# Pricing of Grassland Resources in the Philippines: Rent, Grassland Degradation and Rehabilitation and Alternative Land Uses[1]

Department of Environment and Natural Resources

*Philippine Economic – Environmental and Natural Resources Accounting System*

*Environmental and Natural Resources Accounting Project*

*Supported by the*

USAID

United States Agency for International Development

# Pricing of Grassland Resources in the Philippines: Rent, Grassland Degradation and Rehabilitation and Alternative Land Uses[1]

ENRAP IV TECHNICAL PAPER

by

Herminia A. Francisco[2]
Merlyn N. Rivera
Enriqueta A. Perino
Levi V. Florido
Evangeline T. Castillo
Juan B. Ebora
Florita E. Siapno

January 2000

[1] This document was made possible through a grant provided by the United States Agency for International Development (USAID) under the terms and conditions of Contract No. 492-0465-C-00-4042-00. The opinions expressed herein are those of the authors and do not necessarily reflect the views of the USAID and collaborating institutions. This document may be reproduced or quoted in other publications as long as proper reference is made to the source.

[2] The authors (ERDB-PEENRA team) are researchers at the Ecosystems Research and Development Bureau. Dr. Herminia A. Francisco is a consultant of ENRAP and a faculty member of the College of Economics and Management (CEM) at UP Los Banos.

B

## Table of Contents



c

## List of Tables and Figures

# EXECUTIVE SUMMARY

Recognizing the need to reflect the true value of grasslands in the user's fee for this resource, the Ecosystems Research and Development Bureau (ERDB) in cooperation with the Philippine Environmental and Natural Resources Accounting Project (ENRAP) embarked on a project consisting of three components, namely: (a) Economic Rent of Grazing Lands (1997-1998); (b) Valuation of Grassland Degradation and Rehabilitation (1997-1999) and (c) Economics of Alternative Uses of Grasslands (1997-1999).

The results of the rent estimation provided the basis for the modification of the old DENR Administrative Order (DAO) that governed the use of grassland resources in public lands in the country. The significant changes in the revised DAO (DAO 99-36) include the increase in rental fee to P200-500 per hectare staggered over five years, the use of effective grazing area instead of total area as the basis of the fee computation, the use of a system of incentives amounting to as much as 80 percent deduction in the revised rental rate to encourage improvements in pasture management and soil conservation, and the commitment of the government to provide technical assistance on improved pasture management to the ranchers. The recommendations embodied in the DAO also incorporated some of the suggestions given by the concerned stakeholders through a series of regional and national consultations conducted by DENR.

The study on the valuation of grassland degradation and rehabilitation was carried out for two reasons: first, to assess if the rehabilitation of grassland resources is profitable on the part of the rancher, and second, to have some additional basis for rent adjustment. The first one entailed a comparison of the cost of rehabilitation and the damage from degradation which was successfully carried out in the study. The second required an analysis of the off-site cost of resource degradation. Due to data and time constraints, the study was not able to come up with this estimate. The results of the first effort show that for Classes A and B, the cost of rehabilitation is lower than the cost of degradation. This indicates that it pays to make the investment in rehabilitation efforts for these grassland classes. In the case of class C grasslands however, the land is so degraded that the cost of rehabilitation becomes prohibitive. It would appear then that the more logical approach is to consider alternative uses for this land class.

The third component of this project explored the profitability of the various land use options to which the grasslands may be converted, once government relaxes its provision on the use of this resource. The various uses considered include agroforestry system, agricultural crops, reforestation using fast growing species, and pastureland. The analysis revealed that the net returns from the various land use options were higher than what could be realized by retaining the land as grasslands. In particular, agroforestry and reforestation gave the highest net benefit of PHP 37,546.00 and PHP 12,263.00, per hectare respectively for Class A sites. Returns for these uses in Classes B and C were also highest. It would seem therefore that there are incentives to shifting to other land uses that may be allowed by the DENR for the use of its public lands. Note however that such a shift may not come that easy for the private rancher in view of capital constraints and the high capital tied up to pasture land. In addition, there are other societal considerations such as food security for the meat industry that will have to be considered. Hence, there is a need for a policy on this direction to be made in consultation with the other sectors of society, particularly with the Department of Agriculture which is responsible for the food security program of the country.

## 1.0 INTRODUCTION

Grasslands are lands with natural grass covers, devoid of trees or with very few isolated trees. They usually result from the clearing of a forest after several years of agricultural cultivation and are generally found in marginal areas. When used mainly to raise forage plants for livestock, grasslands are classified as pasturelands or grazing lands. Under PD 705, grazing lands are portions of the public domain which have been set aside in view of the suitability of their topography and vegetation for the raising of livestock (Malvas 1995).

The Philippine grassland ecosystem is highly diverse with some 380 identified grass species (Umali 1977 in Austria 1994). The most dominant species are *Imperata cylindrica* (cogon) covering a big part of the country's natural grassland vegetation, *Themeda triandra* (bagokbok), *Capillipedium parviflorum* (Misamis grass), and *Chrysopogon aciculatus* (amorseco) (Baggayan 1997).

Statistics on the total area of Philippine grasslands ranges from the Department of Environment and Natural Resources (DENR)'s low estimate of 1.5 million hectares (Malvas 1995) to the Department of Agriculture (DA)'s high estimate of 6.5 million hectares (Concepcion and Samar, 1995). The Philippine Council for Agriculture, Forestry, and Natural Resources Research and Development (PCARRD)'s estimate is around 5.1 million hectares (PCARRD 1983). The higher estimates presumably cover grasslands from both public and private lands while DENR reports only on public lands under its jurisdiction.

The Bureau of Soils and Water Management (BSWM), through the Provincial Land Resource Evaluation Project (PLREP), was able to gather data on the distribution of the grassland areas among the various regions and provinces. Appendix Table 1 shows the distribution of grassland areas under pasture lease agreements (PLAs) by region. Area-wise, Region II has the largest grassland area under PLA (29,713 ha) followed by Regions XI (22,779 ha), IV (20,844), V (17,179 ha) and X (15,836 ha). Region VIII has the least area under PLA. Concepcion and Samar (1995) notes that in general, more than 50 percent of the grasslands in the country is severely eroded of which Region 1 ranks first (91%).

This report is divided into six sections. The introductory section is followed by the discussion of the framework of the project where the methodology for each of the studies is also presented. The third section contains the review of literature, followed by the discussion of results in section 4. The highlights and recommendations are given in section 5.

### 1.1 Statement of the Problem

The country's grasslands suffer from low productivity. Many of these areas have been grazed on for so many years but have not been improved at all (Castillo 1993). The grassland soils are also generally acidic in nature and often deficient in nitrogen and phosphorus. This condition results from the intermittent leaching of the soil surface due to heavy rainfall and poor vegetative cover. As a result, the carrying capacity of the native grassland is considered very low at 0.50 animal-unit (au)/ha.[3]

[3] The introduction of improved or high yielding grasses and legumes containing high mineral and protein content is believed to be capable of increasing the carrying capacity of grasslands to 3 au/ha (Castillo 1991; PCARRD 1983; Alvares 1978). The use of high-yielding variety of grasses and legumes will also minimize the encroachment of weed species in the rangelands (Baggayan 1997).

There are several constraints to the adoption of improved management practices in the country's grasslands, among which are: a) the lack of access to source of and/or limited quantity of planting materials; b) high initial investment cost ranging from ₱ 7,000 to ₱13,000 per hectare for sown pasture; and c) lack of effective extension strategies (Moog and Castillo 1995). In addition, there are also some socioeconomic problems that discourage investment in pasture improvements. These include: a) conflicting claims on the use of the land from a number of government projects; b) no security of tenure; c) peace and order problems; d) squatting or encroachment; and e) capital constraints that cause ranchers to rely on the cost-saving but destructive practice of burning. According to Magcale and Galinada (1996), fire has been used as a cheap management tool in shifting cultivation since the early civilization.

The wrong price signals also lead to meager investment in pasture improvement. The very low price paid for the lease of the lands virtually makes the resource a free good— something that can easily be paid for even if the land is not operated at the optimum level. It is thus not surprising to note that although a big part of the leased property is not utilized for grazing, the lessee can still afford to pay for the right to gain control over the whole land area. This could only mean that at the current level of investment, the farm is already able to realize an adequate level of return, with the rents appropriated by the leaseholder himself. It is this current state of affairs that has motivated this research project. Specifically, the study aims to estimate what the appropriate rent should be for the use of the grasslands, particularly those found in public lands.

## 1.2 Importance of the Study

Setting the price of a resource to reflect its true value will not only allow the government to recover all or part of the rents totally appropriated by current leaseholders; it may also encourage investment in pasture improvement. This premise is based on the belief that a rational rancher will have to explore ways to improve the profitability of his farm operation, if he is to recover the full cost of his investment. Full cost pricing as a precursor to efficient utilization of scarce resources is a basic economic principle that guides the development of economic instruments in natural resource management. It recognizes that there exists a general tendency for users of any resource to extract from the resource excessively if they do not pay the full cost of their extraction activity. Rent seeking is a rational behavior and is a logical response to the price signal received by resource users. When this price signal is altered, resource users are expected to behave differently. Thus, the key is to provide them with socially optimal prices to effect the socially efficient level and type of resource use. Based on this premise, the project aims to determine the appropriate user fee for grasslands in the country– a fee that reflects the true worth of the resource to society.

Scarce commodities (good or service) that are priced lower than their true value tend to be used excessively. If this excessive usage also produces environmental damage or pollution, then, society is doubly disadvantaged— first, it is not able to use the resource in the most efficient manner, and second, irreversible harm may result from the excessive generation of the environmental pollutants. The environmental damages may be in the form of health impacts or reduced productivity of certain ecosystems that are important to the welfare of society. Given this situation, it is in society's best interest to price its scarce natural and environmental resources appropriately.

Correct resource pricing has been the central concern of the Philippine Environmental and Natural Resources Accounting Project (ENRAP) of the Philippines. With the Department of Environment and Natural Resources (DENR) as the implementing agency, this USAID-funded project started in 1990 (with initial focus on the forestry sector), and has since made significant contribution in efforts to incorporate the use (and misuse) of the environment in the standard accounting system of economic activities. The technical assistance provided by the Resources, Environment, and Economics Centre for Studies (REECS) and the International Resources Group (IRG) has brought to the fore the important role that environmental economics can play in resource and environmental management. Now in its last phase, ENRAP has commissioned this ERDB study to focus on the grassland resources. The study was conducted primarily by the researchers of the Bureau.

The design of any economic instrument necessitates the development of institutional structures for its implementation. Luckily in the case of the Philippine grasslands, the DENR has already been collecting lease payments for the use of grasslands in public areas through its Forest Management Bureau. A structure is already in place to do the collection, and with additional manpower, monitoring and technical assistance which are important activities in the proposed revised pricing scheme can be implemented.

As earlier pointed out, the current rate for the lease of Philippine grasslands is deemed too low when compared to:(a) the returns from land as an input into the production system; (b) returns from alternative uses of the land; and (c) the environmental costs of the use of the land. The project sought to consider these alternatives in deriving the appropriate payment due to the government for the lease of the grasslands.

## 2.0 RESOURCE PRICING FRAMEWORK

Hartwick and Olewiler (1998) noted that while appropriate fee setting is a difficult and politically sensitive task, the best way to move towards economic efficiency in grassland areas is to charge variable fees. The fee shall depend on regional climatic and productivity factors, season of use, access, species of livestock, and breed of animals. It is along this line that the Ecosystems Research and Development Bureau (ERDB) carried out this study on pricing public grasslands. Specifically, the ERDB considered the variation in agroclimatic condition, productivity factors, and market conditions, among others in estimating the rent for the country's grasslands. The team identified three classes of grassland areas with class A as the most productive resource category and C, the least productive.

The overall analytical framework is shown in Figure 1. The four circles show the components of the project which include: a) estimation of resource rent; b) estimation of environmental damages (limited to on-site production losses due to time constraints); c) analysis of the various resource rehabilitation schemes and corresponding costs; and d) economic assessment of alternative uses of pasture land, particularly in areas where pasture lease agreements (PLAs) have been cancelled. These various components made up the three studies (a, b+c, and d) that comprise the project.

The rent estimation study was completed in 1997-1998 and has resulted in the issuance of the DENR Department Administrative Order (DAO) 99-36 after a series of regional and national consultations with ranchers. The two studies—on resource degradation and rehabilitation, and on the economics of alternative uses of grassland areas, were conducted to support the need for changes in resource pricing in the sector. Information on the cost of degradation and rehabilitation is useful in the bid to encourage pasture lessees to adopt soil conservation practices. As expected, ranchers would only be persuaded to adopt certain practices that result in positive net benefit to them. If they bear the cost of undertaking soil conservation measures, they have to be assured of higher returns (net benefits in terms of damage avoided). Extending the analysis of damage assessment to include off-site cost (or cost passed on to other members of society by current users of the land) will result in subsequent rent adjustment by virtue of the "polluters pay" principle. The initial rent sans the environmental cost adjustment has already evoked an uproar from the affected party, so it may very well be prudent to go slow in further efforts to increase the rent paid by ranchers.

