.74	4.93	70.85
18	San Gabriel	1,169.96	10.84	155.67
19	Santol	1,793.59	7.85	112.83
20	Sudipen	2,000.93	4.80	68.91
	Total	52,045.41	100.00	1,436.58

Area cross tabulation of the slope map for Benguet, La Union, Pangasinan and Tarlac against total gross soil loss range (t/ha/year).

Area (km sq)
Total %
Row %
Col %

Slope	<100	100-200	200-300	300-400	400-500	500-600	>600	Total
0-3%	4,854.00	0.40	0.70	5.30	0.10	1.90	1.10	4,863.50
	39.75	0.00	0.01	0.04	0.00	0.02	0.01	39.83
	99.80	0.01	0.02	0.11	0.00	0.04	0.02	
	49.62	0.09	0.18	1.12	0.03	1.75	0.21	
3-8%	460.20	1.00	0.00	0.00	0.00	0.00	0.10	461.30
	3.77	0.01	0.00	0.00	0.00	0.00	0.00	3.78
	99.75	0.22	0.00	0.00	0.00	0.00	0.03	
	4.70	0.24	0.00	0.00	0.00	0.00	0.02	
8-15%	430.20	145.60	116.30	0.60	0.00	0.00	0.00	692.80
	3.52	1.19	0.95	0.01	0.00	0.00	0.00	5.67
	62.10	21.02	16.79	0.09	0.00	0.00	0.00	
	4.40	34.12	28.19	0.13	0.00	0.00	0.00	
15-25%	471.20	191.90	145.40	247.30	33.10	7.90	1.40	1,098.20
	3.86	1.57	1.19	2.03	0.27	0.06	0.01	8.99
	42.90	17.48	13.24	22.52	3.01	0.72	0.13	
	4.82	44.97	35.23	52.46	6.93	7.51	0.26	
25-40%	875.90	75.40	128.60	204.00	315.30	39.50	147.40	1,786.00
	7.17	0.62	1.05	1.67	2.58	0.32	1.21	14.63
	49.04	4.22	7.20	11.42	17.65	2.21	8.25	
	8.96	17.66	31.15	43.26	66.11	37.40	27.46	
40-60%	497.80	12.50	21.40	14.20	128.40	56.40	386.10	1,116.70
	4.08	0.10	0.18	0.12	1.05	0.46	3.16	9.14
	44.57	1.12	1.92	1.27	11.50	5.05	34.58	
	5.09	2.92	5.19	3.01	26.93	53.34	71.95	
>60%	2,188.30	0.00	0.30	0.10	0.00	0.00	0.60	2,189.30
	17.92	0.00	0.00	0.00	0.00	0.00	0.00	17.93
	99.95	0.00	0.01	0.01	0.00	0.00	0.03	
	22.37	0.00	0.06	0.03	0.01	0.00	0.11	
Reservoir	3.80	0.00	0.00	0.00	0.00	0.00	0.00	3.80
	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.03
	100.00	0.00	0.00	0.00	0.00	0.00	0.00	
	0.04	0.00	0.00	0.00	0.00	0.00	0.00	
Total	9,781.30	426.80	412.70	471.50	476.90	105.70	536.70	12,211.60
	80.10	3.50	3.38	3.86	3.91	0.87	4.39	

Are cross tabulation of the 1990 land use map of Benguet, La Union, Pangasinan and Tarlac against gross soil loss range (t/ha/year).

Area (km sq)
Total %
Row %
Col%

Land Use	<100	100-200	200-300	300-400	400-500	500-600	>600	Total
Forest	570.20	0.00	0.00	0.00	0.00	0.00	0.00	570.20
	4.67	0.00	0.00	0.00	0.00	0.00	0.00	4.67
	100.00	0.00	0.00	0.00	0.00	0.00	0.00	
	5.84	0.00	0.00	0.00	0.00	0.00	0.00	
Forest with associated landuses	1,693.30	0.00	0.00	0.00	0.00	0.00	0.00	1,693.30
	13.88	0.00	0.00	0.00	0.00	0.00	0.00	13.88
	100.00	0.00	0.00	0.00	0.00	0.00	0.00	
	17.33	0.00	0.00	0.00	0.00	0.00	0.00	
Grassland (>90% dominant	574.70	0.00	0.00	0.00	0.00	0.00	0.00	574.70
	4.71	0.00	0.00	0.00	0.00	0.00	0.00	4.71
	100.00	0.00	0.00	0.00	0.00	0.00	0.00	
	5.88	0.00	0.00	0.00	0.00	0.00	0.00	
Mangroves/nipa	28.20	0.20	0.00	0.00	0.00	0.00	0.00	28.30
	0.23	0.00	0.00	0.00	0.00	0.00	0.00	0.23
	99.42	0.58	0.00	0.00	0.00	0.00	0.00	
	0.29	0.04	0.00	0.00	0.00	0.00	0.00	
Ricefield, irrigated	3,349.20	121.00	51.00	9.60	2.40	8.30	0.90	3,542.40
	27.46	0.99	0.42	0.08	0.02	0.07	0.01	29.04
	94.55	3.41	1.44	0.27	0.07	0.23	0.03	
	34.29	28.34	12.36	2.03	0.50	7.83	0.18	
Grassland (70-90% dominant	822.60	99.20	76.80	17.40	70.90	20.10	151.60	1,258.60
	6.74	0.81	0.63	0.14	0.58	0.16	1.24	10.32
	65.36	7.88	6.11	1.38	5.63	1.59	12.05	
	8.42	23.24	18.62	3.69	14.86	18.99	28.25	
Shrubs	555.90	84.00	95.40	60.60	184.80	49.60	81.20	1,111.50
	4.56	0.69	0.78	0.50	1.51	0.41	0.67	9.11
	50.02	7.56	8.58	5.45	16.62	4.46	7.30	
	5.69	19.69	23.10	12.86	38.75	46.97	15.13	
Coconut	127.20	5.00	0.30	0.00	0.00	0.00	0.00	132.50
	1.04	0.04	0.00	0.00	0.00	0.00	0.00	1.09
	96.03	3.78	0.19	0.00	0.00	0.00	0.00	
	1.30	1.17	0.06	0.00	0.00	0.00	0.00	

Land Use	<100	100-200	200-300	300-400	400-500	500-600	>600	Total
Built-up areas	402.50	8.30	5.10	3.30	2.20	0.60	1.00	423.00
	3.30	0.07	0.04	0.03	0.02	0.00	0.01	3.47
	95.14	1.97	1.21	0.78	0.51	0.14	0.25	
	4.12	1.95	1.25	0.70	0.45	0.57	0.19	
Coffee, citrus, lanzones	2.30	0.00	0.00	0.00	0.00	0.00	0.00	2.30
	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.02
	100.00	0.00	0.00	0.00	0.00	0.00	0.00	
	0.02	0.00	0.00	0.00	0.00	0.00	0.00	
Cassava, potatoes, black pepper	79.90	0.20	0.90	1.10	0.00	0.00	1.80	83.90
	0.66	0.00	0.01	0.01	0.00	0.00	0.01	0.69
	95.30	0.21	1.02	1.34	0.00	0.00	2.14	
	0.82	0.04	0.21	0.24	0.00	0.00	0.33	
Sugar cane	337.70	4.60	0.20	0.20	0.50	1.10	0.00	344.20
	2.77	0.04	0.00	0.00	0.00	0.01	0.00	2.82
	98.10	1.34	0.06	0.05	0.14	0.31	0.00	
	3.46	1.08	0.05	0.03	0.10	1.02	0.00	
Grass (<70% dominant)	682.90	66.10	165.00	342.90	197.40	22.90	245.20	1,722.30
	5.60	0.54	1.35	2.81	1.62	0.19	2.01	14.12
	39.65	3.84	9.58	19.91	11.46	1.33	14.24	
	6.99	15.48	39.98	72.71	41.39	21.69	45.69	
Corn (>70% dominant)	13.00	0.30	3.60	0.50	0.00	0.00	0.00	17.40
	0.11	0.00	0.03	0.00	0.00	0.00	0.00	0.14
	75.04	1.72	20.48	2.75	0.00	0.00	0.00	
	0.13	0.07	0.86	0.10	0.00	0.00	0.00	
Fishponds	145.10	0.90	0.00	0.00	0.00	0.00	0.00	146.00
	1.19	0.01	0.00	0.00	0.00	0.00	0.00	1.20
	99.40	0.60	0.00	0.00	0.00	0.00	0.00	
	1.49	0.21	0.00	0.00	0.00	0.00	0.00	
Bamboo	0.80	0.00	0.00	0.00	0.00	0.00	0.00	0.80
	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	96.43	0.00	0.00	0.00	3.57	0.00	0.00	
	0.01	0.00	0.00	0.00	0.01	0.00	0.00	
Ricefield, upland	3.80	0.80	0.00	0.30	2.30	0.00	0.00	7.20
	0.03	0.01	0.00	0.00	0.02	0.00	0.00	0.06
	52.17	11.59	0.00	4.55	31.68	0.00	0.00	
	0.04	0.20	0.00	0.07	0.48	0.00	0.00	

Land Use	<100	100-200	200-300	300-400	400-500	500-600	>600	Total
Saltbeds	7.60	0.10	0.00	0.00	0.00	0.00	0.00	7.70
	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.06
	98.84	1.16	0.00	0.00	0.00	0.00	0.00	
	0.08	0.02	0.00	0.00	0.00	0.00	0.00	
Beach sand	0.10	0.20	0.70	5.30	0.10	1.90	1.30	9.50
	0.00	0.00	0.01	0.04	0.00	0.02	0.01	0.08
	0.63	1.89	7.72	55.59	1.26	19.53	13.39	
	0.00	0.04	0.18	1.12	0.03	1.75	0.24	
Ipil-ipil	0.70	0.60	0.10	0.00	0.00	0.00	0.00	1.30
	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	51.14	44.32	4.55	0.00	0.00	0.00	0.00	
	0.01	0.14	0.01	0.00	0.00	0.00	0.00	
Riverwash	192.00	11.70	4.00	3.00	1.10	0.00	0.00	211.80
	1.57	0.10	0.03	0.02	0.01	0.00	0.00	1.74
	90.65	5.53	1.89	1.42	0.51	0.00	0.00	
	1.97	2.74	0.97	0.64	0.23	0.00	0.00	
Rice terraces	55.70	14.60	2.00	22.40	3.20	0.30	6.30	104.60
	0.46	0.12	0.02	0.18	0.03	0.00	0.05	0.86
	53.22	13.98	1.96	21.42	3.03	0.33	6.07	
	0.57	3.43	0.50	4.75	0.66	0.33	1.18	
Vegetables terraces	76.80	4.20	6.50	4.50	11.50	0.90	47.30	151.70
	0.63	0.03	0.05	0.04	0.09	0.01	0.39	1.24
	50.66	2.74	4.30	2.94	7.57	0.60	31.17	
	0.79	0.97	1.58	0.95	2.41	0.86	8.81	
Mines	5.90	2.90	0.20	0.00	0.00	0.00	0.00	8.90
	0.05	0.02	0.00	0.00	0.00	0.00	0.00	0.07
	66.11	31.89	2.00	0.00	0.00	0.00	0.00	
	0.06	0.67	0.04	0.00	0.00	0.00	0.00	
Filling ponds	0.80	0.10	0.00	0.00	0.00	0.00	0.00	0.90
	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	88.52	11.48	0.00	0.00	0.00	0.00	0.00	
	0.01	0.02	0.00	0.00	0.00	0.00	0.00	
Reservoirs	6.60	0.00	0.00	0.00	0.00	0.00	0.00	6.60
	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.05
	100.00	0.00	0.00	0.00	0.00	0.00	0.00	
	0.07	0.00	0.00	0.00	0.00	0.00	0.00	