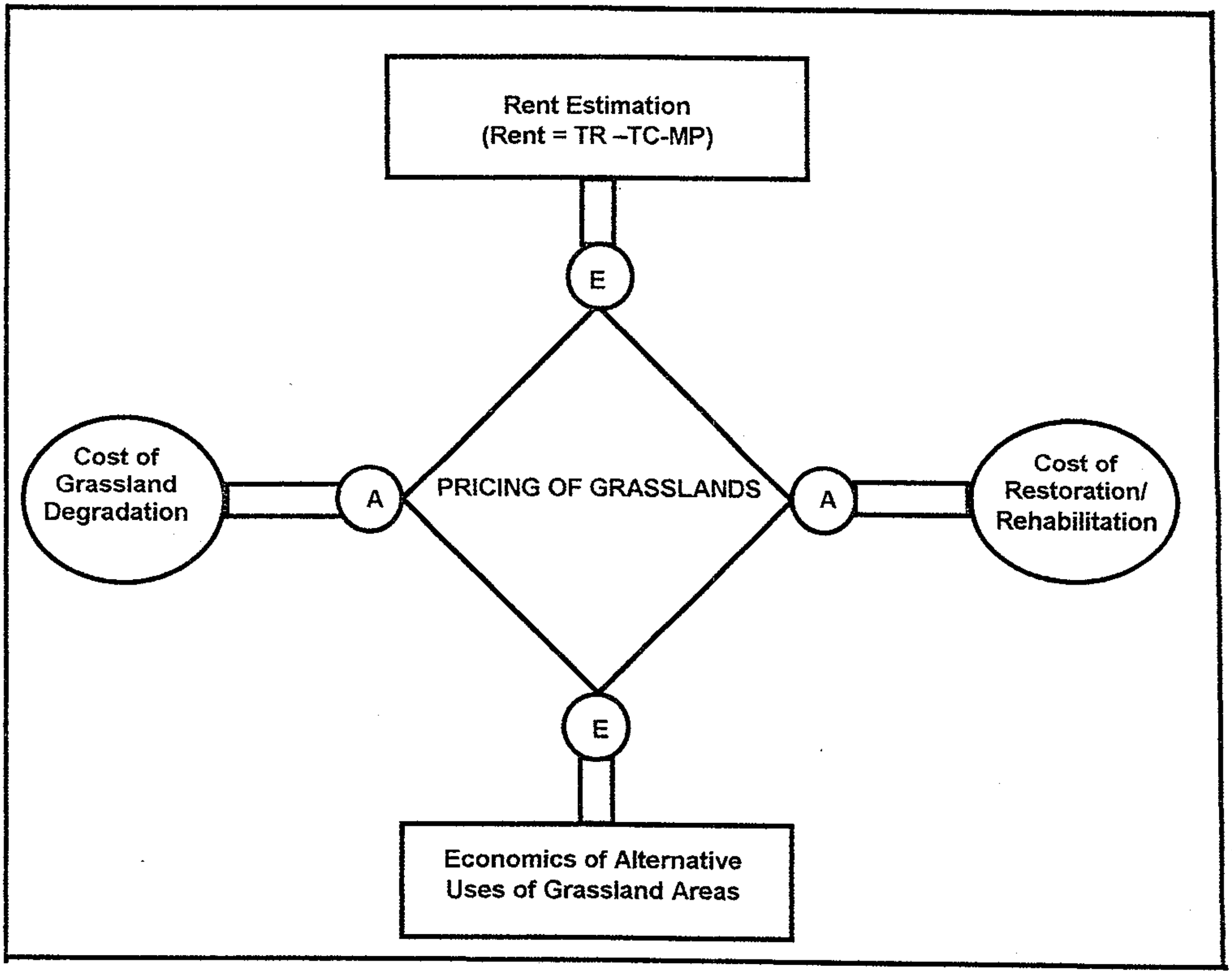



Figure 1. Pricing of Grassland Resources: Basic Considerations

The study on the economics of alternative land uses was carried out to determine the most profitable conversion plan for cancelled PLA. Furthermore, the Secretary of DENR has instructed the ERDB to explore other uses to which grassland areas may be put into that will not compromise environmental concerns. Thus, the alternative land uses considered were those that were also being promoted by DENR like reforestation, agroforestry and limited upland agriculture.

The succeeding discussion elaborates on the frameworks used in the various components of this study.

## 2.1 Rent Estimation

The price for the use of a natural resource is termed as rent. Rental payments for the use of land resources should reflect the returns for the use of the land in production (Barlowe 1972). Land rent is viewed as an economic surplus or that portion of the total returns that remains after payment of total factor costs. Total factor cost would include payments for labor, capital, materials and energy inputs used to convert the natural resource into a product. It also includes allowance for normal returns on investment. The remaining surplus is the payment for the remaining unpaid input in production—in this case, land (inclusive of the other natural and environmental resources found therein).

Land rent will vary depending on the productivity of the resource. Said variation in productivity may be represented by variation in the average cost of production—with the least productive area having the biggest average costs. In Figure 2, three land classes with different productivity levels are presented. Land class A with the lowest average variable cost (AVC) is the most productive of the three and land class C with the highest AVC is the least productive.

Given the same price, the more productive land area will earn a bigger rent. A major weakness of treating land rent as a residual surplus is that this assumes that returns on the other factors of production can be estimated accurately. In reality, what is reflected in the cost calculation are payments (accounting prices) or some imputed payments for the use of these inputs into the production process. To the extent that these values closely reflect the returns to the use of the inputs, then, the land rent estimate is close to the true value. The use of a reasonable margin for profit may also be deficient in cases where the farm is under superior management (Barlowe 1972). In this case, the land rent may be too high if the return to management is assumed to be the going rate.

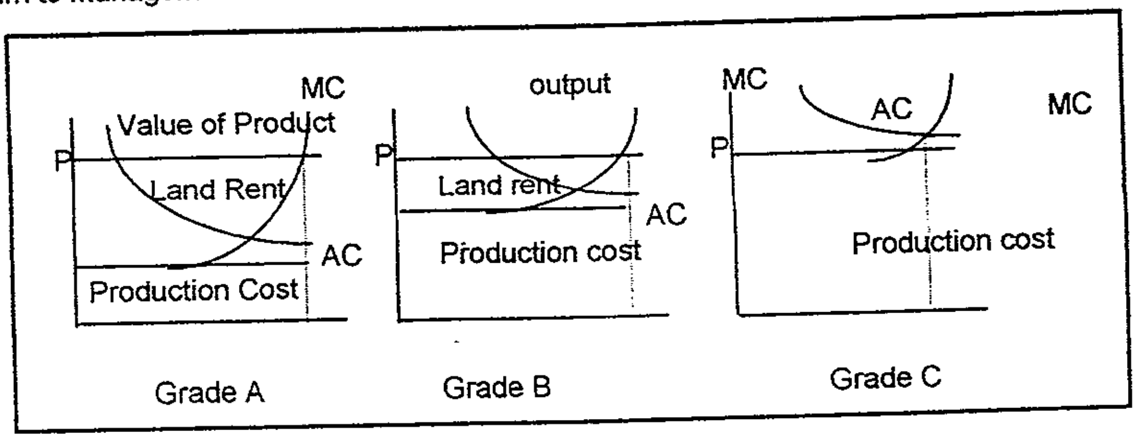



Figure 2. Rent of Pasture Lands with Varying Productivity

The above definition of land rent is consistent with Ricardo's classic formulation of the Rent Theory. For Ricardo, rent exists because soil fertility differs across land areas. He started his analysis by assuming a newly settled country with an "abundance of rich and fertile land, a very small proportion of which is required to be cultivated for the support of the actual population." He then argued that if only the most fertile lands would be brought into cultivation then no payment of rent would be associated with their use. Rents arise on these lands only when increases in population make it necessary for society to bring less fertile lands into use. If the owner of the less fertile lands is able to earn some profits to stay in business, then, the owner of the more fertile lands is expected to be earning a much higher profit. The difference in the profitability of the two farms, assuming that other things are constant, constitutes the land rent.

Ricardo's discussion of rent corresponds to returns from the perdurable matrix characteristic of the soil as discussed in the next section. Particularly, it pertains to returns to the land that results from the land's favorable location, fertility, climate and other natural endowments. The succeeding discussion will demonstrate that rent in Ricardo's sense needs to be adjusted further for other characteristics of the soil, particularly that which reflects soil depletion and that characteristic which requires farmers to adopt soil conservation practices or restoration/rehabilitation measures. Section 2.2 discusses rent adjustment due to soil depletion and Section 2.3 discusses rent and soil conservation.

## 2.2 Land Rent and Soil Depletion

To properly analyze land rent— that is, the income which can be taxed away without affecting output decisions— and how this can be adjusted to take into account the depletion of the resource, one must first examine four economic aspects or characteristics of land or soils given below:

***Perdurable Matrix (Flow Resource).*** This is a pure flow resource with a non-critical zone and it is often determined by location, climate, subsoil, drainage, inexhaustible nutrients, macro-relief and others. Under ordinary circumstances, the pure flow is enduring, permanent or non-perishable but it can be affected by human actions such as strip mining, flooding due to construction of reservoirs, paving, and so on. This characteristic of the soil gives rise to rent in Ricardo's sense.

***Conservable Flow (Flow with Critical Zone).*** The conservable flow element of soil takes some cost to keep it in its original state, but is often worth the effort because they often cost less than replacement cost and less than the present value of future income. Furthermore, measures to conserve this component of the land matrix often yields future incomes whose present value exceeds the present value of conservation costs. Examples of conservable flow elements are humus and thin topsoil. Liquidation of a conservable flow component of the soil is considered to be an "irreversible" loss, not because the soil cannot be rebuilt, but because it can never be rebuilt so cheaply compared to the cost of conserving the virgin soil.

The rent attributable to this soil characteristic is equal to the net income (including as a cost the normal rate of return) due to conservation of flow elements of the soil minus the conservation costs. This is the value that can be taxed away without affecting production decisions.

***Revolving Fund (Stock Resource).*** That element of virgin soil fertility that is not economical to conserve but is economical to replace or renew with materials imported from off-site is referred to as the revolving fund. Examples of revolving components are nutrients such as nitrogen and phosphorus that can be replaced by chemical fertilizers. Revolving fund components leave the soil and become embodied in crops and livestock.

That income imputed to the revolving fund is not part of the rent but is computed as a return to an improvement to the site, analogous to the return on capital.

***Expendable Surplus (Finite Fund).*** The expendable surplus is similar to the perdurable matrix except that the former is infinite while the expendable surplus is a finite stock. The expendable surplus is often very large and hence, its non-use value is very low and hardly perceptible.

They are often not economical to replace when they are expended. Unlike the perdurable matrix that is infinite and hence, all income accruing to it is rent, the expendable surplus is finite, necessitating that a depletion charge be subtracted from the imputed income. Rent is equal to the imputed income minus the depletion charge (van Kooten and Bulten, 1998).

## 2.3 Cost of Grassland Degradation and Rehabilitation

The preceding discussion shows that land rent can also be adjusted to take into account the soil conservation (soil restoration) efforts done in the land resource. This adjustment is particularly necessary for the conservable flow component of the soil.

Investments in range improvements can enhance the productivity of both forest and open grasslands. These investments include prescribed burning, seeding with improved forages, and physical structure. Along with herd management (distribution and duration of grazing), investments can increase the output of the livestock sector. An economic analysis of rangeland investments is needed to determine those practices that yield net benefits to the private land cultivator and to society.

**Valuation of Grassland Degradation.** Valuation of on-site degradation was estimated based on the value of lost animal production due to low forage productivity. Lost animal production was computed based on what the difference in herbage yield (HY) between degraded pasture and the non-degraded pasture could have supported given an average herbage consumption of 25,000 kg/animal/year[4].

Ideally, the valuation of off-site effects of degradation should be based on the costs of damages and losses resulting from the erosion or sedimentation of rivers, of which grazing areas are contributory units. Amount of sediments in river systems involved may be determined and expressed as percent of total sedimentation of the whole watershed area. Reduction in the amount of services to be rendered by downstream infrastructures such as dams may then be valued according to the market price of such goods and services. Unfortunately for this study, time and budget constraints prevented the estimation of this off-site costs. Furthermore, the sample sites do not happen to drain into the major river systems and hence, no infrastructures were affected.

**Valuation of Grassland Rehabilitation.** Rehabilitation of degraded grassland can be done by fertilization, introduction of improved forage species, reforestation and adoption of appropriate biological and structural measures.

Fertilization costs may be computed based on the required amount or level as per the results of soil analysis done between degraded and non-degraded area inclusive of the labor costs of application. Reforestation costs shall be based on the local cost data and the requirement of the site. The cost of introduction of improved forages and other biological and structural measures shall also be based on local prices of materials and labor, as well as, on the degree of degradation of the site.

---

[4] Herbage production can be converted to equivalent animal unit using this formula:

a.u.= (Fresh weight of herbage per hectare X 0.54)/25,000

Perino et al. (1999) discussed the detailed methods/approaches used in the collection of each parameter in a separate report.

## 2.4 Rent and Alternative Uses of the Land

Land resource can also be valued in terms of its opportunity cost—measured in terms of what the land could have earned in its next best alternative use. Retaining the land as pastureland would mean foregoing what the land resource could have earned if used differently.

Land is an important factor input in many economic activities such as agriculture and forestry; residential, commercial and industrial uses; and mineral exploration. It also supports an enormous variety of ecosystems (Hartwick and Olewiler 1998). With various land uses, one is faced with the problem of how the land should be used. Theoretically, the optimum use of the land is that which yields the maximum rent. Assuming that there is no restraint on the use of the land, the area kept as pastureland should depend on the relative value of grasslands as pastureland when compared to its alternative uses.

The decision may also be one of identifying the combination of land uses that yields the maximum rent when multiple-use policy becomes the norm. Forestland often provides a combination of products coming from uses such as timber production, grazing, wildlife preservation, agricultural cultivation, and water production. Some of these uses are complements such as wildlife preservation and water production; they could also be competitors in the case of timber production and wildlife preservation.

**The Opportunity Cost Method.** This method evaluates benefits in terms of the opportunity costs associated with the resource use vis-a-vis different levels of alternative uses for the same use. Opportunity costs can be measured in two ways (Mathur 1978):

a) as foregone income or loss in income or revenue, on account of the present use or level of use instead of an alternative use or level, on the assumption that benefits from present use equal this loss in income; otherwise, it would not have been taken up.

b) as savings in cost, made by taking up the present use or level of use instead of an alternative use or level, on the assumption that benefits from the present use equal this cost saving; otherwise it would not have been taken up.