Land Use	<100	100-200	200-300	300-400	400-500	500-600	>600	Total
Grapes	0.00	0.00	0.50	0.40	0.00	0.00	0.00	0.90
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	0.00	0.00	51.61	48.39	0.00	0.00	0.00	
	0.00	0.00	0.12	0.10	0.00	0.00	0.00	
Mangoes	4.40	0.00	0.10	0.00	0.60	0.00	0.00	5.10
	0.04	0.00	0.00	0.00	0.01	0.00	0.00	0.04
	85.63	0.00	1.76	0.00	12.61	0.00	0.00	
	0.04	0.00	0.02	0.00	0.13	0.00	0.00	
Maguey	1.90	1.60	0.00	0.00	0.00	0.00	0.00	3.50
	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.03
	54.47	45.53	0.00	0.00	0.00	0.00	0.00	
	0.02	0.37	0.00	0.00	0.00	0.00	0.00	
Freshwater swamps	15.20	0.00	0.00	0.00	0.00	0.00	0.00	15.20
	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.12
	99.71	0.00	0.00	0.29	0.00	0.00	0.00	
	0.16	0.00	0.00	0.01	0.00	0.00	0.00	
Kaingin	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.50
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	100.00	0.00	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Vegetable, lowland	10.90	0.40	0.40	0.00	0.00	0.00	0.00	11.60
	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.10
	93.58	3.21	3.21	0.00	0.00	0.00	0.00	
	0.11	0.09	0.09	0.00	0.00	0.00	0.00	
Airport	0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.30
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	100.00	0.00	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Total	9,768.50	426.80	412.70	471.50	476.90	105.70	536.70	12,198.80
	80.08	3.50	3.38	3.87	3.91	0.87	4.40	

Area cross tabulation for the erosion map of Benguet, La Union, Pangasinan and Tarlac against gross soil loss (t/sq.km/year) range.

Area (km sq)
Total %
Row %
Col %

Erosion Cateogry	<100	100-200	200-300	300-400	400-500	500-60	>600	Total
No erosion	4,679.90	90.00	58.10	59.80	33.90	19.10	42.10	4,982.90
	38.33	0.74	0.48	0.49	0.28	0.16	0.34	40.81
	93.92	1.81	1.17	1.20	0.68	0.38	0.84	
	47.85	21.08	14.07	12.69	7.10	18.10	7.84	
None to slight erosion	715.40	20.40	21.20	10.20	18.80	0.90	55.80	842.70
	5.86	0.17	0.17	0.08	0.15	0.01	0.46	6.90
	84.90	2.42	2.51	1.21	2.23	0.11	6.62	
	7.32	4.77	5.13	2.17	3.94	0.86	10.39	
Slight erosion	1,379.50	94.00	64.50	54.50	47.20	13.80	78.90	1,732.40
	11.30	0.77	0.53	0.45	0.39	0.11	0.65	14.19
	79.63	5.42	3.73	3.14	2.72	0.80	4.56	
	14.11	22.02	15.64	11.55	9.89	13.11	14.70	
Moderate erosion	1,841.80	154.40	182.70	190.00	168.70	52.00	105.00	2,694.50
	15.08	1.26	1.50	1.56	1.38	0.43	0.86	22.07
	68.35	5.73	6.78	7.05	6.26	1.93	3.90	
	18.83	36.18	44.26	40.30	35.37	49.20	19.56	
Severe erosion	988.40	58.50	75.10	121.30	207.30	16.50	241.10	1,708.20
	8.09	0.48	0.62	0.99	1.70	0.14	1.97	13.99
	57.86	3.43	4.40	7.10	12.14	0.97	14.12	
	10.11	13.71	18.20	25.72	43.47	15.61	44.93	
Very severe erosion	132.30	8.70	10.90	35.60	1.10	3.30	13.80	205.70
	1.08	0.07	0.09	0.29	0.01	0.03	0.11	1.68
	64.31	4.25	5.31	17.29	0.53	1.60	6.71	
	1.35	2.05	2.65	7.54	0.23	3.12	2.57	
Reservoirs	42.70	0.80	0.20	0.10	0.00	0.00	0.00	43.90
	0.35	0.01	0.00	0.00	0.00	0.00	0.00	0.36
	97.38	1.87	0.51	0.24	0.00	0.00	0.00	
	0.44	0.19	0.05	0.02	0.00	0.00	0.00	
Total	9,780.00	426.80	412.70	471.50	476.90	105.70	536.70	12,210.30
	80.10	3.50	3.38	3.86	3.91	0.87	4.40	

Tables on single area and area cross tabulation analysis for non point pollution sources

SINGLE MAP ANALYSIS

Map : critic1 - Critical areas of non point sources

Window : 00 - Universe

Class	Legend	Area (%)	Cumm	Area (km.sq.)
1	Not critical	96.57	96.57	11,794.70
2	Sub-critical	2.52	99.08	307.40
3	Critical	0.92	100.00	111.90
Total of 3 classes		100.00		12,214.10

Area cross tabulation of the critical areas for nonpoint pollution sources
sources with slope-elevation map of Benguet, La Union, Pangasinan and Tarlac.

Area (km sq)
Total %
Row %
Col %

Slope-Elevation	Critical	Sub-critical	Not Critical
0-15% at 0-5 m	0.00	2.40	754.40
	0.00	0.02	6.20
	0.00	0.32	99.68
	0.00	0.80	6.42
0-15% at 5-50 m	0.00	5.30	2,727.40
	0.00	0.04	22.42
	0.00	0.19	99.81
	0.00	1.72	23.22
0-8% at 50-800 m	0.00	0.00	1,822.00
	0.00	0.00	14.98
	0.00	0.00	100.00
	0.00	0.00	15.51
0-8% at >=800 m	0.00	0.00	78.90
	0.00	0.00	0.65
	0.00	0.00	100.00
	0.00	0.00	0.67
8-15% at 50-800 m	0.00	15.00	497.40
	0.00	0.12	4.09
	0.00	2.92	97.08
	0.00	4.86	4.23
8-15% at >=800 m	0.00	0.40	85.20
	0.00	0.00	0.70
	0.00	0.45	99.55
	0.00	0.13	0.73
15-25% at 0-50 m	4.60	16.00	125.30
	0.04	0.13	1.03
	3.16	10.97	85.87
	4.12	5.21	1.07

Slope-Elevation	Critical	Sub-critical	Not Critical
15-25% at 50-800 m	3.90	50.30	661.40
	0.03	0.41	5.44
	0.55	7.02	92.42
	3.52	16.35	5.63
15-25% at >=800 m	0.00	2.40	222.50
	0.00	0.02	1.83
	0.00	1.07	98.93
	0.00	0.78	1.89
25-40% at 0-5 m	2.10	1.90	55.50
	0.02	0.02	0.46
	3.51	3.14	93.35
	1.87	0.61	0.47
25-40% at 5-50 m	7.60	9.50	140.90
	0.06	0.08	1.16
	4.84	5.99	89.17
	6.83	3.08	1.20
25-40% at 50-800 m	35.20	83.60	1,084.30
	0.29	0.69	8.91
	2.93	6.95	90.13
	31.45	27.18	9.23
25-40% at >=800 m	3.80	14.40	345.50
	0.03	0.12	2.84
	1.04	3.95	95.01
	3.39	4.67	2.94
>40% at 0-5 m	0.20	0.50	2.00
	0.00	0.00	0.02
	6.32	17.82	75.86
	0.15	0.15	0.02
>40% at 5-50 m	0.90	1.40	7.00
	0.01	0.01	0.06
	9.66	14.98	75.36
	0.80	0.45	0.06
>40% at 50-800 m	37.90	69.20	1,150.90
	0.31	0.57	9.46
	3.01	5.50	91.49
	33.81	22.52	9.80

Slope-Elevation	Critical	Sub-critical	Not Critical
>40% at >=800 m	15.70	35.30	1,984.80
	0.13	0.29	16.32
	0.77	1.73	97.49
	14.05	11.49	16.90
Total	111.90	307.40	11,745.30
	0.92	2.53	96.55

Area cross tabulation of the critical areas for nonpoint pollution sources with the slope map of Benguet, La Union, Pangasinan and Tarlac.

Area (km sq.)
Total %
Row %
Col %

Slope	Critical	Sub-critical	Not Critical	Total
0-3%	0.00	0.00	4,863.50	4,863.50
	0.00	0.00	39.83	39.83
	0.00	0.00	100.00	
	0.00	0.00	41.24	
3-8%	0.00	0.00	461.30	461.30
	0.00	0.00	3.78	3.78
	0.00	0.00	100.00	
	0.00	0.00	3.91	
8-15%	0.00	23.10	669.70	692.80
	0.00	0.19	5.48	5.67
	0.00	3.33	96.67	
	0.00	7.51	5.68	
15-25%	8.60	68.70	1,021.00	1,098.20
	0.07	0.56	8.36	8.99
	0.78	6.25	92.97	
	7.65	22.34	8.66	
25-40%	48.70	109.30	1,628.00	1,786.00
	0.40	0.89	13.33	14.63
	2.73	6.12	91.15	
	43.54	35.54	13.81	
40-60%	54.60	106.40	955.70	1,116.70
	0.45	0.87	7.83	9.14
	4.89	9.53	85.58	
	48.81	34.61	8.10	
>60%	0.00	0.00	2,189.30	2,189.30
	0.00	0.00	17.93	17.93
	0.00	0.00	100.00	
	0.00	0.00	18.57	

Slope	Critical	Sub-critical	Not Critical	Total
Reservoir	0.00	0.00	3.80	3.80
	0.00	0.00	0.03	0.03
	0.00	0.00	100.00	
	0.00	0.00	0.03	
Total	111.90	307.40	11,792.30	12,211.60
	0.92	2.52	96.57	

Area cross tabulation of the 1990 land use map across critical areas for nonpoint pollution sources for Benguet, La Union, Pangasinan and Tarlac.