For property valuation purposes, a capitalization formula is commonly used to indicate the discounting of expected future annual net rents that takes place in the computation of land values. The formula may be expressed as:

$$V = \frac{a}{(1+r)} + \frac{a}{(1+r)^2} + \ldots + \frac{a}{(1+r)^n}$$

*where:* V = the value of the property;
a = the expected average annual land rent; and
r = the capitalization interest rate.

This formula reduces to V = a/r.

Modifications are needed in situations where the land rents are expected to change over time (either increase or decrease) or when they are expected to continue for only a limited number of years. In the first situation, the appraiser needs to adjust the estimate of the average annual land rent to take these expected changes into account; or he may shift to use the modified capitalization formula given below (Barlowe, 1972).

$$V = \frac{a}{r} + \frac{I}{r^2}$$

In the modified formula, the notation "a" represents the average annual land rent currently received by the property while "I" represents the average increment of increased or decreased return that is expected to result from more intensive use of the land.

The expected future flows of net land rents associated with various land uses also provide an incentive and a guide for investments in existing and possible future land resource developments. When operators consider the prospect of undertaking new land developments, they ordinarily visualize a future payoff. They assume that the developments under consideration will produce sufficient additional return to the land resources to at least repay their cost.

***Evaluating Land Use Options.*** Land evaluation is the process of assessing land performance when used for specified purposes. However, performance can be assessed only when specific land purposes have been defined.

Evaluating proposed development from the standpoint of the prospects for producing a surplus of economic returns or benefits above their expected costs is important. Barlowe (1972) gave four different approaches that can be used to indicate the relative desirability of single or alternative projects:

a. The first approach measures the net economic benefit or return but gives no weight to the relative costs incurred in each case.

   Net Economic Benefits = Total Benefits – Total Costs

b. The rate of net return may be measured given the expected total costs outlay. Total costs are subtracted from total benefits and the difference is divided by the total cost to get a percentage rate of return.

$$\text{Percentage Rate of Return} = \frac{\text{Total Benefits} - \text{Total Costs}}{\text{Total Costs}}$$

c. The present value of the total expected benefits is divided by the present value of the expected costs to provide a benefit-cost ratio. A positive ratio (>1.0) indicates that a project proposal is economically feasible in the sense that it promises to produce benefits in excess of its costs used in benefit-cost analysis.

$$\text{Benefit-Cost Ratio} = \frac{\text{Present Value of Expected Benefits}}{\text{Present Value of Expected Costs}}$$

d. The present annual value of the expected operating costs is subtracted from the present annual value of the expected benefits, and the difference is divided by the present annual value of the project investment costs to provide a rate of return on project investments.

*Rate of Return on Project Investment Costs*

$$= \frac{\text{(Present Annual Values of Expected Benefits)} - \text{(Present Annual Value of Expected Costs)}}{\text{Present Annual Value of Project Investment Costs}}$$

## 3.0 REVIEW OF RELATED STUDIES

The review of literature is organized based on the three main issues of this pricing study, namely:

a. grassland degradation
b. investment in range improvements
c. alternative uses of grasslands

### 3.1 Grassland Degradation

In addition to low productivity, grasslands can also be suffering from excessive soil erosion. Overgrazing results in trampling and the removal of natural vegetative groundcover, hence, exposes the soil and causes soil compaction and/or erosion (Rosario 1995, as cited in Padilla and Medrano 1996).

Grazing animals affect pastures by defoliating, trampling and excretion. Each factor affects herbage production, herbage quality and botanical composition that in turn affect animal behavior and productivity. Other critical factors that significantly affect the productivity and composition of pastures are climate and soil. The influence of the climate is particularly important since both seasonal and annual differences determine the amount and quality of feed available, and thus affect animal output (Padilla and Medrano 1996).

***Causes of Soil Degradation.*** There are two types of grasslands in the Philippines. The first type is the natural grassland that is produced by the given climatic and edaphic conditions suited only to grassland vegetation. The second type is the anthropogenic grassland that results from man's activity.

Sanchez et al. (1992) reported that land degradation in Kenya could be due to: a) physical causes, which are soil compaction and erosion; b) chemical causes such as increase in soil acidity and decline in available nutrients; and c) biological causes, meaning degradation due to loss of microsymbionts and encroachment of weeds.

Deforestation is one of the major activities that contribute to increased grassland areas in the country. Udarbe (1992) and Onodera (1992) listed the environmental impacts of deforestation to include soil degradation, impairment of water retention capacity, loss of biodiversity and climatic change. Some indirect impacts are loss of income and unbalanced economic development. Gadrinab (1989) reported that poor land resource allocation, persistent destruction of forest, and cultivation of steep lands in two watersheds in Bukidnon have resulted in severe soil losses. For the Muleta watershed, he reported that an estimated 11 megatons/year of soil were lost while for the Manupali watershed, soil loss was estimated to be 14 megatons/year. Among the different land uses, grassland areas were found to be the most erodible in those watershed areas.

According to Attaviroj (1990), the most significant on-site effect of soil erosion was loss of soil fertility. This resulted from the depletion of organic matter and decreased availability of phosphorus, nitrogen and potassium and other trace elements. Increased bulk density and decreased infiltration rate were also found in these areas. He also found that there were serious off-site effects when siltation downstream caused the lowering of the water level in reservoirs, depletion of hydroelectric capacity, degradation of drainage system, and consequent flooding that impeded shipping operations.

***Valuation of Soil Losses.*** Soil loss is the amount of soil moved from a general area or field while the amount of soil formed at a specific point is called sediment yield. Soil erosion is an on-site process that can have on-site costs while sediment yield is off-site which may also entail off-site costs. According to Francisco (1986), the Magat watershed area had an estimated average sheet erosion rate of 51.79 tons/ha/yr, representing 30 to 40 percent of the gross soil loss in the area. Using the replacement cost approach to estimate the cost of soil lost, she reported that the cost of a ton of soil lost is estimated to be worth ₱12.85 of inorganic fertilizer consisting of 2.3 kg urea, 0.80 kg super-phosphate and 0.56 kg muriate of potash (1985 price). For the entire watershed, soil loss can cost ₱274.38 M worth of inorganic fertilizer. She reported that the off-site costs from sedimentation damages were computed from the reduction of the reservoirs' service life. The cost was computed based on the NPV of irrigation and power benefit lost due to reduction in service life. It was estimated that a ton of sediment could cause a loss of ₱0.41 worth of irrigation and power benefits. With a sediment rate of 34.5 tons/ha/yr for the entire watershed, the yearly loss due to sedimentation amounted to ₱5.42 M. The off-site damage cost per hectare was estimated to be ₱13.15.

For the Muleta and Manupali watersheds in Bukidnon, Gadrinab (1989) used the replacement cost approach to compute for the on-site cost of erosion. He reported that forested lands had the highest replacement costs per hectare per year while the lowest was from the grassland area of Muleta. For the Manupali watershed, cornfields had the highest replacement costs while grasslands had the lowest. Although forested areas had the lowest erosion rate, it had the highest replacement costs due to the high nutrient loss. Forest soil had the highest NPK content per ha-cm.

In the Philippines, 80 percent of total loss in rice production was due to siltation and flooding in the lowlands (Pantastico and Cardenas 1980). In Pangasinan, continued pollution in the uplands of Agno and Bued River System resulted in the destruction of agricultural lands and crops estimated at ₱200 M every year (Velasco 1984). From 1986-1987, NIA spent a total of ₱3, 337,462 for the desiltation of canals. An additional ₱24 M is needed to desilt 19 km of silted irrigation canals, 60 km of that have become inoperable due to siltation.

Srivardhana (1986) undertook an off-site valuation of reservoir storage loss in Thailand. He explained that the annual economic losses caused by reservoir sedimentation could be estimated by computing the economic value of the reduction in reservoir outputs for electric energy, irrigation water, and flood control and fish production using applicable market prices. Attaviroj (1990) made another off-site valuation of another watershed area in Thailand. He found that with an assumed water allocation for irrigation of 2,500 $m^3$/rai of cropland, the reservoir storage depletion represented a potential loss of 7,272 rai of irrigable land per year (18.18 multiplied by 106/2,500). The income lost from irrigated rice crops was estimated at 552 baht/rai for a total of 4.01 million baht/yr. In the case of depletion of hydroelectric capacity, he estimated an annual loss of 1.706 million kWh. At a value of 1.50 baht per kWh, the loss would amount to 2.559 million baht/yr which when accumulated for 15 years, would total 38.385 million baht.

Sinden (1990) reported damage costs of land degradation in Australia. Soil erosion costs were estimated using the decline in wheat yield. This method was also used by Girt (1990) in Canada. Soil acidity cost was based on the neutralization of acidity using lime. In the Australian study, damage costs from sedimentation represent the amount of money spent to remove wind and water-borne sediment from roads and culverts and to repair other facilities damaged by sedimentation. In addition, lost fisheries production is also valued.

In Mali, West Africa, Bishop and Allen (1989) estimated on-site costs of erosion based on the net farm income foregone (CPA ha/yr) resulting from every yield penalty. Sinden (1990) estimated the costs of soil degradation in New South Wales, Australia using a system modeling approach. This approach generally follows the procedure of first selecting a conservation program or flow of goods and services and monitoring changes in the condition of natural resources that follow restoration or degradation. The next step is the calculation of the values of costs and benefits of a specific restoration program based on physical changes and financial data. Values of damage functions are derived from physical functions. This approach uses the procedure that may be summarized using the Natural Resource Damage Loss Equation (NARDLEs) which is:

$$\text{Cost of Degradation} = \text{Physical Decrease in Output} \times \text{Value of a Unit of Change in Output}$$

$$\text{Value of Restoration} = \text{Physical Increase in Output} \times \text{Value of a Unit of Change in Output}$$

***Forage Degradation.*** Grazing lands subjected to severe animal utilization or overgrazing can be easily degraded over a short period of time. Native grassland areas have very low productivity and improper utilization of such areas with unregulated grazing systems can lead to a more degraded condition in which productivity is severely affected. The seasonality of growing activities due to local climatic condition characteristics and the poor soil conditions of most grazing areas are major factors contributing to their vulnerability. Heavy and continuous grazing definitely leads to the decline in forage production as reported by Alderfer and Robinson (1947). Overgrazing is also known to reduce the amount of root growth and root density. Palis (1995) reported that forage vigor and production of some species could be sustained if grazing is conducted at a 60-day interval.

According to Mott (undated), only a small portion of biomass should be utilized in order to avoid irreparable damages to forage production. Overgrazing inhibits the vegetation to re-grow because the roots of the plant cannot develop properly and cannot go deep in the soil due to compaction which also results in the reduction of the soil retention capacity (Mishua and Santra 1996). The reduction of forage production and botanical composition as a result of grazing is also caused by selective consumption and the higher intensity of utilization of the more preferred and palatable plants, and the avoidance of other less preferred species which could lead to retrogression (Duffey, et al. undated). High intensity of utilization can affect production directly through the loss of photosynthetic tissues, meristems and propagules and indirectly through reduction in root growth and carbohydrate reserves.

Degraded vegetation exhibits an altered composition, and low vigour, density and cover. The aboveground biomass of degraded vegetation is 4-6 times lower than that of the underground. The palatability and nutrient status of forage from degraded vegetation is also lower (Kumar 1992).

## 3.2 Investment in Range Improvements

Philippine grasslands, either natural or those that follow deforestation, constitute a major land resource. It is ideal to allow clear-cut areas to grow back into a forest, but this will require a massive scale of resources and effort.

Several studies on pastures (Magadan 1974; Montemayor 1974; and Marban 1995, as cited in Bondoc 1995) have reported the wide variability in PLAs in terms of farm size, soil conditions and slopes across extensive grassland areas. Local pastures have variable herbage productivity but usually with low dry matter yields and short maturity period. While predominant species of *Themeda triandra* and *Imperata cylindrica* species are able to adapt in deteriorated soils, this is usually a temporary condition. Soil deficiencies were also detected for some nutrient elements such as phosphorus, magnesium, copper and zinc. These deficiencies hamper attempts to improve pasture yields.

Marban (1995) reported that local pasture herbage yields ranged from 10 to 15 t/ha (fresh wt) that supported only 0.1 to 0.3 animal unit (au) per hectare or a carrying capacity of 0.8 to 1.4 au/ha in ranches with slope of 15 to 47 percent. Intensive pasture management of grasses and legumes, and utilization of by-products from rice, corn and sugarcane farming promised to increase the carrying capacity up to 4 au/ha.

There are a number of management practices that can enhance the productivity of rangelands. Seeding of forest clear cuts to forage is one possibility. Although native forage is available on clear cuts, there are benefits to seeding domestic species. In addition to such benefits as erosion control, increased soil fertility and mitigation against weed invasion, seeding of domestic species increases the productivity of the range for cattle. Studies of burn sites for example found that yields on seeded sites reached 3,400 kg/ha as compared to only 1,300 kg/ha on sites left to regenerate on their own; undisturbed sites yielded about 500 kg/ha. However, there is little information concerning the biophysical aspects of seeding clear cuts, let alone economic feasibility (Hartwick and Olewiler 1998).

Based on the low productivity levels of local pastures and the diverse ranching conditions nationwide, it is anticipated that the implementation of a common pasture improvement plan for all grasslands will entail large investments but this should be encouraged. Bondoc (1995) found that greater profitability was obtained from small-sized leased pastures (about 78 ha) than from either medium (137 ha) or large (412 ha) sized pasture-leased areas.

***Rehabilitation measures.*** The rapid degradation of grassland areas is primarily due to ill-managed grazing activities and extreme climatic condition. Restoration of the land to a more productive state requires realistic and effective methods and strategies. Different soil conditions, climatic types, topographic status and even the conditions of land degradation require different rehabilitation approaches. These approaches include vegetative and engineering measures and fertilizer application.

1. *Vegetative Approach*

Vegetative measures as means of rehabilitation include the introduction of improved grasses and legumes and reforestation of sites not suitable for other land use or grazing use.