Area (km sq.)
Total %
Row %
Col %

Land use	Critical	Sub-critical	Not Critical	Total
Forest	0.00	0.00	570.20	570.20
	0.00	0.00	4.67	4.67
	0.00	0.00	100.00	
	0.00	0.00	4.84	
Forest with associated land uses	0.00	0.00	1,693.30	1,693.30
	0.00	0.00	13.88	13.88
	0.00	0.00	100.00	
	0.00	0.00	14.37	
Grasslands (>90% dominant)	0.00	0.00	574.70	574.70
	0.00	0.00	4.71	4.71
	0.00	0.00	100.00	
	0.00	0.00	4.88	
Mangrove/nipa	0.00	0.00	28.30	28.30
	0.00	0.00	0.23	0.23
	0.00	0.00	100.00	
	0.00	0.00	0.24	
Ricefield, irrigated	19.60	27.40	3,495.30	3,542.40
	0.16	0.22	28.65	29.04
	0.55	0.77	98.67	
	17.55	8.92	29.67	
Grassland (90 -70% dominant)	15.10	56.80	1,186.70	1,258.60
	0.12	0.47	9.73	10.32
	1.20	4.51	94.29	
	13.45	18.48	10.07	
Shrubs	3.30	61.90	1,046.30	1,111.50
	0.03	0.51	8.58	9.11
	0.30	5.57	94.14	
	2.96	20.13	8.88	

Land use	Critical	Sub-critical	Not Critical	Total
Coconut	0.30	0.30	131.90	132.50
	0.00	0.00	1.08	1.09
	0.19	0.26	99.55	
	0.23	0.11	1.12	
Built-up Areas	2.20	3.30	417.50	423.00
	0.02	0.03	3.42	3.47
	0.52	0.79	98.70	
	1.95	1.08	3.54	
Coffee, citrus, lanzones	0.00	0.00	2.30	2.30
	0.00	0.00	0.02	0.02
	0.00	0.00	100.00	
	0.00	0.00	0.02	
Cassava, potatoes, black pepper	0.70	0.60	82.60	83.90
	0.01	0.00	0.68	0.69
	0.86	0.66	98.49	
	0.64	0.18	0.70	
Sugar cane	0.00	0.70	343.50	344.20
	0.00	0.01	2.82	2.82
	0.00	0.21	99.79	
	0.00	0.24	2.92	
Grassland (<70% dominant)	61.40	139.70	1,521.20	1,722.30
	0.50	1.15	12.47	14.12
	3.56	8.11	88.32	
	54.83	45.45	12.91	
Corn (>70% dominant)	1.30	1.20	14.90	17.40
	0.01	0.01	0.12	0.14
	7.31	6.71	85.97	
	1.13	0.38	0.13	
Fishponds	0.00	0.10	145.90	146.00
	0.00	0.00	1.20	1.20
	0.00	0.05	99.95	
	0.00	0.02	1.24	
Bamboos	0.00	0.00	0.80	0.80
	0.00	0.00	0.01	0.01
	0.00	0.00	100.00	
	0.00	0.00	0.01	

Land use	Critical	Sub-critical	Not Critical	Total
Ricefield, upland	0.00	0.00	7.20	7.20
	0.00	0.00	0.06	0.06
	0.00	0.00	100.00	
	0.00	0.00	0.06	
Saltbeds	0.00	0.00	7.70	7.70
	0.00	0.00	0.06	0.06
	0.00	0.00	100.00	
	0.00	0.00	0.07	
Beach sands	0.00	0.00	9.50	9.50
	0.00	0.00	0.08	0.08
	0.00	0.00	100.00	
	0.00	0.00	0.08	
Ipil-ipil	0.00	0.00	1.30	1.30
	0.00	0.00	0.01	0.01
	0.00	0.00	100.00	
	0.00	0.00	0.01	
Riverwash	0.20	1.40	210.20	211.80
	0.00	0.01	1.72	1.74
	0.08	0.68	99.24	
	0.16	0.47	1.78	
Rice terraces	0.00	0.40	104.20	104.60
	0.00	0.00	0.85	0.86
	0.00	0.43	99.57	
	0.00	0.15	0.88	
Vegetable terraces	7.80	12.00	131.80	151.70
	0.06	0.10	1.08	1.24
	5.17	7.90	86.93	
	7.01	3.90	1.12	
Mines	0.00	0.90	8.00	8.90
	0.00	0.01	0.07	0.07
	0.00	10.35	89.65	
	0.00	0.30	0.07	
Filling ponds	0.00	0.00	0.90	0.90
	0.00	0.00	0.01	0.01
	0.00	0.00	100.00	
	0.00	0.00	0.01	

Land use	Critical	Sub-critical	Not Critical	Total
Reservoirs	0.00	0.00	6.60	6.60
	0.00	0.00	0.05	0.05
	0.00	0.00	100.00	
	0.00	0.00	0.06	
Grapes	0.00	0.00	0.90	0.90
	0.00	0.00	0.01	0.01
	0.00	0.00	100.00	
	0.00	0.00	0.01	
Mango	0.00	0.50	4.60	5.10
	0.00	0.00	0.04	0.04
	0.00	9.68	90.32	
	0.00	0.16	0.04	
Maguey	0.10	0.00	3.40	3.50
	0.00	0.00	0.03	0.03
	2.98	0.00	97.02	
	0.09	0.00	0.03	
Freshwater swamp	0.00	0.00	15.20	15.20
	0.00	0.00	0.12	0.12
	0.00	0.00	100.00	
	0.00	0.00	0.13	
Kaingin	0.00	0.00	0.50	0.50
	0.00	0.00	0.00	0.00
	0.00	0.00	100.00	
	0.00	0.00	0.00	
Vegetable, lowland	0.00	0.10	11.50	11.60
	0.00	0.00	0.09	0.10
	0.00	1.03	98.97	
	0.00	0.04	0.10	
Airport	0.00	0.00	0.30	0.30
	0.00	0.00	0.00	0.00
	0.00	0.00	100.00	
	0.00	0.00	0.00	
Total	111.90	307.40	11,779.50	12,198.80
	0.92	2.52	96.56	

Area cross tabulation of critical areas for nonpollution sources with the elevation map of Benguet, La Union, Pangasinan and Tarlac.

Area (km sq.)
Total %
Row %
Col %

Elevation	Critical	Sub-critical	Not Critical	Total
<1 m	2.10	10.80	757.70	770.60
	0.02	0.09	6.23	6.33
	0.27	1.41	98.32	
	1.88	3.53	6.45	
1-3 m	0.30	0.70	40.50	41.40
	0.00	0.01	0.33	0.34
	0.61	1.73	97.66	
	0.23	0.23	0.34	
3-5 m	0.50	0.50	46.90	47.80
	0.00	0.00	0.39	0.39
	1.00	1.00	98.00	
	0.43	0.16	0.40	
5-10 m	0.80	1.80	156.20	158.80
	0.01	0.01	1.28	1.31
	0.52	1.14	98.34	
	0.73	0.59	1.33	
10-50 m	11.80	23.10	2,812.40	2,847.20
	0.10	0.19	23.11	23.39
	0.41	0.81	98.78	
	10.50	7.51	23.93	
50-75 m	4.90	14.50	824.00	843.40
	0.04	0.12	6.77	6.93
	0.58	1.71	97.71	
	4.35	4.70	7.01	
75-100 m	4.50	16.40	567.20	588.10
	0.04	0.14	4.66	4.83
	0.76	2.79	96.44	
	4.02	5.35	4.83	
100-150 m	9.90	21.80	679.30	711.00
	0.08	0.18	5.58	5.84
	1.39	3.07	95.54	
	8.82	7.10	5.78	

Elevation	Critical	Sub-critical	Not Critical	Total
150-300 m	18.80	48.10	1,197.50	1,264.40
	0.15	0.40	9.84	10.39
	1.49	3.81	94.71	
	16.80	15.65	10.19	
300-400 m	6.60	24.50	471.90	503.00
	0.05	0.20	3.88	4.13
	1.32	4.86	93.82	
	5.94	7.95	4.02	
400-600 m	15.10	64.20	851.50	930.80
	0.12	0.53	7.00	7.65
	1.63	6.89	91.48	
	13.52	20.88	7.25	
600-800 m	17.20	28.50	627.90	673.60
	0.14	0.23	5.16	5.53
	2.55	4.24	93.21	
	15.35	9.29	5.34	
800-900 m	2.80	6.10	260.80	269.70
	0.02	0.05	2.14	2.22
	1.05	2.25	96.70	
	2.54	1.97	2.22	
900-1,000 m	2.50	5.00	240.70	248.20
	0.02	0.04	1.98	2.04
	0.99	2.02	96.99	
	2.20	1.63	2.05	
1,000-1,150 m	1.60	8.20	382.30	392.10
	0.01	0.07	3.14	3.22
	0.42	2.09	97.50	
	1.45	2.66	3.25	
1,150-1,300 m	0.90	6.40	343.80	351.10
	0.01	0.05	2.83	2.89
	0.24	1.83	97.92	
	0.76	2.09	2.93	
>1,300 m	11.70	26.80	1,490.90	1,529.50
	0.10	0.22	12.25	12.57
	0.77	1.75	97.48	
	10.49	8.71	12.69	
Total	111.90	307.40	11,751.40	12,170.80
	0.92	2.53	96.55	

Area cross tabulation of critical areas for nonpoint pollution sources with the erosion map of Benguet, La Union, Pangasinan and Tarlac.

Area (km sq)
Total %
Row %
Col %

	Critical	Sub-critical	Not Critical	Total
No erosion	14.20	26.80	4,941.90	4,982.90
	0.12	0.22	40.47	40.81
	0.29	0.54	99.18	
	12.70	8.70	41.91	
None to slight erosion	6.80	15.70	820.10	842.70
	0.06	0.13	6.72	6.90
	0.81	1.87	97.32	
	6.11	5.12	6.96	
Slight erosion	5.90	28.80	1,697.80	1,732.40
	0.05	0.24	13.90	14.19
	0.34	1.66	98.00	
	5.24	9.36	14.40	
Moderate erosion	24.30	104.70	2,565.50	2,694.50
	0.20	0.86	21.01	22.07
	0.90	3.89	95.21	
	21.71	34.05	21.76	
Severe erosion	58.90	116.40	1,532.90	1,708.20
	0.48	0.95	12.55	13.99
	3.45	6.81	89.74	
	52.64	37.86	13.00	
Very severe erosion	1.80	15.00	188.90	205.70
	0.01	0.12	1.55	1.68
	0.86	7.31	91.83	
	1.59	4.89	1.60	
Reservoir	0.00	0.00	43.80	43.90
	0.00	0.00	0.36	0.36
	0.00	0.10	99.90	
	0.00	0.01	0.37	
Total	111.90	307.40	11,790.90	12,210.30
	0.92	2.52	96.57	

Area cross tabulation of the critical area for nonpoint pollution sources within the Agno River Basin.

Area (km sq)
Total %
Row %

	Critical	Sub-critical	Not Critical	Total
Central	17.07	28.94	4,038.23	4,084.24
Plain	0.22	0.37	51.82	52.41
	0.42	0.71	98.87	
	25.32	15.05	53.61	
S1	0.58	11.41	92.23	104.22
	0.01	0.15	1.18	1.34
	0.56	10.95	88.49	
	0.86	5.94	1.22	
S2	0.07	2.32	35.48	37.87
	0.00	0.03	0.46	0.49
	0.20	6.11	93.69	
	0.11	1.20	0.47	
S3	0.07	7.87	110.39	118.34
	0.00	0.10	1.42	1.52
	0.06	6.65	93.28	
	0.11	4.10	1.47	
S4	0.00	0.94	40.08	41.02
	0.00	0.01	0.51	0.53
	0.00	2.29	97.71	
	0.00	0.49	0.53	
S5	0.00	4.33	219.13	223.46
	0.00	0.06	2.81	2.87
	0.00	1.94	98.06	
	0.00	2.25	2.91	
S6	0.37	14.18	251.65	266.20
	0.00	0.18	3.23	3.42
	0.14	5.33	94.53	
	0.55	7.37	3.34	
S7	0.00	0.73	34.10	34.84
	0.00	0.01	0.44	0.45
	0.00	2.10	97.90	
	0.00	0.38	0.45	

	Critical	Sub-critical	Not Critical	Total
S8	0.00	0.39	115.32	115.71
	0.00	0.00	1.48	1.48
	0.00	0.34	99.66	
	0.00	0.20	1.53	
S9	0.00	0.49	152.49	152.98
	0.00	0.01	1.96	1.96
	0.00	0.32	99.68	
	0.00	0.26	2.02	
S10	0.00	0.00	30.62	30.62
	0.00	0.00	0.39	0.39
	0.00	0.00	100.00	
	0.00	0.00	0.41	
S11	0.00	0.00	54.48	54.48
	0.00	0.00	0.70	0.70
	0.00	0.00	100.00	
	0.00	0.00	0.72	
S12	0.00	0.03	128.81	128.84
	0.00	0.00	1.65	1.65
	0.00	0.02	99.98	
	0.00	0.02	1.71	
S13	0.00	0.40	109.77	110.17
	0.00	0.01	1.41	1.41
	0.00	0.37	99.63	
	0.00	0.21	1.46	
S14	0.00	0.04	36.94	36.99
	0.00	0.00	0.47	0.47
	0.00	0.12	99.88	
	0.00	0.02	0.49	
S15	8.31	11.61	33.01	52.93
	0.11	0.15	0.42	0.68
	15.69	21.93	62.38	
	12.31	6.04	0.44	
S16	0.15	1.20	38.79	40.14
	0.00	0.02	0.50	0.52
	0.37	2.98	96.65	
	0.22	0.62	0.52	

	Critical	Sub-critical	Not Critical	Total
S17	0.85	3.08	7.71	11.64
	0.01	0.04	0.10	0.15
	7.32	26.44	66.24	
	1.26	1.60	0.10	
S18	3.26	7.35	32.55	43.16
	0.04	0.09	0.42	0.55
	7.55	17.03	75.42	
	4.83	3.82	0.43	
S19	2.46	3.53	48.50	54.49
	0.03	0.05	0.62	0.70
	4.52	6.47	89.01	
	3.65	1.83	0.64	
S20	1.66	9.89	112.26	123.81
	0.02	0.13	1.44	1.59
	1.34	7.99	90.67	
	2.46	5.14	1.49	
S21	6.24	10.37	84.01	100.62
	0.08	0.13	1.08	1.29
	6.21	10.30	83.49	
	9.26	5.39	1.12	
S22	0.63	1.30	56.26	58.18
	0.01	0.02	0.72	0.75
	1.08	2.23	96.69	
	0.93	0.68	0.75	
N1	2.32	5.21	46.94	54.46
	0.03	0.07	0.60	0.70
	4.25	9.57	86.18	
	3.43	2.71	0.62	
N2	0.00	0.12	8.38	8.50
	0.00	0.00	0.11	0.11
	0.00	1.41	98.59	
	0.00	0.06	0.11	
N3	1.28	3.20	39.21	43.69
	0.02	0.04	0.50	0.56
	2.94	7.32	89.74	
	1.90	1.66	0.52	

	Critical	Sub-critical	Not Critical	Total
N4	0.79	1.28	29.38	31.46
	0.01	0.02	0.38	0.40
	2.52	4.08	93.40	
	1.17	0.67	0.39	
N5	1.24	2.20	61.25	64.68
	0.02	0.03	0.79	0.83
	1.92	3.39	94.69	
	1.84	1.14	0.81	
N6	0.00	0.72	47.40	48.12
	0.00	0.01	0.61	0.62
	0.00	1.49	98.51	
	0.00	0.37	0.63	
N7	0.00	0.24	47.40	47.64
	0.00	0.00	0.61	0.61
	0.00	0.50	99.50	
	0.00	0.12	0.63	
N8	0.00	0.00	74.44	74.44
	0.00	0.00	0.96	0.96
	0.00	0.00	100.00	
	0.00	0.00	0.99	
N9	0.00	0.30	99.98	100.28
	0.00	0.00	1.28	1.29
	0.00	0.30	99.70	
	0.00	0.16	1.33	
N10	0.00	0.00	74.62	74.62
	0.00	0.00	0.96	0.96
	0.00	0.00	100.00	
	0.00	0.00	0.99	
N11	0.00	2.75	139.82	142.57
	0.00	0.04	1.79	1.83
	0.00	1.93	98.07	
	0.00	1.43	1.86	
N12	0.73	1.70	93.26	95.69
	0.01	0.02	1.20	1.23
	0.76	1.78	97.46	
	1.09	0.89	1.24	

	Critical	Sub-critical	Not Critical	Total
N13	1.28	2.17	84.18	87.63
	0.02	0.03	1.08	1.12
	1.47	2.47	96.06	
	1.90	1.13	1.12	
N14	0.00	1.31	103.85	105.17
	0.00	0.02	1.33	1.35
	0.00	1.25	98.75	
	0.00	0.68	1.38	
N15	0.00	0.03	114.44	114.47
	0.00	0.00	1.47	1.47
	0.00	0.03	99.97	
	0.00	0.02	1.52	
N16	0.00	0.00	10.29	10.29
	0.00	0.00	0.13	0.13
	0.00	0.00	100.00	
	0.00	0.00	0.14	
N17	1.85	2.21	51.31	55.38
	0.02	0.03	0.66	0.71
	3.35	3.99	92.66	
	2.75	1.15	0.68	
N18	0.18	2.12	10.77	13.07
	0.00	0.03	0.14	0.17
	1.37	16.23	82.40	
	0.27	1.10	0.14	
N19	0.00	0.00	5.03	5.03
	0.00	0.00	0.06	0.06
	0.00	0.00	100.00	
	0.00	0.00	0.07	
N20	4.78	7.04	16.09	27.90
	0.06	0.09	0.21	0.36
	17.13	25.21	57.66	
	7.09	3.66	0.21	
N21	0.76	5.36	14.04	20.17
	0.01	0.07	0.18	0.26
	3.78	26.59	69.63	
	1.13	2.79	0.19	

	Critical	Sub-critical	Not Critical	Total
N22	2.26	4.18	13.59	20.03
	0.03	0.05	0.17	0.26
	11.26	20.88	67.86	
	3.34	2.18	0.18	
N23	0.39	0.73	2.29	3.41
	0.00	0.01	0.03	0.04
	11.40	21.49	67.11	
	0.58	0.38	0.03	
N24	0.19	0.22	14.91	15.33
	0.00	0.00	0.19	0.20
	1.27	1.46	97.27	
	0.29	0.12	0.20	
N25	0.42	5.36	18.45	24.23
	0.01	0.07	0.24	0.31
	1.73	22.13	76.14	
	0.62	2.79	0.24	
N26	0.00	0.00	21.36	21.36
	0.00	0.00	0.27	0.27
	0.00	0.00	100.00	
	0.00	0.00	0.28	
N27	0.00	0.00	28.11	28.11
	0.00	0.00	0.36	0.36
	0.00	0.00	100.00	
	0.00	0.00	0.37	
N28	0.28	0.07	51.33	51.69
	0.00	0.00	0.66	0.66
	0.55	0.14	99.31	
	0.42	0.04	0.68	
N29	0.00	0.00	6.50	6.50
	0.00	0.00	0.08	0.08
	0.00	0.00	100.00	
	0.00	0.00	0.09	
N30	0.00	0.01	10.20	10.22
	0.00	0.00	0.13	0.13
	0.00	0.15	99.85	
	0.00	0.01	0.14	

	Critical	Sub-critical	Not Critical	Total
N31	0.96	1.84	11.73	14.52
	0.01	0.02	0.15	0.19
	6.58	12.65	80.76	
	1.42	0.96	0.16	
N32	0.00	0.07	13.09	13.16
	0.00	0.00	0.17	0.17
	0.00	0.57	99.43	
	0.00	0.04	0.17	
N33	0.00	0.01	31.40	31.42
	0.00	0.00	0.40	0.40
	0.00	0.05	99.95	
	0.00	0.01	0.42	
N34	2.58	5.45	53.39	61.43
	0.03	0.07	0.69	0.79
	4.21	8.88	86.92	
	3.83	2.84	0.71	
N35	1.63	4.88	69.06	75.57
	0.02	0.06	0.89	0.97
	2.15	6.46	91.38	
	2.41	2.54	0.92	
N36	0.93	6.48	91.83	99.23
	0.01	0.08	1.18	1.27
	0.93	6.53	92.53	
	1.37	3.37	1.22	
N37	0.85	4.54	60.57	65.97
	0.01	0.06	0.78	0.85
	1.29	6.88	91.83	
	1.26	2.36	0.80	
Total	67.45	192.23	7,532.73	7,792.40
	0.87	2.47	96.67	

Area cross tabulation of the critical areas for nonpoint pollution sources in the municipalities of Pangasinan.