Reforestation in heavily disturbed and degraded sites of Carranglan, Nueva Ecija was conducted in 1976. Of the 20 species examined for adaptation, *Acacia auriculiformis* had the best growth followed by *Gmelina arborea* (Sakurai, et al. 1992). In a related study of the same species at the same sites, de la Cruz (1992) reported the effect of the two species on the microclimate and soil changes. She found that the more abundant foliage and deeper crown cover of *A. auriculiformis* brought about improved microclimate while the N-fixing ability of the species contributed to the improvement of soil. *Gmelina arborea* contributed to the modification of soil condition due to its faster decomposition rate but only to a lesser extent compared with *A. auriculiformis*. Sanchez et al. (1992) reported that the establishment of *Acacia mangium* in some *Imperata* grasslands in the Philippines had been successful but constraints lay in the susceptibility of this species to fire.

Ipil-ipil is also found to thrive well in most Philippines soils and hence is a good candidate for rehabilitation. Oakes (1968) as cited by Ecuacion (1985) stated that its advantages over other species were due to its N-fixing ability, higher organic matter content contribution and its deep rooting characteristics that could penetrate even compacted soil.

Native grasses are low-yielding and also contain low nutritive values, being the product of poor soil condition and extreme climatic condition. Its low productivity provides less feed supply for animals and poor cover for the soil during heavy rains, resulting in soil losses and degraded condition. It had been reported by PCARRD (1976) that native pasturelands have a very low carrying capacity of about 0.25-0.5 a.u.

Increase in the stocking rate requires augmenting the forage yield through the introduction of improved grasses and forages. The important species selection criteria needed to turn a degraded pasture into a productive one include: a) tolerance of grasses and legume forages to acidic, less fertile and drier condition; b) high yield; c) high moisture value; d) palatability; e) soil fertility enhancing ability; and f) soil protection capability. Palis (1977) found that *Para grass + stylo and Kikuyu* were among the top forages that could reduce soil losses. The introduction of legume forage can help alleviate the low productivity of degraded pasturelands. It can increase soil fertility due to nodulation and N-fixation without inoculation. Legume forage also possesses deep roots and can tolerate drought (Aresta, et al. 1996).

2. *Engineering Approach*

Hedgerows, fascine, bench brush layers and wattling are applied for slope stabilization. Wattling is used for trenches and gully formation. Brush cover or matting is used for complete soil surface protection and is found to be the most stable among the live structures and is suitable for steep slopes and unstable soils (Agpaoa, et al. 1975). Jasmin and Martin (1984) reported that in sites where vegetation cannot be easily established for prompt erosion control in severely eroded areas, engineering structures may be used. Among the engineering structures tested, the use of check dams is among the most effective in stabilizing gully formation. However, the rock check dam is more expensive than the brush check dam and is also effective for gully stabilization.

3. *Vegineering Approach*

A combination of vegetative and engineering measures can be used in grassland rehabilitation. The vegineering approach utilizes the capability of both vegetative and engineering structures to control erosion. Continuous soil movement from the up-slope cannot be totally controlled by engineering structures. The soil binding capability of plant roots is also necessary to accomplish the purpose. Among the effective structures tested, sodding was not only effective but also cost-efficient.

#### 4. *Fertilization Approach*

Fertilization of forages at appropriate levels can result to high herbage production. This was found by Aresta et al. (1996) in his study in Cagayan Valley. He reported that stylo fertilized with 90 kg NPK/ha gave the highest herbage production rate of 52.2 kg/ha/day or dry matter yield average of 3.13 tons/ha every 60 days. This was compared with 30 kg NPK/ha and 60 kg NPK/ha that produced lower yields. Stylo planted in Palawan significantly resulted in a higher yield when fertilized with 50-100- 50 kg/ha of NPK.

Schofield and Endeavour stylo were the most productive legume forages tested producing 50 tons/yr when fertilized (1976). Phosphorous fertilizer should be applied within the range of 50-250 kg/ha/yr to attain desirable results (Cabanayan 1981).

***The Costs of Rehabilitation.*** Moog and Castillo (1995) estimated the costs of introducing improved grasses and legumes to range from ₱7,000/ha (for overseeding legumes) to ₱13,000/ha (for sown pasture). Reforestation costs, according to PCARRD (1982), were estimated to be ₱1,357.00/ha (1980 price). To fertilize an average number of seedlings of 2,500/ha with 20g application per seedling, one bag of fertilizer of 50 kg will be needed per hectare (Agpaoa, et al.1975). At the current price of ₱ 375.00 /bag of NPK, the cost of fertilization per hectare is placed at ₱375.00 /ha using 1975 prices.

### 3.3 Economic Valuation of Alternative Uses of Grasslands

Most land areas are suited for a variety of uses as reported by Lal (undated). In the absence of a definite system indicating the importance-priorities of various types of land use, it is not unusual to find wide differences in individual choices concerning the uses to which different areas are put. Rational landowners will use their land resource for those purposes that promise them the highest return. In this respect, they tend to allocate their land resources in accordance with the concept of highest and best use.

Land use planning should aim at identifying the "best" use of land given societal objectives and the prevailing agroecological and socioeconomic conditions of the area.

Forestland use is an economic issue, as each land use decision will have economic costs and benefits. When forests are logged, degraded or converted to other uses such as agriculture, important environmental functions and resources are lost, perhaps irreversibly, such as NTFP (non-timber forest products), the watershed functions of a tropical forest and biodiversity. This does not mean that preservation or conservation is necessarily the best economic option. What is important is for all the benefits and costs of each land use option to be accounted for, so that the best use of a given forest area might be determined. This requires a comprehensive social cost-benefit analysis which takes into account the full range of benefits and costs, social and environmental associated with each land use option (IIED 1994). In addition, the impact of alternative land uses on the welfare of the communities should be a central factor in investment decisions.

Calub (1995) pointed out that economic returns from grasslands are marginal but alternative uses such as reforestation may not be better, especially in highly acidic soils. In such circumstances, ranching may still be an economically important land use option, given minimal support such as liberal credit terms.

## 4.0 DISCUSSION OF RESULTS

This chapter first describes the administrative setup for charging resource user fee for grasslands in the Philippines. It then presents the results of the rent estimation analysis using survey data on 90 pasture farms in the country. Subsequently, it discusses the results of efforts to measure the environment damages associated with pasture farming and the cost of rehabilitation of degraded grasslands. The next part focuses on the findings of the economic analysis of alternative uses of grassland areas, particularly relevant to cancelled pasture lease areas. Finally, an assessment is made of efforts to institutionalize ENRA (environment and natural resource accounting) principles and approaches into the activities of the Ecosystems Research Development Bureau (ERDB).

### 4.1 Institutional Structure Governing Management of the Country's Grassland Resources

The management and control of the country's grasslands is vested on the DENR, particularly, in its Forest Management Bureau (FMB). As mandated in PD 705, the DENR shall ensure that no forestland 50 percent in slope or over is utilized for pasture purposes. It shall also determine the size of the forest pastureland and decide on other special uses that can be allowed therein. The law also states that pasturelands in the forest shall be maintained and managed to prevent environmental degradation and destruction (Lina and Nuque 1996).

The DENR regulates the use of public grasslands through lease agreements and permit systems. The term of the lease is 25 years, renewable for another 25 years. A permit is issued yearly when the lease contract is not yet approved. The size of the lease area ranges from 50 to 2,000 hectares. The DENR may also declare a portion of the grassland as Communal Grazing Land upon representation of the community. In 1995, there were 713 grazing lease agreements granted by DENR covering 252,000 hectares. Individuals and corporations are awarded Pasture Lease Agreements (PLAs) or Forest Land Grazing Lease Agreements (FLGLAs). Based on DENR records, a total of 661 lease agreements covering 314,300 hectares have already been cancelled (Malvas 1995).

The DENR can also decide on the alternative uses of the grasslands that have already been evaluated as unsuitable for grazing purposes. Alternative land uses may be as tree farms, industrial tree plantations, integrated social forestry projects, or other government projects depending on the needs and suitability of the area. The same land uses are being considered in cancelled leased areas.

The issuance of the lease or permit necessitates that DENR, through its Land Capability Survey Team, be able to determine first whether the area applied for is suitable and available for leasehold. Once established, the applicant has to submit: a) an application fee; b) affidavit certifying that the applicant is the legal party wanting to develop the land; c) cash bond deposit; d) proof of capitalization; and e) a seven-year management plan for the use of the area. Once approved, the lease agreement will be executed between the lessee and the government, represented by the DENR.

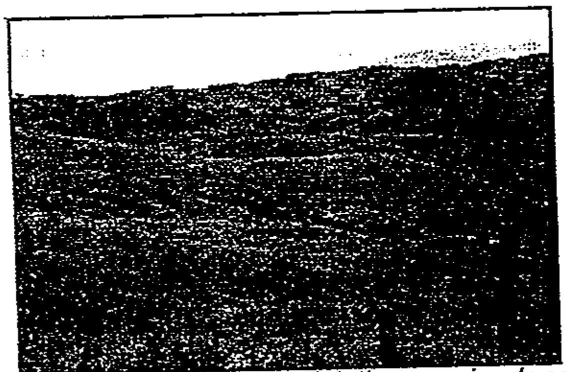
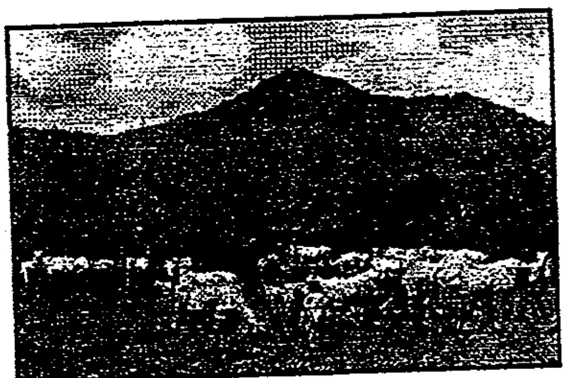
The contract specifies the amount of the annual rental, as well as, the terms and conditions of the agreements. In his paper, Malvas (1995) listed these conditions to include: a) introduction of high-yielding varieties; b) reforestation of 10 percent of the leased area; c) practice of rotation grazing; d) fencing the area's perimeter; e) protection of the area from squatters; and f) practice of improved grazing practices. The DENR, through its Land Capability Survey Team, is tasked to monitor the extent to which these conditions are being met. But the limited capacity of the government for monitoring and enforcement makes these conditions virtually non-enforceable.

Table 1 shows the leading regions and provinces in terms of the number of grazing leases and permits. Southern Tagalog has the highest number and the largest area of grasslands, a big part of which is found in Mindoro Occidental (Moog and Castillo 1995).

## 4.2 Rent Estimation for the Country's Grasslands

Rent collected by the government for grassland resources has been historically low with a one-time rate remaining unchanged for more than 40 years. From 1939 to 1982, the rent stayed at P0.60 per hectare per year for 1st class, P0.30 for second class and P0.25 for 3rd class. An adjustment was made in 1982 which lasted until May 1993 for a fixed fee of P1.00 per hectare per year, regardless of class. This fee was further adjusted to reflect differences in productivity across climatic zones. For 1st climatic type, the fee was increased to P15.00 per hectare per year while all other zones had P20.00 per hectare per year. This fee structure lasted until August 1999. With the approval of the recommended schedule of fees by the ERDB-ENRAP team, the revised guidelines on rental of pasture land took effect in August 1999. The succeeding discussion presents the process and the results of the rent estimation study conducted by the team.

The ERDB team launched a nationwide survey of representative pasture lease areas from January to April 1997 covering 90 representative ranches. This number represents 12 percent of the total lessee population nationwide and was taken from 13 provinces representing three climatic types (I, III and IV)[5]. The sample ranches were further categorized by productivity classes as defined using key parameters such as ranch size, rainfall, topography, soil fertility, water supply availability, accessibility, and forage productivity. The various parameters were consistent with those that were used in the Grazing Land Classification of 1939, with some minor modifications. In particular, ranch size was added while soil fertility and soil compaction were used in place of soil depth and soil texture, respectively. The group also included an index of vegetation yield potential for native and improved pasture areas. The relative distribution of the sample ranches into the Grazing Land Classes is shown in Appendix Table 2.

*Existing grazing lands under lease agreement.*

[5] The sample provinces were: Climatic Type I-Mindoro Occidental, Zambales, Nueva Ecija, and Palawan; Climatic Type III-Bukidon, Misamis Oriental, Ifugao, Masbate, and Nueva Viscaya; Climatic Type IV- Isabela, Cagayan, South and North Cotabato.

The financial profitability of the sample ranches was estimated and after a 30 percent allowance for margin for profit and risk, the following rent estimates were obtained: ₱ 542/ha/yr for Ranch Class A, ₱484/ha/yr for Ranch Class B and ₱358/ha/yr for Ranch Class C.

Table 1. Leading regions and provinces in number and area of grazing leases and permits

| Region/Province | Number/Rank | Area('000ha)/Rank |
|---|---|---|
| Region | | |
| Southern Tagalog | 177/(1) | 61.9/(1) |
| Cagayan Valley | 172/(2) | 55.0/(2) |
| Bicol | 108/(3) | 37.8/(4) |
| Northern Mindanao | 93/(4) | 29.05/(5) |
| Southern Mindanao | 80/(5) | 44.2/(3) |
| Province | | |
| Mindoro Occidental | 108/(1) | 42.2/(2) |
| Masbate | 101/(2) | 33.9/(3) |
| South Cotabato | 76/(3) | 42.8/(1) |
| Isabela | 70.4/(4) | 22.2/(5) |
| Bukidnon | 63/(5) | 27.0/(4) |

Source: FMB Statistics

The research team presented the results of the study to the DENR technical and field personnel for validation of both the findings and the methodology adopted by the group. After a series of discussions, the results were presented to the ranchers through regional and national consultations. After thorough consultations with the ranchers, the following agreements were reached:

a) That the rent payment will be reflected as a form of government sharing in return for the use of the land instead of being referred to as a lease payment. Consequently, the current Pasture Lease Agreements (PLA) shall be converted into a profit-sharing agreement during the transitory period;

b) That there shall be an assessment of the government share every five years to be conducted by a multi-disciplinary team;

c) That only the effective grazing area shall be subjected to the government share;

d) That there shall be incentives for adoption of improved management practices and soil conservation measures that will amount to a maximum score of 80 percent of the payable amount of government share;

e) That the government share shall be imposed on a staggered basis based on the following payment schedules:
Year 1: P200 per ha per year
Year 2: P275 per ha per year
Year 3: P350 per ha per year
Year 4: P425 per ha per year
Year 5: P500 per ha per year

f) That the government (as represented by the DENR) shall provide technical and management assistance to the leaseholders, particularly in their efforts to adopt improved management practices and soil conservation measures.