Area (km sq)
Total %
Row %
Col %

Municipal/ Islands	Critical	Sub-critical	Not Critical	Total
San Fabian	0.00	0.81	74.45	75.26
	0.00	0.02	1.47	1.48
	0.00	1.07	98.93	
	0.00	0.53	1.53	
Mangaldan	0.00	0.00	45.68	45.68
	0.00	0.00	0.90	0.90
	0.00	0.00	100.00	
	0.00	0.00	0.94	
Dagupan	0.00	0.00	50.67	50.67
	0.00	0.00	1.00	1.00
	0.00	0.00	100.00	
	0.00	0.00	1.04	
Calasiao	0.00	0.00	53.21	53.21
	0.00	0.00	1.05	1.05
	0.00	0.00	100.00	
	0.00	0.00	1.10	
Binmaley	0.00	0.00	48.06	48.06
	0.00	0.00	0.95	0.95
	0.00	0.00	100.00	
	0.00	0.00	0.99	
San Carlos	0.00	0.00	177.72	177.72
	0.00	0.00	3.50	3.50
	0.00	0.00	100.00	
	0.00	0.00	3.66	
Lingayen	0.00	0.00	59.72	59.72
	0.00	0.00	1.18	1.18
	0.00	0.00	100.00	
	0.00	0.00	1.23	

Municipal/ Islands	Critical	Sub-critical	Not Critical	Total
Labrador	3.09	3.08	107.47	113.64
	0.06	0.06	2.12	2.24
	2.72	2.71	94.57	
	4.44	2.01	2.21	
Sual	1.81	0.79	142.63	145.23
	0.04	0.02	2.81	2.86
	1.24	0.55	98.21	
	2.60	0.52	2.94	
Alaminos	0.28	1.70	158.66	160.65
	0.01	0.03	3.12	3.16
	0.18	1.06	98.76	
	0.41	1.11	3.27	
Bani	0.88	5.78	211.62	218.28
	0.02	0.11	4.17	4.30
	0.40	2.65	96.95	
	1.27	3.78	4.36	
Bolinao	0.81	4.17	157.63	162.60
	0.02	0.08	3.10	3.20
	0.50	2.56	96.94	
	1.16	2.73	3.25	
Anda	0.00	2.99	71.12	74.11
	0.00	0.06	1.40	1.46
	0.00	4.03	95.97	
	0.00	1.95	1.46	
Silaqui	0.00	0.00	0.13	0.13
	0.00	0.00	0.00	0.00
	0.00	0.00	100.00	
	0.00	0.00	0.00	
Santiago	0.00	0.00	21.51	21.51
	0.00	0.00	0.42	0.42
	0.00	0.00	100.00	
	0.00	0.00	0.44	
Siapar	0.00	0.00	2.02	2.02
	0.00	0.00	0.04	0.04
	0.00	0.00	100.00	
	0.00	0.00	0.04	

Municipal/ Islands	Critical	Sub-critical	Not Critical	Total
Hundred Islands	0.00	1.20	100.00	0.00
	0.00	0.00	0.02	0.02
	0.00	0.00	100.00	
	0.00	0.00	0.02	
Cabalitian	0.00	0.00	1.69	1.69
	0.00	0.00	0.03	0.03
	0.00	0.00	100.00	
	0.00	0.00	0.03	
Agno	1.22	9.55	127.86	138.63
	0.02	0.19	2.52	2.73
	0.88	6.89	92.23	
	1.76	6.24	2.63	
Burgos	0.88	8.07	114.14	123.09
	0.02	0.16	2.25	2.42
	0.72	6.55	92.73	
	1.27	5.28	2.35	
Mabini	11.71	16.73	198.38	226.82
	0.23	0.33	3.91	4.47
	5.16	7.38	87.46	
	16.83	10.94	4.09	
Dasol	0.70	11.13	158.57	170.40
	0.01	0.22	3.12	3.36
	0.41	6.53	93.06	
	1.01	7.28	3.27	
Infanta	2.36	3.78	227.73	233.87
	0.05	0.07	4.48	4.61
	1.01	1.62	97.37	
	3.39	2.47	4.69	
Bugallon	5.14	14.34	136.07	155.55
	0.10	0.28	2.68	3.06
	3.30	9.22	87.48	
	7.39	9.38	2.80	
Aguilar	5.89	11.77	126.93	144.59
	0.12	0.23	2.50	2.85
	4.07	8.14	87.79	
	8.46	7.70	2.61	

Municipal/ Islands	Critical	Sub-critical	Not Critical	Total
Pozorubbio	1.37	0.42	77.84	79.64
	0.03	0.01	1.53	1.57
	1.73	0.53	97.75	
	1.98	0.27	1.60	
Sison	3.24	3.72	105.06	112.02
	0.06	0.07	2.07	2.21
	2.89	3.32	93.79	
	4.66	2.43	2.16	
Binalonan	0.00	0.00	65.00	65.00
	0.00	0.00	1.28	1.28
	0.00	0.00	100.00	
	0.00	0.00	1.34	
Urdaneta	0.00	0.00	128.30	128.30
	0.00	0.00	2.53	2.53
	0.00	0.00	100.00	
	0.00	0.00	2.64	
Asingan	0.00	0.00	74.60	74.60
	0.00	0.00	1.47	1.47
	0.00	0.00	100.00	
	0.00	0.00	1.54	
San Manuel	1.88	1.88	112.17	115.94
	0.04	0.04	2.21	2.28
	1.62	1.62	96.75	
	2.71	1.23	2.31	
San Nicolas	13.09	24.96	181.87	219.92
	0.26	0.49	3.58	4.33
	5.95	11.35	82.70	
	18.81	16.32	3.75	
Tayug	0.00	0.00	43.44	43.44
	0.00	0.00	0.86	0.86
	0.00	0.00	100.00	
	0.00	0.00	0.89	
Natividad	0.84	6.14	78.77	85.75
	0.02	0.12	1.55	1.69
	0.98	7.16	91.86	
	1.20	4.02	1.62	

Municipal/ Islands	Critical	Sub-critical	Not Critical	Total
Mangatarem	9.13	16.39	261.09	286.61
	0.18	0.32	5.14	5.64
	3.18	5.72	91.10	
	13.12	10.72	5.38	
Urbiztondo	0.00	0.00	53.96	53.96
	0.00	0.00	1.06	1.06
	0.00	0.00	100.00	
	0.00	0.00	1.11	
Basista	0.00	0.00	29.89	29.89
	0.00	0.00	0.59	0.59
	0.00	0.00	100.00	
	0.00	0.00	0.62	
Malasiqui	0.87	0.82	117.53	119.22
	0.02	0.02	2.31	2.35
	0.73	0.69	98.58	
	1.25	0.54	2.42	
Sta. Barbara	0.00	0.00	69.40	69.40
	0.00	0.00	1.37	1.37
	0.00	0.00	100.00	
	0.00	0.00	1.43	
Mapandan	0.00	0.00	21.94	21.94
	0.00	0.00	0.43	0.43
	0.00	0.00	100.00	
	0.00	0.00	0.45	
San Jacinto	0.00	0.00	30.32	30.32
	0.00	0.00	0.60	0.60
	0.00	0.00	100.00	
	0.00	0.00	0.62	
Manaoag	1.93	1.14	42.84	45.91
	0.04	0.02	0.84	0.90
	4.20	2.47	93.33	
	2.77	0.74	0.88	
Laoac	0.00	0.00	31.24	31.24
	0.00	0.00	0.62	0.62
	0.00	0.00	100.00	
	0.00	0.00	0.64	

Municipal/ Islands	Critical	Sub-critical	Not Critical	Total
San Quintin	0.00	0.00	114.19	114.19
	0.00	0.00	2.25	2.25
	0.00	0.00	100.00	
	0.00	0.00	2.35	
Sta. Maria	0.00	0.00	48.71	48.71
	0.00	0.00	0.96	0.96
	0.00	0.00	100.00	
	0.00	0.00	1.00	
Umingan	0.00	0.00	257.76	257.76
	0.00	0.00	5.08	5.08
	0.00	0.00	100.00	
	0.00	0.00	5.31	
Balungan	0.00	0.00	76.63	76.63
	0.00	0.00	1.51	1.51
	0.00	0.00	100.00	
	0.00	0.00	1.58	
Rosales	0.00	0.00	65.86	65.86
	0.00	0.00	1.30	1.30
	0.00	0.00	100.00	
	0.00	0.00	1.36	
Villasis	0.91	0.28	77.38	78.58
	0.02	0.01	1.52	1.55
	1.16	0.36	98.48	
	1.31	0.19	1.59	
Sto. Tomas	0.00	0.00	12.79	12.79
	0.00	0.00	0.25	0.25
	0.00	0.00	100.00	
	0.00	0.00	0.26	
Alcala	1.55	1.46	41.95	44.96
	0.03	0.03	0.83	0.89
	3.46	3.26	93.29	
	2.23	0.96	0.86	
Bautista	0.00	0.00	68.15	68.15
	0.00	0.00	1.34	1.34
	0.00	0.00	100.00	
	0.00	0.00	1.40	

Municipal/ Islands	Critical	Sub-critical	Not Critical	Total
Bayambang	0.00	1.02	92.08	93.10
	0.00	0.02	1.81	1.83
	0.00	1.09	98.91	
	0.00	0.66	1.90	
Total	69.58	152.91	4,855.66	5,078.15
	1.37	3.01	95.62	

Area cross tabulation of the critical areas for nonpoint pollution sources in the municipalities of Benguet

Area (km sq.)
Total %
Row%
Col %

	Not Critical	Sub-critical	Critical	Total
Bakun	165.78	0.00	0.00	165.78
	6.05	0.00	0.00	6.05
	100.00	0.00	0.00	
	6.20	0.00	0.00	
Mankayan	234.75	0.00	0.00	234.75
	8.57	0.00	0.00	8.57
	100.00	0.00	0.00	
	8.77	0.00	0.00	
Buguias	106.49	9.62	5.42	121.54
	3.89	0.35	0.20	4.44
	87.62	7.92	4.46	
	3.98	21.09	30.95	
Kibungan	161.08	0.64	0.63	162.35
	5.88	0.02	0.02	5.93
	99.22	0.40	0.39	
	6.02	1.41	3.58	
Kabayan	153.73	3.32	1.24	158.29
	5.61	0.12	0.05	5.78
	97.12	2.10	0.78	
	5.75	7.27	7.08	
Atok	138.51	0.34	0.00	138.85
	5.06	0.01	0.00	5.07
	99.75	0.25	0.00	
	5.18	0.75	0.00	
Kapangan	145.62	0.45	0.12	146.19
	5.32	0.02	0.00	5.34
	99.61	0.31	0.08	
	5.44	0.98	0.68	
Tublay	93.74	1.02	0.88	95.63
	3.42	0.04	0.03	3.49
	98.02	1.06	0.92	
	3.50	2.23	5.03	

	Not Critical	Sub-critical	Critical	Total
Sablan	103.99	1.48	0.21	105.67
	3.80	0.05	0.01	3.86
	98.40	1.40	0.20	
	3.89	3.24	1.19	
La Trinidad	75.42	1.49	1.34	78.26
	2.75	0.05	0.05	2.86
	96.37	1.91	1.72	
	2.82	3.28	7.67	
Tuba	330.87	15.48	4.15	350.50
	12.08	0.57	0.15	12.80
	94.40	4.42	1.18	
	12.37	33.93	23.70	
Baguio	50.91	4.59	1.66	57.15
	1.86	0.17	0.06	2.09
	89.07	8.02	2.90	
	1.90	10.06	9.46	
Itogon	546.05	6.66	1.87	554.58
	19.94	0.24	0.07	20.25
	98.46	1.20	0.34	
	20.41	14.61	10.66	
Bokod	368.53	0.52	0.00	369.05
	13.46	0.02	0.00	13.48
	99.86	0.14	0.00	
	13.77	1.15	0.00	
Total	2,675.47	45.61	17.52	2,738.60
	97.69	1.67	0.64	

Area cross tabulation of critical areas for nonpoint pollution sources in the municipalities of Tarlac.

Area (km sq.)
Total %
Row %
Col %

Municipal	Critical	Sub-critical	Not Critical	Total
Bamban	2.12	9.58	133.44	145.14
	0.07	0.31	4.35	4.73
	1.46	6.60	91.94	
	62.01	16.13	4.44	
Concepcion	0.00	0.00	214.32	214.32
	0.00	0.00	6.98	6.98
	0.00	0.00	100.00	
	0.00	0.00	7.13	
O'Donnel	1.02	31.36	482.01	514.38
	0.03	1.02	15.70	16.75
	0.20	6.10	93.71	
	29.69	52.81	16.03	
Tarlac	0.28	16.82	740.18	757.28
	0.01	0.55	24.11	24.66
	0.04	2.22	97.74	
	8.30	28.33	24.61	
La Paz	0.00	0.00	123.14	123.14
	0.00	0.00	4.01	4.01
	0.00	0.00	100.00	
	0.00	0.00	4.09	
Victoria	0.00	0.00	121.52	121.52
	0.00	0.00	3.96	3.96
	0.00	0.00	100.00	
	0.00	0.00	4.04	
Pura	0.00	0.00	32.74	32.74
	0.00	0.00	1.07	1.07
	0.00	0.00	100.00	
	0.00	0.00	1.09	

Municipal	Critical	Sub-critical	Not Critical	Total
Gerona	0.00	0.54	118.70	119.24
	0.00	0.02	3.87	3.88
	0.00	0.45	99.55	
	0.00	0.91	3.95	
Sta. Ignasia	0.00	0.66	117.07	117.73
	0.00	0.02	3.81	3.83
	0.00	0.56	99.44	
	0.00	1.11	3.89	
Mayantoc	0.00	0.03	349.17	349.20
	0.00	0.00	11.37	11.37
	0.00	0.01	99.99	
	0.00	0.05	11.61	
Camiling	0.00	0.31	183.20	183.52
	0.00	0.01	5.97	5.98
	0.00	0.17	99.83	
	0.00	0.53	6.09	
Paniqui	0.00	0.00	94.14	94.14
	0.00	0.00	3.07	3.07
	0.00	0.00	100.00	
	0.00	0.00	3.13	
Ramos	0.00	0.00	31.67	31.67
	0.00	0.00	1.03	1.03
	0.00	0.00	100.00	
	0.00	0.00	1.05	
Nampicuan	0.00	0.00	25.37	25.37
	0.00	0.00	0.83	0.83
	0.00	0.00	100.00	
	0.00	0.00	0.84	
Moncada	0.00	0.00	119.95	119.95
	0.00	0.00	3.91	3.91
	0.00	0.00	100.00	
	0.00	0.00	3.99	
San Manuel	0.00	0.00	50.01	50.01
	0.00	0.00	1.63	1.63
	0.00	0.00	100.00	
	0.00	0.00	1.66	

Municipal	Critical	Sub-critical	Not Critical	Total
San Clemente	0.00	0.09	71.08	71.17
	0.00	0.00	2.31	2.32
	0.00	0.13	99.87	
	0.00	0.15	2.36	
Total	3.42	59.38	3,007.72	3,070.52
	0.11	1.93	97.95	

Area cross tabulation of critical areas for nonpoint pollution sources in the municipalities of La Union.

Area (km sq.)
Total %
Row %
Col %

Municipal	Critical	Sub-critical	Not Critical	Total
Bangar	0.48	0.19	40.75	41.42
	0.03	0.01	2.84	2.88
	1.15	0.47	98.38	
	2.23	0.38	2.99	
Luna	0.81	0.60	39.03	40.44
	0.06	0.04	2.72	2.81
	1.99	1.48	96.53	
	3.77	1.18	2.86	
Balaoan	0.00	0.00	69.90	69.90
	0.00	0.00	4.87	4.87
	0.00	0.00	100.00	
	0.00	0.00	5.12	
Bacnotan	1.21	3.93	60.05	65.19
	0.08	0.27	4.18	4.54
	1.86	6.03	92.12	
	5.65	7.75	4.40	
San Juan	0.96	3.72	55.57	60.25
	0.07	0.26	3.87	4.19
	1.59	6.17	92.24	
	4.46	7.34	4.07	
San Fernando	0.54	2.00	96.26	98.80
	0.04	0.14	6.70	6.88
	0.54	2.03	97.43	
	2.51	3.95	7.05	
Bauang	3.60	3.88	68.34	75.83
	0.25	0.27	4.76	5.28
	4.75	5.12	90.13	
	16.81	7.66	5.01	
Caba	0.00	0.00	49.46	49.46
	0.00	0.00	3.44	3.44
	0.00	0.00	100.00	
	0.00	0.00	3.62	

Municipal	Critical	Sub-critical	Not Critical	Total
Aringay	4.11	10.55	83.79	98.44
	0.29	0.73	5.83	6.85
	4.17	10.71	85.11	
	19.18	20.81	6.14	
Agoo	0.04	0.25	38.82	39.12
	0.00	0.02	2.70	2.72
	0.11	0.65	99.24	
	0.21	0.50	2.85	
Sto. Tomas	0.00	0.54	61.32	61.86
	0.00	0.04	4.27	4.31
	0.00	0.87	99.13	
	0.00	1.06	4.49	
Rosario	1.24	1.27	66.73	69.24
	0.09	0.09	4.64	4.82
	1.79	1.83	96.38	
	5.79	2.51	4.89	
Pugo	0.03	1.93	41.62	43.57
	0.00	0.13	2.90	3.03
	0.07	4.42	95.51	
	0.14	3.80	3.05	
Tubao	2.02	4.06	50.76	56.84
	0.14	0.28	3.53	3.96
	3.55	7.15	89.30	
	9.41	8.02	3.72	
Naguilian	5.15	7.33	82.49	94.98
	0.36	0.51	5.74	6.61
	5.43	7.72	86.85	
	24.06	14.47	6.05	
Burgos	0.81	1.31	60.86	62.98
	0.06	0.09	4.24	4.38
	1.28	2.09	96.63	
	3.77	2.59	4.46	
Bagulin	0.00	3.66	67.19	70.85
	0.00	0.25	4.68	4.93
	0.00	5.17	94.83	
	0.00	7.22	4.92	
San Gabriel	0.24	4.88	150.55	155.67
	0.02	0.34	10.48	10.84
	0.15	3.14	96.71	
	1.12	9.64	11.03	

Municipal	Critical	Sub-critical	Not Critical	Total
Santol	0.00	0.00	112.83	112.83
	0.00	0.00	7.85	7.85
	0.00	0.00	100.00	
	0.00	0.00	8.27	
Sudipen	0.19	0.57	68.15	68.91
	0.01	0.04	4.74	4.80
	0.28	0.82	98.89	
	0.91	1.12	4.99	
Total	21.42	50.69	1,364.48	1,436.58
	1.49	3.53	94.98	

A Study on the Sediment Loading of the Agno River Basin due to Surface Erosion Using Geographic Information Systems[1]

James N. Paw[2]

Sediment loading of the Agno River Basin can be estimated using the Universal Soil Loss Equation (USLE). McElroy et al. (1976) defined sediment loading as "the quantity of soil material that is eroded and transported into the watercourse. It is dependent on *in situ* erosion and delivery or the ability of runoff to carry the eroded material into the receptor water." It is an empirical, deterministic and lumped model using regression analysis.

The sediment loading function is:

$$Y(S)_E = \sum_{i=1}^{n} [A_i(R \cdot K \cdot L \cdot S \cdot C \cdot P \cdot S_d)_1] \qquad (1)$$

Where

$Y(S)_E$ = sediment loading from surface erosion, t/yr

n = number of subareas in the study area

A_i = areal extent of subarea i, km^2

R = rainfall erosivity factor, mm

K = soil erodibility factor, t/ha per R unit

L = slope-length factor, dimensionless ratio

S = slope-steepness factor, dimensionless ratio

C = vegetation cover factor (land use), dimensionless ratio

P = erosion control practice factor, dimensionless ratio

S_d = sediment delivery ratio, dimensionless

Applicability

The USLE can be used to predict sediment loading resulting from sheet and rill erosion of noncrop- and croplands. The equation does not predict sediment contributions from gully erosion, streambank erosion or mass soil movement.

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1 Activity 1 of the GISCAMP Project.

2 International Center for Living Aquatic Resources Management (ICLARM), MC P.O. Box 2631, Makati, Philippines.

Procedure to Use the Sediment Loading Function

The procedure to use the USLE is based on McElroy et al. (1976). Surface erosion should be estimated for each land use type. If ≥90% of the area consist of one soil type, soil loss calculation for land use may be based on that soil type. If one soil type is <90%, soil loss calculation should be based on each soil type that makes up at least 10% of the land use and then obtain a weighted average for the entire land use area.

Parameters and Basic Data Required

Study Area (A)

The entire Agno River Basin is situated in 9 provinces with headwaters in the boundary of Benguet and Ifugao. The study area, however, comprises 4 provinces - Benguet, La Union, Pangasinan and Tarlac. Sub-basins situated in La Union and the southwest part of Benguet such as the Bued and Pantalan Rivers are allied basins of the Agno River Basin.

The base map of the study area is constructed from 1:250,000 topographic maps (UTM) published by the National Mapping and Resource Information Authority (NAMRIA). The overall basin boundaries have been delineated based on the studies conducted by the National Irrigation Authority (NIA) and the Department of Public Works and Highways (DPWH). For the study area, the eastern, southern and southwestern boundaries followed the provincial boundaries of the 4 provinces instead of the actual delineated basin boundaries. The provincial boundaries were constructed from 1:50,000 topographic map (UTM) published by NAMRIA.

The Agno River Basin has been divided into 3 sub-areas. These are the northeastern mountainous sub-area, Pangasinan central plain and the southwestern mountainous sub-area. Except for the Pangasinan central plain, the 2 mountainous sub-areas have been sub-divided into sub-basins based on the boundaries set by the Agno River Basin Study under the Japan International Cooperation Agency (JICA) and DPWH. There are 60 sub-basins in the study. The unit used is in km^2.

Rainfall Factor (R)

The rainfall factor (R) is defined by McElroy et al. (1976) as "expressing the erosion potential of average annual rainfall in the locality, is a summation of the individual storm products of the kinetic energy of rainfall, in hundreds of m-t/ha-cm, and the maximum 30-min rainfall intensity, in cm/hr, for all significant storms, on an average annual basis. The R is also called index of erosivity and erosion index. When lines are drawn to connect points with the same erosion index value such lines are called iso-erodents and a map showing such lines is known as iso-erodent map.