The study also tried to point out the problems confronting the ranchers in relation to their use of grasslands. These problems were classified into biophysical, technical, economic, social and institutional constraints. The biophysical problems include the low productivity of the soil due to its high acidity which manifests in low herbage productivity and high incidence of weed infestation. Some complained about ranches that were quite inaccessible and had proportion of areas with steep topography. In some areas, prolonged dry season and volcanic ash/lahar devastation, particularly in Region III, were mentioned.

Among the economic problems given were the high costs of fencing, supplies/ materials for food supplementation, the low price caused by trade liberalization, and in some cases, the low prices paid by cattle traders. The technical problem often mentioned was the inadequate technical assistance received from the government. The respondents also cited the persistent problems of squatting and the peace and order situation in many ranches.

They also considered the lack of clear-cut policy by the government on the pasturelands particularly with respect to conflicting land claims on the area as a major institutional problem that they face. In addition, the bureaucratic red tape affecting their land application and the poor linkages among the various government agencies were also mentioned.

## 4.3 Valuation of Grassland Degradation and Rehabilitation

Grazing lands are intended primarily to attain sustained forage for animal production and at the same time maintain stability within the grassland ecosystem. However, the productive potential of the country's grazing lands, particularly those in the public domain, is fast declining. Generally, grassland soils have turned acidic, shallow and often deficient in nutrients--characteristics which often result from mismanagement such as frequent burning, unregulated grazing, and other forms of land abuses. The low productivity of the soil manifests in poor vegetative cover, uncontrolled invasion of weeds, high compaction, and high erosion and runoff.

The soil fertility assessments carried out by the ERDB team in cattle-raising provinces of the country in March 1997 revealed that many grassland areas are in marginal state. If this condition continues, the carrying capacity of these lands will decline to the level that may eventually turn the area uneconomical for grazing purposes.

The growing concern for ecological sustainability and the need to improve grassland resource productivity call for an assessment of the factors that contribute to grassland degradation. Corollary to this is the urgent need for measures that will rehabilitate these degraded lands. The management practices adopted by the ranchers vary substantially with some adopting pasture improvement practices and others, relying on native vegetation.

The study undertook the following activities:

1. Determination of the extent of grassland degradation in study areas;

2. Valuation of on-site (productivity effects) damages of grassland degradation; and

3. Establishment of cost estimates for various grassland resource rehabilitation measure(s)/ environmental alleviation strategies for the country's grazing areas.

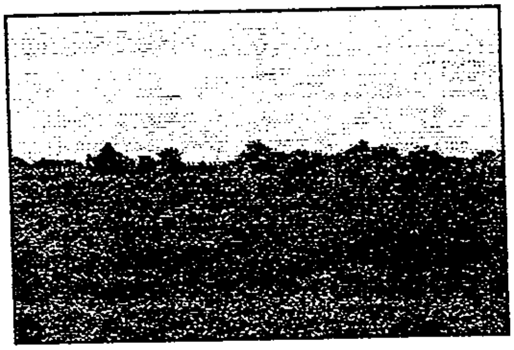
The study initially intended to cover off-site damage estimation as well but time and resource constraints did not allow the estimation of this social cost to be completed. Nonetheless, the estimation of on-site damages is important in itself to help in the efforts to promote adoption of soil conservation practices among the ranchers. In particular, from the rancher's perspective, it would pay to invest in soil conservation practices if the gains (measured in terms of on-site damages avoided plus any additional yield increase from the improvement in soil fertility) exceed the cost of the investment. If the private gains are less than the private cost of investment in soil conservation measures, then, the government may have to provide some subsidy given the social costs of grassland degradation.

This section presents a comparison of the cost of on-site degradation and the cost of soil conservation measures. Note that the comparison of the two estimates corresponds only roughly to a benefit-cost comparison since the estimates of on-site damages and costs of soil conservation measures are also rough measures.

Data were collected from grazed and ungrazed areas of six (6) provinces (Bukidnon, Occidental Mindoro, Isabela, Misamis Oriental, Nueva Vizcaya and Palawan) with representation from the relevant productivity classes per province. A total of 24 ranchers were selected for more in-depth study. The representative sample pasture lands/farms are given in Perino, E. et al. 1999. The Community Environment and Natural Resource Office range management unit of the above-mentioned provinces provided assistance in data collection activities. Primary data collected include: Soil analysis (N, P, K, Mg, Ca, CEC, pH, organic matter, and soil texture) of samples taken from varying depth, extent of erosion and overgrazing, and that of weed infestation, slope gradient, and herbage yield. The study also utilized secondary data, particularly those pertaining to the biophysical characterization of the area such as rainfall, erodibility of the soil, and prices of relevant inputs and outputs.

The study used the SCUAF (Soil Changes Under Agroforestry) model (Young et al. 1996) to predict the effects of changes in land use systems (grazing practices) on soil erosion and herbage yield using a 10-year planning period. For a more detailed discussion of this model, see King et al. (1999).

**Physical Manifestation of Grassland Degradation.** Table 2 shows the extent of grassland degradation in the selected study areas using some biophysical indicators. Specifically, degradation was assessed in terms of the proportion of the farm area with weed infestation (%), proportion of the farm area that are overgrazed (%) and length of gullies ($m^3$) per hectare, as well as, length of landslide area ($m^3$) per hectare (shown in figures).



*Infestation of C. odorata in most grazing lands considered as a form of degradation.*

*Soil degradation due to animal trails in sloping grazing areas.*

*Gully formation in most grazing lands resulting from disturbance due to grazing animals and unstable soil condition.*

*Landslide occurrence in some grazing lands due to unstable soil structure and animal trampling.*

Weed infestation occurs in areas with high rainfall and where forages are severely defoliated resulting in slow recovery that makes competition against invading weeds difficult. Once weeds are able to gain foothold over the area, control becomes difficult as they spread rapidly by wind. Furthermore, they are often toxic and are therefore unsuitable for feeding. Overgrazing does not only make the area susceptible to weed growth but also exposes the soils to wind, sun, and rain. Once exposed, the soils become prone to erosion, nutrient losses and to soil drying that cause further decline in vegetation. The formation of gullies and occurrence of landslides are both manifestations of the poor conditions of the soil that may have come about from overgrazing.

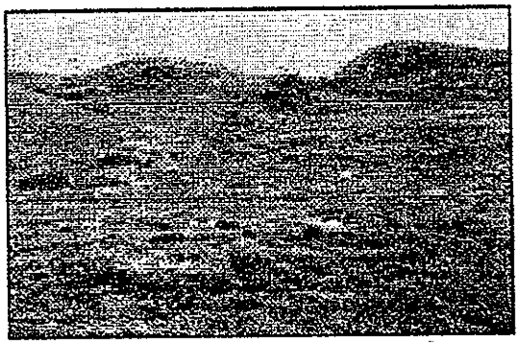
As indicated, 3.4 percent of class A lands is infested with weeds while 9.4 percent is considered as overgrazed. The situation is far more serious in class C ranches where the extent of weed infestation is quite high at 44 percent of the total ranch area. The extent of overgrazing is not as bad when compared to the two classes. For all classes, about 10 percent of the area is overgrazed or eroded. Based on the SCUAF model, the study predicted an average erosion rate of 6,727 kg/ha/yr for Class A, 9,428 kg/ha/yr for Class B, and 11,427 kg/ha/yr for Class C. The soil fertility status of Class C pastures is, as expected, the lowest but not much difference was noted between classes A and B.

Table 2. Extent of grassland degradation, selected pasture lease areas in the Philippines by category, 1998

| CLASS | Ranch Size (ha) | Weeds (%) | Overgrazed/ Eroded (%) | Gullies ($m^3$/ha) | Landslides ($m^3$/ha) | Soil Loss (kg/ha/yr) | Soil Fertility (%) (N-P-K) | | |
|---|---|---|---|---|---|---|---|---|---|
| A | 653.33 | 3.4 | 9.4 | 3.98 | 2.65 | 6,727 | 0.5 | 5.2 | 0.8 |
| B | 225.00 | 4.7 | 13.3 | 27.16 | 1.81 | 9,428 | 0.5 | 7.2 | 0.6 |
| C | 275.83 | 44 | 8.9 | 6.04 | 25.62 | 11,427 | 0.3 | 3.5 | 0.3 |

Other physical manifestations of grassland degradation are soil loss and low soil fertility status. Using the SCUAF model, the rates of soil loss for the three classes of pastureland were predicted. Results showed that Class A has an average erosion rate of 6.73 tons/ha/yr. Classes B and C have higher erosion rates of 9.43 tons/ha/yr and 11.43 tons/ha/yr., respectively.

**Production Performance as Indicator of Grassland Degradation.** The state of degradation of any natural resource often manifests itself in the system's productivity. In the case of pasturelands, productivity can be measured in terms of herbage yield that translates to a measure of cattle productivity (in a.u. per hectare per year). Table 3 shows the results of the productivity assessment of pasturelands given current conditions and the potential productivity of the area by type of system. As indicated, the native pasture has a productivity potential of 0.25-0.75 au/ha depending on the class category of the pasture area. For an improved pasture, the potential productivity is twice (0.50-1.50 a.u.) that of a native pasture (shown in figures).



*Overgrazed sites showing rock outcrops and declined forage production.*

*Improved pasture planted to star grass species.*

The actual productivity of a native pasture is only 28 percent of the potential (0.21 au/ha) for class A and also for class B (0.14 a.u.). For class C, the native pasture has reached 60 percent of the potential productivity (0.15 a.u.). Under an improved pasture system, the actual productivity is 39 percent of the potential (0.58 a.u.) for Class A, 53 percent for Class B (0.53 a.u.), and 40 percent for Class C (0.20 a.u.). Figure 3 shows clearly the big disparity between actual and potential yield for both improved and native grassland conditions. For both the improved and native pasture systems, the production potential was not being realized due in part to the degraded state of the grassland and to some mismanagement in the ranching operations. It would have been ideal to be able to isolate the impact of grassland degradation on this shortfall in production potential but the small size of the sample did not permit the conduct of said decomposition analysis in this paper. Roughly, however, the wide difference between actual and potential productivity (other things being constant) does indicate the seriousness of resource degradation problem in the area.

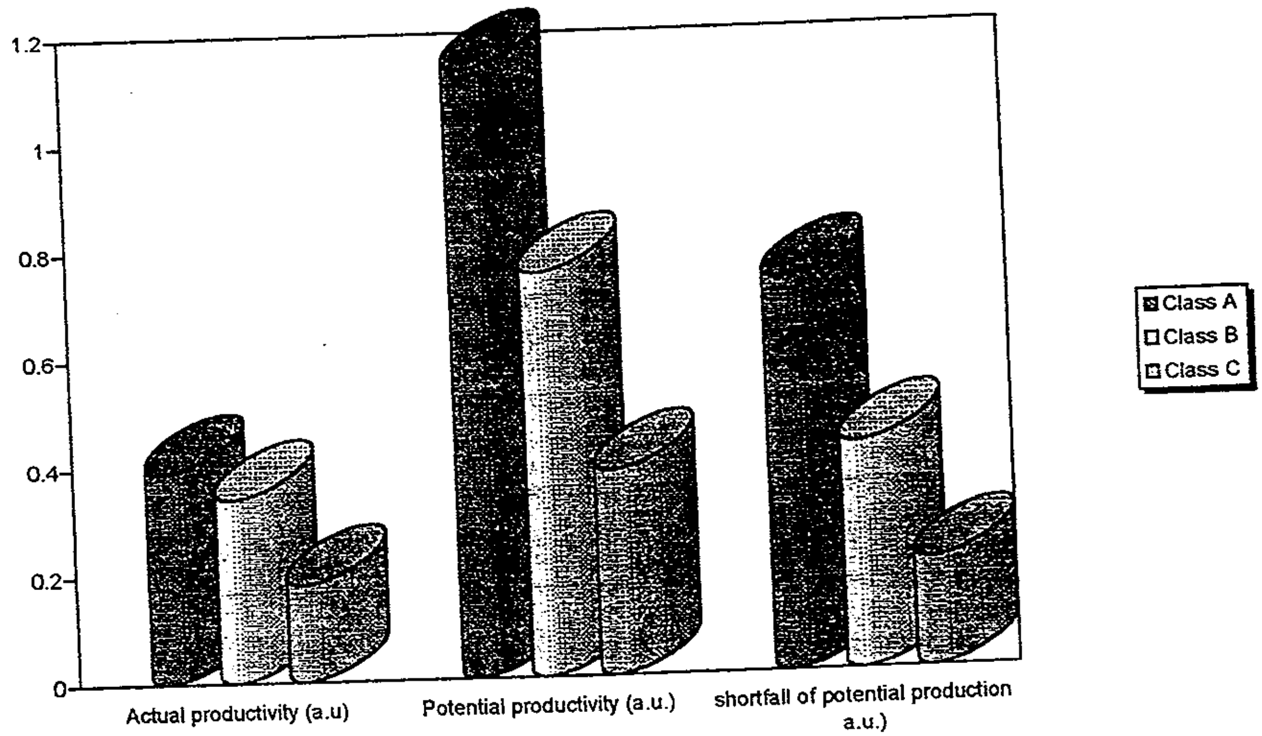



Figure 3. Actual vs Potential Yield for Native and Improved Pasture

**Valuation of Grassland Degradation: Differences between Actual and Potential Production.** Again, other things being equal in terms of input usage and management practices under each system, the difference in actual and potential productivity under any system may be used as the value of grassland degradation in the study areas. In the case of the native pasture system, the average shortfall in production for Class C is 0.20 au/ha (62 kg live weight of livestock), 0.42 au/ha for Class B (130 kg equivalent) and 0.73 au/ha (226 kg in livestock weight) for Class A. When valued using ₱54.00 per kg of live weight as the price, the shortfall in production amounts to ₱3,348.00 /ha for Class C to as high as P12,214.80 /ha for Class A. This value represents what could have been earned in the grassland if the area were not degraded, assuming other things are constant.