The R can be derived using the following formula (David 1987):

$$R = A \cdot P_i^m \qquad (2)$$

where

R = daily rainfall > 25 mm
i = counter for the days of the year (number of days with rainfall >25 mm)
A = 0.002
m = 2.0

Precipitation records on a daily basis are generally difficult to obtain although in the case of the rainfall stations in the Agno River Basin, they are available for most of the stations. Eq. 2 is usually not convenient to use, particularly if daily rainfall data are not available. In this study, an empirical formula developed by Roose (1977) for a large part of West Africa as reported by Mitchell and Bubenzer (1980) was used.

$$R_{an}/H_{an} = 0.50 \pm 0.05 \quad (3)$$

where R_{an} = average annual erosivity index
H_{an} = average annual rainfall amount, mm

An iso-erodent or isohyetal map was constructed using annual rainfall values in 34 rainfall stations with at least 10 years continuous records. The 34 stations are located within and outside of the Agno River Basin.

Soil Erodibility Factor (K)

The soil erodibility factor (K) is a quantitative measure of the rate at which a soil will erode and expressed as t/ha per unit of R. It is independent of the effect of management. Typically, a nomograph is used to determine the K but generally, the calculated values may be inaccurate or even meaningless because of geographical variability. Another method of estimating K is by using the formula described by David (1985) as follow:

$$K = [(0.043)(pH) + (0.62/OM) + 0.0825(Sa) - 0.0062(C)]Si \quad (4)$$

Where
pH = soil pH
OM= percent organic matter
Sa = percent sand
C = clay ratio = % clay/(% sand + % silt)
Si = % silt/100

The difficulty in using Eq. 4 is that detailed soil data is required (physio-chemical paramaters). Since most soil data were collected from a reconnaissance level survey, details on soil types are sometimes not available. In this study, a table showing organic matter content versus soil types were used in determining the K factor. See Annex 1 for details. A soil texture table with the corresponding organic matter content and K factor was constructed.

Slope Length - Gradient Factor (LS)

The slope length - gradient factor is a combination of slope length (L) and slope steepness (S). Erosion process is typically high in steep slopes, especially where there is low vegetation cover. The LS defines the transport portion of the erosion process where it influences the flow and velocity of runoff. The slope length factor (L) is the ratio of soil loss from a specific length of slope usually referred to as horizontal slope length to the slope length of the USLE unit equivalent to 22.13 m (72.6 ft). It is defined as the "distance from the point of origin of overland flow to the point where deposition begins, or the runoff water enters a well-defined channel that may be part of a drainage network." This is represented by the following equation (Wischmeier and Smith 1978):

$$L = (l / l_u)^m \quad (5)$$

where
- L = slope length factor
- l = horizontal slope length
- l_u = slope length of the USLE unit plot = 22.13 m
- m = slope length exponent

The slope length exponent (m) has a value of 0.5 for slope of 9% and slope length of 22.13 m as inferred from the data of Wischmeier (see McCool et al. 1989). Thus, the LS value is 1.0 (McElroy et al. 1076). The slope length exponent varies according to slope steepness. It increases from 0.2 to 0.5 with slope steepness increasing from 0 to 5%. Above 5%, the value 0.5 is recommended (McCool et al. 1989). The constraint in using Eq. 5 is that it cannot be generalized for use in humid tropical conditions as the effect of slope gradient is considered more pronounced than in temperate countries. Another variation of Eq. (5) from Cruz (1990) for the Ibulao watershed in Laguna, Philippines can be used.

$$LS = [4.705(L/22.13)^m][(7.6 + 5.3S + 0.76S^2)10^{-3}] \quad (6)$$

where
- L = slope length
- S = slope gradient of the area
- m = slope length exponent

L is computed using the following formula:

$$L = 0.5 (A_t/L_C) \quad (7)$$

where
- A_t = area of a cell, km^2
- L_C = length of a cell, km

The slope length exponent will vary according to slope steepness:

$m = 0.5$	if $S > 5\%$
$m = 0.4$	if $5\% > S > 3\%$
$m = 0.3$	if $3\% > S > 1\%$
$m = 0.2$	if $S < 1\%$

Areas with rugged reliefs make it difficult to determine the LS factor. Construction of an elevation map to estimate the LS factor would be best done using digital elevation models (DEMs) but are usually unavailable. Alternately, elevation map can be constructed through surface interpolation by Triangulated Irregular Network (TIN) technique using digitized spot heights and points at various contour levels. This method requires substantial number of points to capture rugged reliefs.

For this study, the LS factor was computed using the following equation (David 1987):

$$LS = 0.10 + 0.21(S^{4/3}) \quad (8)$$

where S = slope in percent

A slope map (S) prepared by the BSWM was digitized. Using Eq. 8, the LS factor is

computed at various slope level.

Crop Cover Factor (C)

The crop cover factor (C) is also known as crop management or cover management factor. It represents the ratio of soil quantity eroded from land that is cropped or treated under specified condition to corresponding loss (eroded) from clean-tilled fallow under identical slope and rainfall conditions. It reflects the protective influence of vegetation and ground cover. With respect to croplands (agriculture), cropping year is usually divided into 6 periods (Wischmeier and Smith 1978):

Period F	Rough fallow - turn plowing to seeding.
Period SB	Seedbed - seeding to 1 month thereafter or 10% canopy cover.
Period 1	Establishment - from 1 to 2 months after seeding or 50% canopy cover.
Period 2	Development - growing crop, 75% canopy cover.
Period 3	Maturing crop - end of period 2 to crop harvest.
Period 4	Residue or stubble - from crop harvest to turn plow or new seedbed.

The 6 cropping stages can be used for cereals, fruits and vegetables. In the Philippines, large area cultivation of vegetables and fruits (e.g., pineapple) is generally few unlike rice and corn. Hence, the C factor will vary for rice, corn, selected fruits and vegetables based on various cropping stages. For our purpose, however, vegetables will be classified under diversified crops.

The C factor enumerated below are taken from David (1987). Although the C factors have not been properly assessed, studies done in Pantabangan and Magat Reservoirs showed that the USLE results (using the C factors enumerated below) agreed well with the sediment deposition in the two reservoirs. Since the C factors of some land use units (e.g., fishponds, filling ponds) are not listed by David (1987; David and Collado, n.d.), the C factors were determined based on the probable behaviour of soil eroding from such units. For example, fishponds are generally located in flat areas and contain substantial erosion control bunds. Soil erosion would behave very similarly to irrigated rice fields. Hence, the C factor of fishponds would be the same as irrigated rice fields.

The following are the C values as applied to Philippine condition by David (1987).

Cover	C Value
Bare Soil	1.0
Primary forest (with dense undergrowth)	0.001
Second-growth forest with good undergrowth and high mulch cover	0.003
Second-growth forest with patches of shrubs and plantation crops of 5 yrs or more	0.006
Industrial tree plantation (ITP)	
Benguet Pine with high mulch cover	0.007
Mahogany, Narra, 3-8 yrs with good cover crop	0.05-0.10
Mahogany, Narra, 8 yrs or more with good undergrowth	0.01-0.05
Yemane, 8 yrs or more	0.08
Mixed stand of ITP plant species, 8 yrs or more	0.07

Agroforestry tree species	
Cashew, mango and jackfruit, <3 yrs, withoutintercrop and with ring weeding	0.25
Cashew, mango and jackfruit, 3 to 5 yrs without intercrop and with ring weeding	0.15
Cashew, mango and jackfruit, with intercrop or native grass undercover	0.08
Mixed stand of agroforestry species, 5 yrs or more with good cover	0.08
Coconut with tree intercrops	0.05-0.10
Coconuts, with annual crops as intercrop	0.10-0.30
Ipil-ipil, good stand, 1st yr with native grass intercrop	0.20
Ipil-ipil, good stand, 2 yrs or more with high mulch cover	0.10
Ipil-ipil, newly cut for leaf meal or charcoal	0.30
Grasslands	
Imperata or themeda grasslands, well established and undisturbed, with shrub	0.007
Imperata or themeda grasslands, slightly grazed, with patches of shrub	0.15
Shrubs with patches of open, disturbed grasslands	0.15
Well-managed rangeland, slightly grazed cover of slow development, 1st yr	0.3-0.8
Well-managed rangeland cover of fast development, 1st yr, ungrazed	0.05-0.10
Well-managed rangeland, slightly grazed cover of slow development, 2 yrs or more	0.01-0.10
Well-managed rangeland, cover of fast development, ungrazed, 2 yrs or more	0.01-0.05
Grassland, moderately grazed, occasionally	0.20-0.40
Overgrazed grasslands, burned regularly	0.40-0.90
Annual cash crops	
Corn, sorghum	0.30-0.60
Rice	0.10-0.20
Peanut, mungbean, soybean	0.30-0.50
Cotton, tobacco	0.40-0.60
Pineapple	0.20-0.50
Bananas	0.10-0.30
Diversified crops	0.20-0.40
New kaingin areas, diversified crops	0.30
Old kaingin areas, diversified crops	0.80
Others	
Built-up rural areas, with home gardens	0.20
Riverwash .	0.50
Reservoir	0.20
Filling ponds	0.20
Mining areas	0.50
Fishponds	0.20
Saltbeds	0.20

The C in the GIS is represented by the Land Use map also shows vegetation cover including special areas like built-up areas (settlements), marginal lands and riverwash, etc. A table is created showing the different land use classes with corresponding class values. A separate column is inserted and the C values (above) encoded corresponding to the different land use classes. Note that when constructing the land use map, it is important that both dominant and associated crops (based on land area) should be assessed, particularly for agricultural areas.

Erosion Control Practice Factor (P)

The erosion control practice factor (P) is also referred to as conservation practice factor or simply the practice factor. The P accounts for control practices that reduce the effect of erosion due to runoff by their influence on drainage patterns, runoff concentration and runoff velocity (McElroy et al. 1976). It is the ratio of soil loss from specified conservation practice to the soil loss due to ploughing up and down the steepest slope. The worst case scenario, therefore, will have a P value of 1.0. A value of 1.0 also denotes the non-existence of conservation, particularly for non-vegetated areas (e.g., beach areas). Examples of conservation practices are terracing and contour ridges which effectively change slope characteristics, particularly in areas where slope is steep (e.g., hills and mountains).

The quantitative effect of terracing, once constructed, can be accounted by the slope length factor, L since the horizontal terrace interval becomes the slope length. The P factors for some of land use units have been determined similar to that for C factor. For example, built-up areas or settlements have many impervious surfaces (roads, parking lots, buildings) which are not erodible compared to bare soil. Hence, the P factor would be the same as a surface covered with 80 to 100% legume like *Centrosema*. The P values from various conservation practices in the Philippines and shown below were taken from David (1987).

Crop Management		P
Cashew orchard		
1.	Establish grass intercrop like centrosema, 80% surface cover	0.11
2.	Grass intercrop, 60% surface cover	0.23
3.	Broad-based terraces	0.20
4.	Broad-based terraces with cover intercrop at 80% cover	0.23
Corn		
1.	Contour-strip cropping	0.40-0.50
2.	Zoned tillage	0.25
3.	Zoned tillage with contouring	0.90-0.95
4.	Zoned tillage, contour farming and mulching at 40% cover	0.40
5.	Broad-based terraces, contouring and mulching at 40% cover	0.18-0.20
6.	Broad-based terraces with mulch tillage contour farming	0.26
7.	Broad-based terraces, mulching at 80% cover and contouring	0.15
8.	Broad-based terraces, zoned tillage and contouring	0.25
Old Kaingin		
1.	Contour strip cropping, mulching at 60% cover, zoned tillage contour farming	0.30

With GIS, P values are tabulated relative to specific land use units. It may be necessary for one dominant land use to have different P factor based on different associated crops.