Table 3. Actual and potential productivity of pasture systems in selected sites in the Philippines by pasture classes, 1998.

| Pasture Class | Actual Productivity (a.u.) | Potential Productivity (a.u.) | Shortfall of Potential Production (a.u.) | Shortfall of Potential Production (liveweight kg[6]) | Value of Shortfall in Production (Pesos) |
|---|---|---|---|---|---|
| A | | | | | |
| Improved Pasture | 0.58 | 1.50 | 0.92 | 285.00 | 15,390.00 |
| Native Pasture | 0.21 | 0.75 | 0.54 | 167.00 | 9,039.60 |
| Average | 0.39 | 1.13 | 0.73 | 226.00 | 12,214.80 |
| B | | | | | |
| Improved Pasture | 0.53 | 1.00 | 0.47 | 145.58 | 7,861.80 |
| Native Pasture | 0.14 | 0.50 | 0.36 | 111.60 | 6,026.40 |
| Average | 0.34 | 0.75 | 0.42 | 128.59 | 6,944.40 |
| C | | | | | |
| Improved Pasture | 0.20 | 0.50 | 0.30 | 93.00 | 5,022.00 |
| Native Pasture | 0.15 | 0.25 | 0.10 | 31.00 | 1,674.00 |
| Average | 0.18 | 0.38 | 0.20 | 62.00 | 3,348.00 |

**Valuation of Grassland Degradation: Soil Erosion-Induced Productivity Loss:** Grassland degradation manifests physically in loss of soil as the vegetative cover is removed and as the soil becomes compacted with overgrazing. Using the SCUAF model, the study predicted the rate of soil loss and corresponding herbage productivity of the three pasture classes over a period of 10 years (Table 4). The productivity of the soil is expected to decline with loss of soil nutrients, as nutrients that could have been used up by grasses for higher production are lost in the process. Likewise, the damage to the soil structure due to soil loss reduces the water and nutrient holding capacity of the soil, thus, impairing its ability to support the full growth potential of any vegetation.

For Class A pasturelands, the average erosion rate per hectare per year is 6.73 tons. This corresponds to an herbage yield of 4,331 dry matter kg /ha that translates into 0.92 animal unit. This animal unit is equivalent to 285 kg live weight of cattle valued at ₱15,322/ha. The predicted herbage and cattle productivity for classes B and C are not so different at around 0.65 au/ha valued at close to ₱11,000.00. Over the years, the productivity of the land declines with soil loss. The relationship between herbage productivity and soil loss is shown in Figure 4 and in the negative coefficient for soil loss in all pasture classes. As indicated, the biggest coefficient for soil erosion-induced decline in productivity was noted for Class A where soils are presumably more fertile than in the two classes. Class A pastures also registered the biggest average yearly decline in productivity at ₱2,134.00 /ha compared to only ₱963 for Class B and ₱725 for class C (Table 4). (For a detailed year-by-year information on the parameters contained in Table 4, please refer to Appendix Table 3.)

The higher yearly decline in cattle production for Class A grazing lands is mainly due to the higher productivity of this resource relative to the other classes of pasture land. This observation was supported by the high yield-soil loss coefficient of –0.21 for this class as

[6] One animal unit has a live weight of 310 kg. A kg of live weight of cattle is priced at P54 using 1998 prices.

compared to only –0.02 and –0.05 for classes B and C, respectively. Efforts to reduce soil loss therefore will have the higher payoff for Class A lands.

Table 4. Predicted soil loss and herbage productivity by pasture class, average over a 10 year- period, selected sample farms, 1998.

| Parameter | Class A | Class B | Class C |
|---|---|---|---|
| Soil erosion (kg/ha/yr) | 6,727 | 9,428 | 11,427 |
| Herbage yield (DM kg/ha/yr) | 4,331 | 3,020 | 3,373 |
| a.u. equivalent | 0.92 | 0.64 | 0.65 |
| Kg live weight of cattle equivalent | 285 | 198 | 202 |
| Value of cattle supported by a hectare of grassland (pesos) | 15,322 | 10,685 | 11,935 |
| Average yearly decline in value of grassland productivity (measured in cattle supported by grassland) | 2,134 | 963 | 725 |
| Intercept in yield-soil loss function (pesos) | 5,760 | 4,317 | 4,190 |
| Coefficient of soil loss in the yield-soil loss function | -0.21 | -0.02 | -0.05 |

**Cost of Rehabilitation of Degraded Grasslands.** There are several ways of rehabilitating degraded grasslands. A simple fertilizer application may be done to supplement the nutrient requirements of the forage. One can also invest in weed control measures through the use of herbicides or the laborious manual weeding process. Degraded grasslands may also be subjected to reforestation efforts or to pasture improvement. These various measures are often combined in a given pasture area, depending on the conditions prevailing in the area.

The cost of weed control was estimated based on the recommended dosage of two liters of 2,4 D herbicides per hectare priced at P397.50 per liter + labor cost of ₱1,500 for brushing the weeds and ₱150.00 for chemical application, all on a per hectare basis. The total cost for weed control amounts to ₱2,445.00 /ha. In physical terms, the area infested with weeds in Class A averaged 22.33 ha while for classes B and C, the weed infested areas were 10.67 and 121.33 ha, respectively. Given the wide extent of weed infestation in Class C pasture areas, the cost of investment is highest for ranches in this class, amounting to ₱1,075.50 /ha or as much as ₱296,652.00 per ranch. For classes A and B where the extent of weed infestation is relatively low, cost of weed control averaged only ₱83.57 and ₱116.00/ha, respectively.

Pasture improvement over degraded/over-grazed area would cost about ₱6,350/ha to ₱8,800/ha, depending on the type of planting materials used. The specific cost items include ₱1,500 /ha of labor costs for brushing unpalatable grasses and herbaceous species, ₱3,500 for plowing and harrowing, ₱300/ha for seed sowing or ₱750/ha for planting of cuttings and ₱600-₱3,500 for planting materials of cuttings and seeds, respectively. The assessment made by the team on the selected ranches showed an average over-grazed/degraded area of 61.46 hectares for Class A (with ranch size of 653.33 ha), 30 ha for Class B (out of 225 ha ranch size) and 24.50 ha in Class C (275.83 ranch size average). Using the low-cost estimate of ₱6,350/ha, Class A ranches would require an investment of pure improvement of ₱597.35/ha while a much higher investment is required in Class C farms of ₱2,793.19/ha.

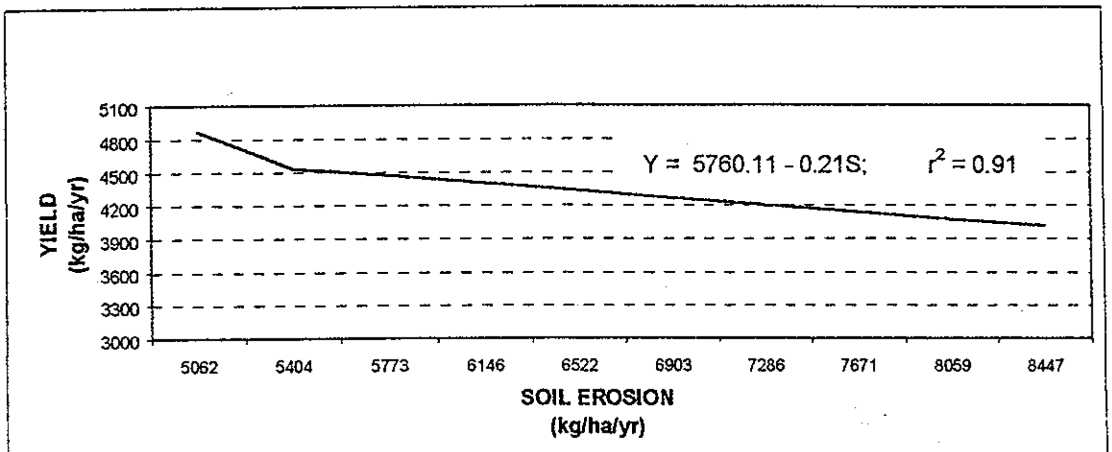



Fig. 4.a. CLASS A PASTURES

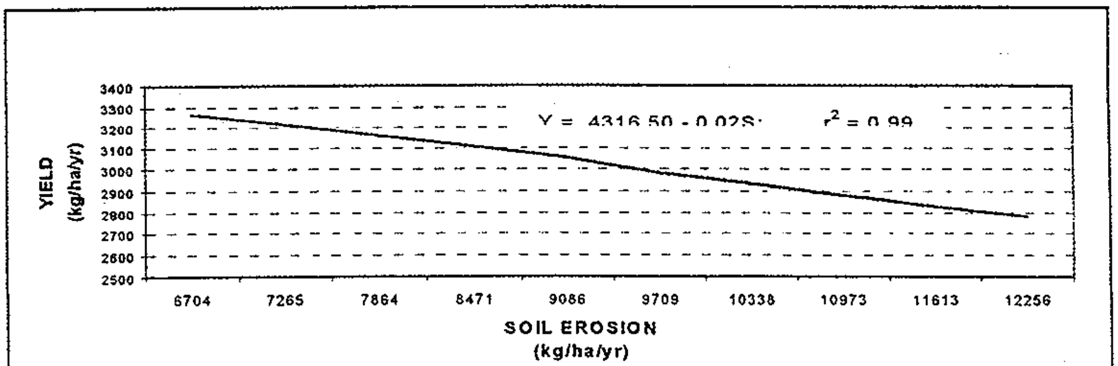



Fig. 4.b. CLASS B PASTURES

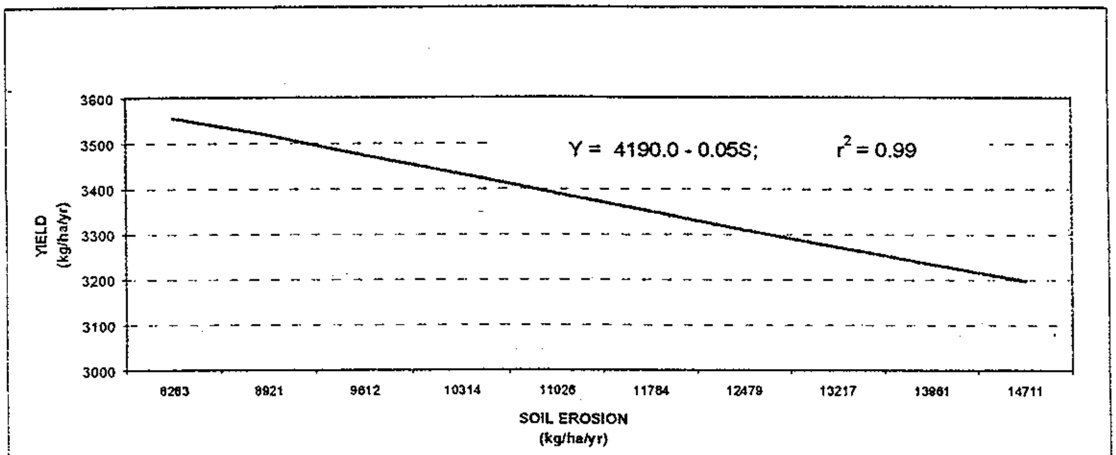



Fig. 4. c. CLASS C PASTURES

Figure 4. Relationship of soil erosion rate to herbage productivity in Class A, B, C pastures

The degraded area may also be supplemented with some chemical fertilizers. Appendix Table 4 shows the analysis of the nutrient content of soil loss and their fertilizer equivalent. If one will assume that all the nutrients lost through soil erosion are required for plant growth, then, all of the lost nutrients need to be returned to the soil through the application of chemical fertilizers. The cost of fertilizer may then be used as a proxy for the cost of rehabilitating the degraded soil. A major limitation of this approach is that it assumes that the plant for its growth uses all the nutrients contained in the soil. Different crops will have different requirements and so some of the nutrients available in the soil may have zero opportunity cost as far as contribution to crop growth is concerned. For Class A, the fertilizer equivalent of the nutrients washed away through soil loss averaged P937.53/ha. For Class B, the nutrients lost through soil loss is ₱1,336.83/ha while it is ₱1,502.49/ha for Class C pasturelands.

The reforestation cost estimates were based on prevailing cost requirement in the survey areas. Cost of reforestation per hectare was highest for Class A at ₱15,633.30/ha and lowest in Class C ranch at ₱13,200.00/ha. A slightly higher cost of reforestation is needed for ranches in Class B at ₱13,508.33/ha. Considering that not the entire ranch land area needs reforestation, then, the cost per hectare is much lower at ₱1,470.65 for Class A, ₱1,801.11 for Class B, and ₱1,172.46 for Class C.

For the control of gully formation, Dano (1993) recommended the use of rock check dams. At the cost of ₱400 per cubic meter, the cost of gully control amounts to ₱15.90/ha for Class A ranch; ₱24.17/ha for Class C, and a high value of ₱108.64/hectare for Class B ranches.

Table 5. Cost of possible rehabilitation measures in degraded grasslands, selected study sites in pesos/hectare, 1998.

| CLASS | Weed Control | Pasture Improvement | Fertilizer Application | Reforestation | Gully Control |
|---|---|---|---|---|---|
| A | 83.57 | 597.35 | 937.53 | 1,470.65 | 15.90 |
| B | 116.00 | 846.66 | 1,336.83 | 1,801.11 | 108.64 |
| C | 1,075.50 | 2,793.19 | 1,502.49 | 1,172.46 | 24.17 |

**Comparison of the Cost of Degradation and the Cost of Rehabilitation.** Of the various rehabilitation measures, some degree of substitution may exist among pasture improvement, reforestation, and fertilizer application—as these are all applied only on degraded/over-grazed pasture areas. Weed control may need to be done, as well as that of investing in control of gully formation; but on a per hectare basis, these two measures do not cost as much. A rough comparison of the assessed value of damages from grassland degradation (using either of the two approaches discussed earlier) and the cost of rehabilitation revealed some positive returns to the adoption of one or a combination of these approaches, for Classes A and B (Table 6). The high cost of rehabilitation for Class C grasslands on account of the extensive degradation and the low productivity of this type of grazing land do not seem to support the economic viability of investment in grassland rehabilitation. It can be concluded therefore that the potential improvement in yield from erosion control and pasture improvement is highest for Class A and least for Class C.

Table 6. Comparison between Cost of Degradation and cost of Rehabilitation of Degraded Grasslands, 1998.

| Class | Cost of Degradation/ Benefit of Rehabilitation | Cost of Rehabilitation | | | | |
|---|---|---|---|---|---|---|
| | | Weed Control | Pasture Improvement | Fertilizer Application | Reforestation | Gully Control |
| A | 2,134 | 84 | 598 | 938 | 1,471 | 16 |
| B | 963 | 116 | 847 | 1,337 | 1,801 | 109 |
| C | 725 | 1,076 | 2,793 | 1,502 | 1,172 | 24 |

## 4.4. Economics of Alternative Uses of Grasslands: With Focus on Areas with Cancelled Pasture Lease Agreements

As of March 1999, there were 490 existing pasture leaseholders with a total land area of 150,187 hectares and 720 cancelled PLAs covering 336,723 hectares (FMB, Bureau Files, 1999). Some of these areas with cancelled PLAs have already been converted to other land uses, often illegally, as the concerned government agencies have been unable to act appropriately on many of the cancelled PLAs. Thus, former leaseholders continue to occupy the area without having to pay for the lease. In some cases, squatters have mushroomed in some of the cancelled PLA areas. Delays in necessary actions eventually cost the government some revenue and society some rent from the use of these lands. There is thus an urgent need to assess to what alternative uses lands with cancelled PLAs can be put into.

*A cancelled pasture area that is utilized for food production*

In addition, the degraded status of many of the country's grasslands has led the DENR Secretary to direct the ERDB to explore other uses the country's grasslands may be converted into. It was noted though that the identification of alternative land uses should consider the institutional rules that govern the use of the public lands. These uses define the boundary for consideration in this analysis. The study aimed to assess the costs and benefits of alternative uses of grasslands to provide possible options to the government and to potential and existing lessees, if and when the government will allow the conversion of use from grassland to other uses.

The research team used secondary data based on 449 cancelled PLAs taken from the files of the Forest Management Bureau (FMB). These data were supplemented with primary data taken from selected case study sites in various parts of the country. Most of the cancelled PLAs (97) are in Region IV covering 41,613 ha. The three other top ranking regions with cancelled PLAs are Regions X (58), II (56) and III (54). The aggregate grassland area in these three regions is 88,956 ha or 41 percent of the total grassland areas in the country (Table 7). The files of cancelled PLAs include information on a) biophysical characteristics, b) existing land uses, c) land suitability assessment of the area, and d) reasons for cancellation of the PLA. These data sets are analyzed and presented below.

***Bio-physical Conditions of Areas with Cancelled PLAs.*** The conditions of the pasturelands were assessed by the FMB using several parameters. These include the a) presence of vegetation and physical barriers such as rocks/boulders or gullies; b) condition of water supply; and c) presence of roads and trails (Table 7).

As far as vegetation is concerned, 95 pasturelands (21%) are reported to still have significant vegetation, 86 (19%) are reported to be rocky, and 113 (25%) have gullies which signify high degree of land degradation. The highly vegetated areas are located in Region III with 20 cases, followed by Regions II, IV and XI. Most of the gullies are reported in Region IV (39 cases); XI (30 cases); III (17 cases) and II (15 cases).

Water supply in the grazing area was assessed in terms of adequacy or inadequacy in relation to the requirements of animal and vegetation in the area. There are 361 pasturelands (80%) which are assessed to have adequate water supply, 81 cases of which are found in Region IV. There are only six (6) pasture areas identified as having inadequate water supply; the rest did not provide information on this subject. Regions II, III, and XI have more than 40 pasturelands with adequate water supply condition. Those with inadequate water supply are usually found in highly sloping areas.

The presence of roads is also an indicator of the site condition and the accessibility of the pastureland, which translates to the ease in transporting the inputs and outputs (animals) to and from the markets. Roads measuring 0.1 to 5 km are indicated in 128 PLAs with the highest number (29) reported in Region II followed by Region IV (25). Roads of more than 5 km were likewise reported highest in Region IV. There are 83 PLAs with no road system existing near their grazing areas.

The presence or absence of trails is also an indication of accessibility. There were 153 PLAs assessed to have trails of 0.1 to 5 km long while 79 PLAs had trails of more than 5 km long. There were 43 with no trails and 173 not indicating any information.

***Existing Land Uses.*** There are three types of land uses identified from the cancelled PLAs: forage improvement, food production and industrial tree plantation (Table 8). It was noted that there is incomplete information on the files with regards to existing land uses – only 51.44% or 97,554.5 ha have such information. This land area, 27,656 ha or 28.35 percent have sites devoted to industrial tree plantations; 39,143.5 ha or 40.12 percent have some plots for food production; and 30,755 ha or 31.52 percent have areas for forage improvement. The effective area devoted to these various land uses is quite insignificant based on the records and is something that will be verified during the field visits.

As per the records, only 2,458 hectares or 7.04 percent of the total area has data on existing land uses. Industrial tree plantations (ITP) or areas planted to forest species cover only 558 ha or 2.01 percent while 1,648 ha or 4.21 percent has been developed for food production. The largest area (327 ha) developed for ITPs is located in Region XI while 113 ha are found in Region II. These regions are well known for the production of timber-based products. These trees are planted either in the perimeter of the area or in contiguous spaces. They also exist along ravines and river/stream banks. Trees mostly grown in these areas include ipil-ipil, yemane and other naturally growing tree species.

A large area of 826 hectares found in Region IX is devoted to food production. A considerable hectarage within pasture lands of Region IV (180 ha), Region XI (162 ha), Region X (160 ha), Region III (138 ha) and Region VI (107 ha), is likewise devoted to food production. Since food production is the highest reported land use in cancelled PLA areas, this study evaluated the profitability of the most common crops grown in the study areas. In CAR, corn and gabi are cultivated while in Region I, root crops such as gabi and ginger are planted. There are many cases where rice, vegetables, mango and banana are also grown. In other regions, the planting of root crops, vegetables, palay, and other fruit bearing trees such as mango and papaya is quite common. This particular land use is found acceptable with some limits on area relative to total landholdings as defined in the provisions of PD No. 472.

It is disturbing to note that only 252 hectares or 0.82 percent of the areas with cancelled PLAs was developed for forage production in spite of the area being pastureland. It was expected that the lessee would pursue activities on forage improvement as stipulated also in MAO Series of 1982 which specified that forage improvements should be done to attain a grazing and carrying capacity of at least one animal unit or more for every hectare. It is obvious that very few ranchers complied with this requirement. This may be due to the various problems raised by the ranchers themselves during the land rent study conducted by ERDB in 1997. These include the inadequacy of forage planting materials, low survival of improved grasses due to poor soils and unfavorable climatic conditions and insufficient technical know-how of the DENR range management officers and ranchers.

The region that seemed to have exerted considerable efforts to improve forage production is Region IV wich improved forage plantation on 68.9 hectares. On the other hand, Regions I, II and X made attempts to pursue forage improvement in their pasture areas by establishing improved pastures in 52.85, 39.09 and 32.2 hectares, respectively.

***Land Suitability Assessment.*** There are four (4) basic land suitability classifications identified as options for pasture areas: occupancy (O), grazing (G), industrial tree plantation (ITP) and food production (FP). There are also other land suitability combinations which include: FP and ITP; ITP and G; FP and G; O and G; O and ITP; FP, ITP and G; FP, G and O; ITP, O and G; and FP, ITP, O and G.

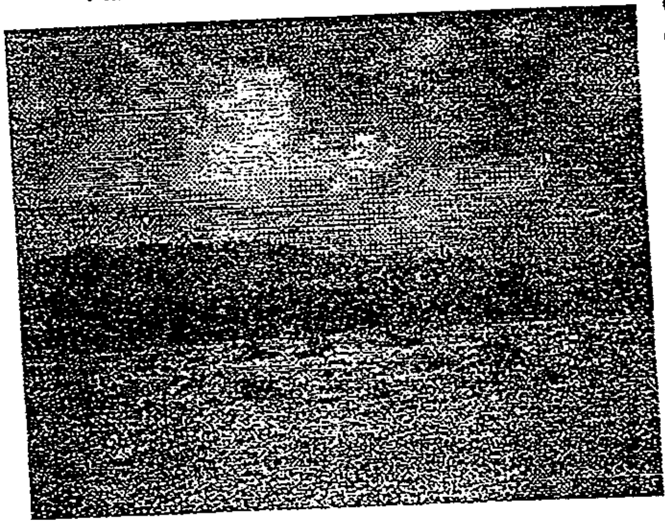
Of these land suitability classifications, the FMB assessed that only 69.22 percent is suitable for grazing while 71.18 percent is suitable for occupancy. The area identified as suitable for forest species represents 38.46 percent. If forest use and grazing will be pursued, 54.65 percent of the total area may be developed. Fifty-two PLAs have been assessed to be suitable for this land use combinations, most of which are in Region IV (22), Region III (12) and Region VI (7). If food production and grazing will be given emphasis, 45.39 percent of the land area may be developed as seen in the 27 PLAs in seven regions while 62.18 percent is possible if occupancy and grazing will be combined. Table 8 provides the other combinations of land uses.

On the whole, although there were various land suitability classes and combinations identified, the area is presently utilized either for pasture, ISF projects, tree plantation, open/

vacant areas and dwelling places of squatters and rebel returnees. Illegal occupancy has been identified in Regions I, II, IV, IX, XI and XII.

***Reasons for Cancellation.*** As of March 1999, there was a total of 720 cancelled pasture lease agreements (PLAs) covering 336,723 hectares. Of this number, only 449 have adequate information for this study's analysis.

Various reasons have been forwarded as to why the PLAs have been cancelled (Table 9). These include the incidence of drought that resulted in low productivity, unstable peace and order condition and cattle rustling in Regions I and CAR. Lessees in Region II had experienced the presence of squatters or illegal occupants and insurgency problems. A number of reasons have also been forwarded by lessees in Regions III and IV. These include their non-compliance with the rules and regulations as stipulated in the lease agreement, conversion of big portions of the area into a secondary forest as a consequence of the non-cutting of planted trees, presence of weeds, absence of cattle grazed in the area, non-payment of fees, non-improvements made on the lease area, unsuitability of the area for grazing, disinterest of lessee and abandonment.



Area with cancelled PLA

Table 7. Biophysical conditions of cancelled PLAs by region, 1998.

| Region | Total No. | Total Area | Roads (km) | | | | | | | | Trails (km) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | A | | B | | None | | Not Indicated | | A | | B | | None | | Not Indicated | |
| | | | No. | Area | No. | Area | No. | Area | No. | Area | No. | Area | No. | Area | No. | Area | No. | Area |
| CAR | 19 | 5,732 | 6 | 2,178 | 0 | - | 13 | 3,554 | | | 5 | 1,072 | 1 | 210 | 13 | 4,450 | | |
| I | 41 | 10,430 | 14 | 4,361 | 2 | 200 | 13 | 3,886 | 12 | 1,983 | 13 | 4,820 | 10 | 2,914 | 6 | 1,406 | 12 | 1,290 |
| II | 56 | 28,876 | 29 | 10,174 | 5 | 2,082 | 2 | 564 | 20 | 16,056 | 9 | 2,837 | 1 | 560 | 6 | 3,266 | 40 | 22,213 |
| III | 54 | 27,073 | 17 | 9,479 | 18 | 9,479 | 0 | - | 19 | 8,115 | 21 | 9,911 | 6 | 3,372 | 3 | 1,440 | 24 | 12,350 |
| IV | 97 | 41,613 | 25 | 8,872 | 35 | 15,432 | 21 | 10,647 | 16 | 6,662 | 46 | 17,570 | 27 | 14,053 | 1 | 140 | 23 | 9,850 |
| V | 13 | 8,664 | 3 | 636 | 3 | 2,845 | 4 | 3,070 | 3 | 2,113 | 3 | 1,355 | 1 | 322 | 2 | 2,260 | 7 | 4,727 |
| VI | 25 | 11,015 | 3 | 1,192 | 11 | 3,926 | 6 | 3,107 | 5 | 2,790 | 9 | 3,779 | 1 | - | 3 | 2,160 | 12 | 5,076 |
| VII | 11 | 5,600 | 2 | 515 | 6 | 2,767 | 1 | 1,000 | 2 | 1,318 | 1 | 120 | 2 | 1,395 | 1 | 1,020 | 7 | 3,065 |
| VIII | 4 | 3,621 | 0 | - | 0 | - | 0 | - | 4 | 3,621 | 4 | 3,621 | 0 | - | 0 | - | 0 | - |
| IX | 15 | 7,435 | 4 | 2,585 | 7 | 2,590 | 2 | 900 | 2 | 1,360 | 7 | 3,133 | 3 | 1,110 | 1 | 530 | 4 | 2,662 |
| X | 58 | 33,007 | 11 | 5,615 | 21 | 15,273 | 4 | 1,490 | 22 | 10,629 | 12 | 4,939 | 12 | 8,300 | 4 | 1,766 | 30 | 18,002 |
| XI | 50 | 27,606 | 13 | 8,260 | 6 | 5,130 | 16 | 8,001 | 15 | 6,216 | 21 | 13,057 | 15 | 11,885 | 2 | 946 | 12 | 1,718 |
| XII | 6 | 7,167 | 1 | 1,085 | 2 | 304 | 1 | 440 | 2 | 5,338 | 2 | 304 | 0 | - | 1 | 1,085 | 3 | 5,778 |
| Total | 449 | 217,839 | 128 | 54,952 | 116 | 60,028 | 83 | 36,659 | 122 | 66,200 | 153 | 66,518 | 79 | 44,121 | 43 | 20,469 | 174 | 86,731 |