Typically, C*P column is constructed alongside the C column of a C table.

Sediment Delivery Ratio (S_d)

The sediment delivery ratio (S_d) involves that portion of eroded sediment (gross sediment load) that is delivered to a stream. There are several factors that affect S_d. These include proximity of sediment sources from the stream; size, texture and density of sediment; velocity and volume of water discharge; terrain; and availability of deposition areas (e.g., valleys). There is no established formula to estimate S_d. However, the following equation for construction site derived empirically could be used (McElroy et al. 1976).

$$S_d = D^{-0.22} \qquad (8)$$

where S_d = sediment delivery ratio
D = overland distance between the erosion site and the receptor water, in ft

Eq. 8 can be used for intensely disturbed areas such as mines, construction sites, fishponds, filling ponds and built-up areas. The D is usually between 0 and 250 m (800 ft).

For general croplands and forestlands, the S_d is determined using drainage density and soil type (McElroy et. al 1976). Essentially, the S_d is related to the inverse of drainage density for relatively homogeneous basins. The reciprocal of drainage density (DD^{-1}) relates to the closeness of spacing of channels within the basin. The drainage density (DD) is determined as follow:

a. DD = total channel-segment lengths in km divided by the drainage area in km^2.

b. Digitize the river systems or tributaries found within each sub-basin.

c. Compute for the total area of each of the sub-basin.

d. Measure each river-segment length in each of the sub-basins and then sum all the values.

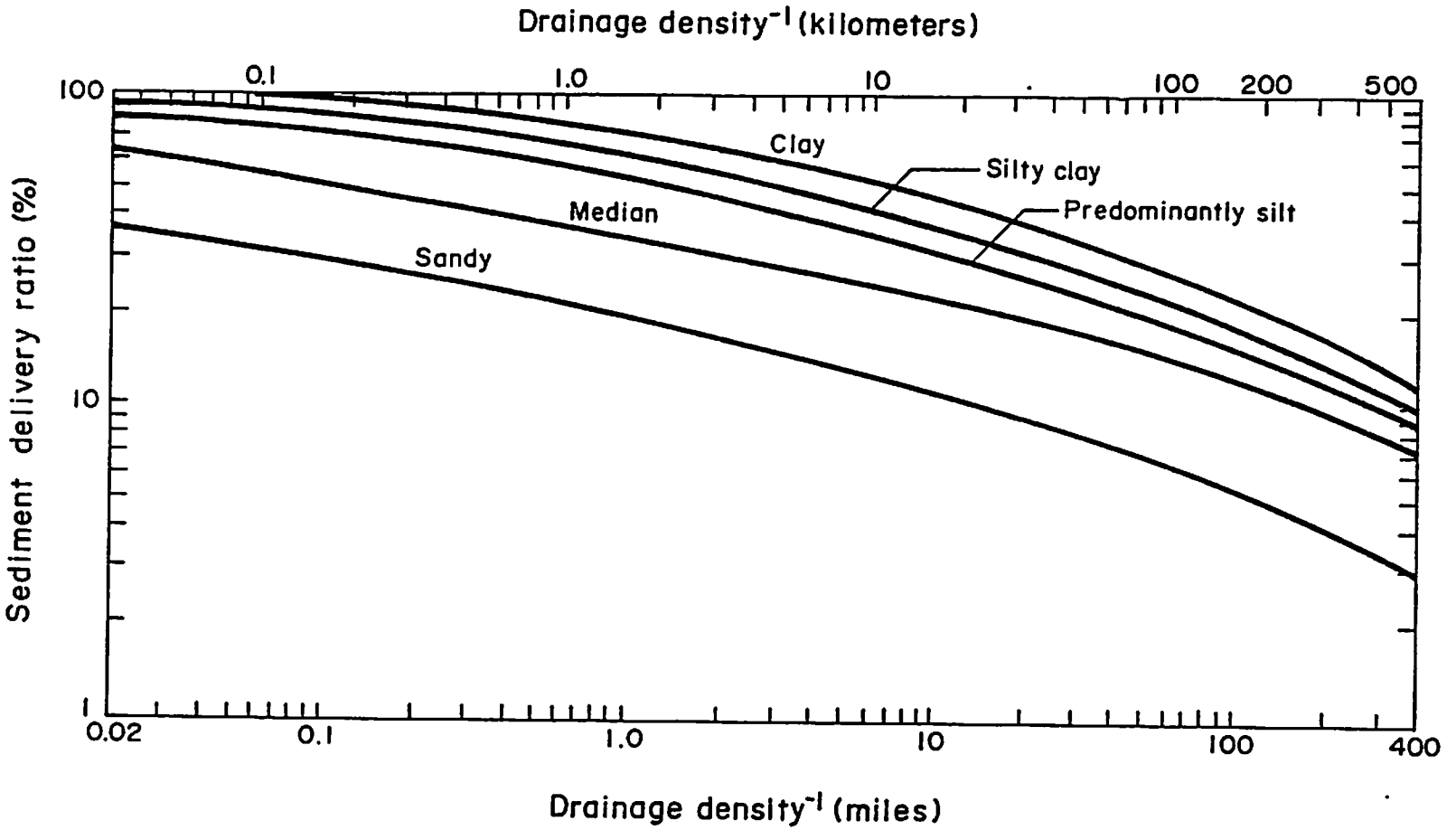
e. Divide the total river-segment lengths by the total sub-basin area to get DD. Then, divide DD by 1.

f. Determine the dominant soil type of the sub-basin.

g. Using the sediment delivery ratio graph, locate the position of the DD^{-1} of the sub-basin.

h. Move vertically and intersect with the appropriate soil texture, then move horizontally to the vertical axis to locate the S_d value for the sub-basin.

i. Generate a table of S_d for all sub-basins.


Drainage density⁻¹ (kilometers)
0.1
1.0
10
100
200
500
100
10
1
Sediment delivery ratio (%)
Clay
Silty clay
Predominantly silt
Median
Sandy
0.02
0.1
1.0
10
100
400
Drainage density⁻¹ (miles)

Sediment Yield Estimates

Annual sediment yield for each sub-basin is computed by multiplying the S_d with the sediment loss (Y) of the entire Agno River Basin:

$$Y(S)_E = \sum_{i=60}^{n} [A_{60}(Y \cdot S_d)_{60}] \quad (9)$$

where $Y = R \cdot K \cdot L \cdot S \cdot C \cdot P$

The $Y(S)_E$ should be adjusted to account for the presence of dams and other sediment trapping systems in the Agno Basin.

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Soil Erodibility Factor (K)

The soil erodibility factor (K) was computed per soil type based on per cent organic matter content. The K values were derived using the table reported by Mitchell and Bubenzer (1980). This table is used instead of a nomograph or using Eq. 4 as there were inadequate data on the physio-chemical characteristics of soils in the Agno River Basin. The values for K and % organic matter are averages of broad range of specific soil values.

With respect to the soil organic matter contents covering the four provinces (Benguet, La Union, Pangasinan and Tarlac), available quantitative values for specific soil types were not available. Most of the data were ordinal (high, moderate, low). However, even with such values, there is no standard system that is adapted by the Bureau of Soils and Water Management (BSWM). In the 5 Land Management Reports of BSWM, organic matter is variously categorized as follow:

Benguet	- no data
La Union	- adequate, marginal, low
Pangasinan	- medium, low, very low
Camarines Sur	- high, moderate, adequate
Tarlac	- no data

Quantitative values for organic matter content were reported for Tarlac, La Union and Pangasinan. However, only the La Union land management report had a quantitative equivalent as follows:

Organic Matter content (%)	Rating
> 3	Adequate
1-3	Marginal
<1	Deficient

Currently, BSWM uses the following categories:

Organic Matter content (%)	Rating
8-1	Adequate (Marginal)
<1	Deficient

The numerical equivalent of marginal is not included in the BSWM reports.

Under the United States Department of Agriculture (USDA) (Landon, eds. 1991), the organic matter contents converted from organic carbon values (x 1.72) are much higher:

Organic Matter content (%)	Rating
>34.4	Very high
17.2 - 34.4	high
6.88 - 17.2	medium
3.44 - 6.88	low
<3.44	very low

In the Agno River Basin, most of the quantitative values reported for organic matter fall below 4%. Organic matter content varies according to soil texture, landuse pattern and physiographic unit but the absence of such data presents a constraint towards accurately determining the K factor. In order to arrive at some estimate of K factor, several assumptions are made.

1. The rating on organic matter used in the La Union Land Management Report was adapted and adjusted to match the table of Mitchel and Bubenzer (1980).

2. The values of organic matter content from Mitchel and Bubenzer (1980) were giving some rating equivalent to BSWM system as follows:

Value	Rating (Adjusted)
<0.5 %	Deficient or very low
2.0 %	Low or marginal
4.0 %	High, moderate or medium

3. Although organic matter varies according to soil texture and physiographic unit, the absence of quantitative values for the study area makes it impossible to differentiate between differing physiographic units having the same soil texture. Therefore, the organic matter content for one soil type was assumed to be the same regardless of its physiographic characteristic.

4. Some of the soil texture types assigned to certain soils like undifferentiated mountain soils, rockland and complex were based the Land Management Project Reports (BSWM 1985a, b,c, d and 1987) wherein the location (with reference to soil maps) of the soils were matched with the physiographic units. The latter was described in some detail in the reports with corresponding information on soil texture and soil fertility parameters.

With the above assumptions, the following K factors have been generated for the Agno River Basin comprising four provinces:

Soil Texture	OM Content		K factor
Hydrosol (clay loam)	medium	4%	0.21
Loam	low	2%	0.34
Clay loam	medium	4%	0.21
Silty clay loam	medium	4%	0.26
Sandy clay loam	medium	4%	0.21
Gravel (silty) clay loam	low	2%	0.26
Sandy loam	medium	4%	0.24
Gravel (silt) loam	medium	4%	0.33
Silt loam	low	2%	0.33
Sand	low	2%	0.03
Beach sand	medium	4%	0.03
Clay	medium	4%	0.13
Mountain soils (clay)	medium	4%	0.13
Mountainous land (loam)	low	2%	0.29
Gravel (silt)	low	2%	0.42
Riverwash (siltloam)	low	2%	0.48
Complex (loam)	medium	4%	0.34
Fine sand	medium	4%	0.14
Fine sandy loam	medium	4%	0.16
Rockland (clay)			0.13
Undifferentiate soil	medium	4%	0.29
of Tarlac (loam)			

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