Table 7. Biophysical conditions of cancelled PLAs by region, 1998. *(continued…)*

| Region | Total No. | Total Area | Physical Barriers | | | | | | | | | | Water Supply | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | A (vegetation) | | B (rocks) | | C ( gullies) | | None | | Not Indicated | | A (adequate) | | B (inadequate) | | Not Indicated | |
| | | | No. | Area | No. | Area | No. | Area | No. | Area | No. | Area | No. | Area | No. | Area | No. | Area |
| CAR | 19 | 5,732 | 4 | 2,200 | 0 | - | 0 | - | 13 | 3,405.0 | 2 | 127.0 | 16 | 4,879 | 1 | 210 | 2 | 643 |
| I | 41 | 10,430 | 3 | 656 | 6 | 1,482 | 3 | 686 | 20 | 5,424 | 9 | 2,183 | 34 | 7,862 | - | - | 7 | 2,568 |
| II | 56 | 28,876 | 15 | 5,991 | 20 | 9,130 | 15 | 7,578 | 2 | 710 | 4 | 5,468 | 44 | 17,553 | 1 | 200 | 11 | 11,123 |
| III | 54 | 27,073 | 20 | 11,285 | 7 | 3,304 | 17 | 7,930 | 3 | 775 | 7 | 3,779 | 45 | 25,180 | - | - | 9 | 1,893 |
| IV | 97 | 41,613 | 18 | 6,369 | 19 | 5,456 | 39 | 16,770 | 10 | 3,438 | 11 | 9,580 | 81 | 33,160 | 2 | 310 | 14 | 8,143 |
| V | 13 | 8,664 | 6 | 2,596 | 2 | 1,879 | - | - | 1 | 141 | 4 | 4,048 | 10 | 6,790 | - | - | 3 | 1,874 |
| VI | 25 | 11,015 | 13 | 5,200 | 6 | 3,174 | - | - | - | - | 6 | 2,641 | 19 | 7,860 | - | - | 6 | 3,155 |
| VII | 11 | 5,600 | 1 | 298 | 1 | 1,000 | 2 | 907 | 1 | 200 | 6 | 3,195 | 11 | 5,600 | - | - | - | - |
| VIII | 4 | 3,621 | - | - | 0 | - | 3 | 2,911 | - | - | 1 | 710 | 4 | 3,621 | - | - | - | - |
| IX | 15 | 7,435 | 3 | 1,367 | 1 | 548 | 1 | 585 | 2 | 773 | 8 | 4,162 | 13 | 6,391 | - | - | 2 | 1,044 |
| X | 58 | 33,007 | 4 | 2,321 | 16 | 11,404 | 2 | 575 | - | - | 36 | 18,707 | 27 | 16,709 | 1 | 116 | 30 | 16,182 |
| XI | 50 | 27,606 | 8 | 5,209 | 6 | 2,740 | 30 | 17,494 | 6 | 2,163 | - | - | 43 | 25,480 | 1 | 500 | 6 | 1,626 |
| XII | 6 | 7,167 | - | - | 2 | 1,205 | 1 | 184 | 1 | 440 | 2 | 5,338 | 4 | 1,829 | - | - | 2 | 5,338 |
| Total | 449 | 217,839 | 95 | 43,492 | 86 | 41,322 | 113 | 55,620 | 59 | 17,469 | 96 | 59,937 | 351 | 162,914 | 6 | 1,338 | 92 | 53,589 |

Table 8. Existing uses in cancelled PLAs by region, 1998.

| Region | Total No. of PLAS | Total Area of PLAs | Without ITP | | With ITP | | | PLAs not indicated | | Without FP | | With FP | | | PLAs not indicated | | Without Forage Impv't | | With Forage Improvement | | | PLAs not indicated | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Total No. | Total Area | Total No. | Total Area | Actual Area | Total No. | Total Area | Total No. | Total Area | Total No. | Total Area | Actual Area | Total No. | Total Area | Total No. | Total Area | Total No. | Total Area | Actual Area | Total No. | Total Area |
| CAR | 19 | 5,732 | 1 | 62 | 5 | 948 | 24 | 13 | 4,722 | 1 | 280 | 2 | 202 | 3 | 16 | 5,250 | 7 | 2,383 | 3 | 1,350 | 7 | 9 | 1,999 |
| I | 41 | 10,430 | 11 | 2,094 | 11 | 3,348 | 33 | 19 | 4,989 | 17 | 3,393 | 8 | 2,241 | 22 | 16 | 4,797 | 24 | 4,973 | 9 | 3,663 | 39 | 8 | 1,794 |
| II | 56 | 28,876 | 13 | 4,004 | 22 | 8,094 | 113 | 21 | 16,778 | 16 | 6,469 | 23 | 8,808 | 138 | 17 | 13,599 | 30 | 12,137 | 15 | 4,669 | 53 | 11 | 12,071 |
| III | 54 | 27,073 | 7 | 2,504 | 4 | 1,452 | 11 | 43 | 23,117 | 10 | 4,660 | 5 | 1,798 | 17 | 39 | 20,615 | 22 | 12,317 | 5 | 2,186 | 8 | 27 | 12,570 |
| IV | 97 | 41,613 | 31 | 12,318 | 10 | 5,104 | 15 | 56 | 24,191 | 31 | 14,285 | 26 | 11,328 | 180 | 40 | 16,000 | 51 | 22,805 | 19 | 8,375 | 69 | 27 | 10,433 |
| V | 13 | 8,664 | 2 | 899 | 2 | 957 | 10 | 9 | 6,808 | 2 | 899 | 2 | 957 | 10 | 9 | 6,808 | 5 | 2,095 | 3 | 2,194 | 11 | 5 | 4,375 |
| VI | 25 | 11,015 | 6 | 2,953 | 2 | 584 | 6 | 17 | 7,478 | 6 | 2,414 | 5 | 1,558 | 107 | 14 | 6,043 | 15 | 7,895 | 2 | 872 | 3 | 8 | 2,248 |
| VII | 11 | 5,600 | 4 | 1,078 | 0 | - | 0 | 7 | 4,522 | 6 | 3,098 | 1 | 200 | 5 | 4 | 2,302 | 7 | 4,240 | - | - | - | 4 | 1,360 |
| VIII | 4 | 3,621 | 0 | - | 0 | - | 0 | 4 | 3,621 | 0 | - | 0 | - | 0 | 4 | 3,621 | 1 | ni | 1 | in | in | 2 | 3,621 |
| IX | 15 | 7,435 | 4 | 1,548 | 0 | - | 0 | 11 | 5,887 | 5 | 2,048 | 2 | 1,360 | 826 | 8 | 4,027 | 6 | 2,645 | 2 | 830 | 8 | 7 | 3,960 |
| X | 58 | 33,007 | 23 | 10,274 | 9 | 4,144 | 20 | 26 | 18,589 | 24 | 14,483 | 12 | 5,605 | 160 | 22 | 12,919 | 35 | 20,018 | 6 | 2,398 | 32 | 17 | 10,591 |
| XI | 50 | 27,606 | 17 | 9,227 | 3 | 3,026 | 327 | 30 | 15,353 | 17 | 10,103 | 7 | 4,647 | 162 | 26 | 12,856 | 34 | 17,858 | 4 | 4,218 | 23 | 12 | 5,530 |
| XII | 6 | 7,167 | 0 | - | 0 | - | 0 | 6 | 7,167 | 1 | 1,016 | 1 | 440 | 18 | 4 | 5,711 | 3 | 1,318 | 0 | - | 0 | 3 | 5,849 |
| **Total** | **449** | **217,839** | **119** | **46,961** | **68** | **27,656** | **558** | **262** | **143,222** | **136** | **63,147** | **94** | **39,144** | **1,648** | **219** | **114,549** | **240** | **110,683** | **69** | **30,755** | **252** | **140** | **76,401** |

Table 9. Reasons for cancellation of PLAs by region, 1998.

| Region | Reasons |
|---|---|
| CAR | non-payment of rental fees, abandoned, no GMP/AGR |
| I | Abandoned violation of Sect. 46 of MAO No. 50, violation of the terms and condition of the lease contract, peace and order conditions, non-payment of rentals |
| II | No AGR, non-payment of rental, abandoned, no livestock grazed in the area, entry of squatters, the lessee is no longer interested in the area, non-compliance to the terms and condition of the PLA |
| III | Violation of some provisions, abandonment, no improvements, squatted, non-payment of rental, failure to comply with the requirements of PLA |
| IV | Within MNR Reserved subject for resettlement, non-payment of rental, non-submission of AGR/MNR, abandoned, no longer interested to develop the area, violation of the terms and conditions |
| V | Abandoned, squatted, non-payment of annual rental, failure to submit requirements, no improvement in the area |
| VI | no rentals made, abandoned, non-compliance with the requirements, squatted |
| VII | abandoned, squatted, no GMP/AGR |
| VIII | non-payment of rentals and non-submission of AGR |
| IX | non-payment of rentals and no improvements |
| X | violation of terms and conditions, no AGR/GMP, non-compliance with the requirements, squatted, unsuitable for grazing |
| XI | abandoned and no AGR/GMP |
| XII | no GMP/AGR, non-payment of rental, abandoned squatted |

Region V lease agreements have been cancelled partly because some areas were identified as part of a timberland and thus, were not suitable for grazing. Other reasons include non-payment of fees, presence of squatters and unstable peace and order condition. The same reasons had been given by the lessees in the other regions of the country that resulted to their giving up of the right to use these areas for grazing purposes.

**Economics of Alternative Uses of Grassland Areas.** The preceding discussions have focused on the analysis of the secondary data on cancelled PLAs based on files kept by the Forest Management Bureau. The research team also undertook primary data collection in areas covered by 30 cancelled PLAs in Luzon and Mindanao to assess what the alternative uses are to grazing. The team considered existing land uses in the site, access factor, the market situations in the area, the development activities (both current and potential as reflected in the development plan for the municipality and the province) and the social conditions (such as presence of squatters) in the area. Table 10 presents a summary of the findings of the team.

Squatters and/or former leaseholders already occupy almost all of the sites visited. The inaction of the government about their presence and the discontinued collection of whatever small lease payments they used to collect means foregone revenue to the government. The dominant land uses in the area are agriculture, agroforestry, reforestation, and in some case, still that of grazing. These are also considered to be the likely land uses that are alternatives to grazing. There is no noticeable difference in the dominant land uses, regardless of distance to the market.

Table 10. Characteristics of the Sample PLA for the Alternative Use Analysis. 1999

| Specific/Typology | CLASS A | CLASS B | CLASS C |
|---|---|---|---|
| Region surveyed | X | CAR, I, III, V | IV |
| Average ranch size (ha) | 246 | 315 | 215 |
| % of area with occupants | 100 | 81 | 100 |
| Access to roads (distance from highway in km) | 1 | 4 | 10 |
| Access to markets | Very accessible | Relatively accessible | Far from the market |
| Development plans | Being applied as a community-based forest management (CBFM) reforestation site | Eco-destination site; CBFM site | Not identified/fully occupied but is quite inaccessible |
| Land use of adjacent areas | Agriculture; agroforestry; reforestation | Agriculture; agroforestry; reforestation | Agriculture; agroforestry |
| Present Land Use | Agriculture | Agriculture; agroforestry; grazing | Agriculture; agroforestry |
| Potential Land Use | Reforestation; CBFM | Reforestation; agroforestry; CBFM | Reforestation; Agroforestry; and CBFM |

Table 11 shows the annualized income that could be earned for the various land uses under consideration in the cancelled PLA areas. It was seen that the income from pasture is the lowest for all classes of area. With the lifting of institutional restraint for the use of the land, it will be best to encourage adoption of all the other land uses where returns are expected to be higher. The income from agroforestry system is the highest (₱22,102-37,546), followed by upland agriculture (₱4,700-!2,256) and reforestation (₱5,815-12,263). Consequently, the economic rent that the government can appropriate from the use of the grasslands would be higher with the adoption of the alternative land uses.

There may be constraints to the adoption of some of these alternative land uses. For one, upland agriculture on its own will likely not be allowed due to environmental concerns. The practice of reforestation and agroforestry may be encouraged but if these will be implemented by the many upland households who have occupied the area illegally, then, the constraints on capital will be a major consideration in the adoption of these alternative land uses. The government will have to consider these concerns in planning for the development of the alternative land uses in the cancelled PLA areas. This resource constraint may not be a serious concern for those within existing PLAs, if the government will approve the change in land use in the grassland areas.


*An agroforestry area which was previously a pasture land.*

In addition, there is also the concern for food security in as far as the cattle industry is concerned. While DENR is in charge of the grassland areas, the cattle industry is under the management of the Department of Agriculture (DA). The ranchers claim that the DENR policy of raising rental fees will not make it easy for them to be competitive in the light of the trade liberalization program of the country. And yet, the DA is also encouraging them keep on ranching in line with the country's Food Security Program. There is a clamor for a closer coordination between the two department with regard to any policy that each unit will make on account of this jurisdictional overlap of concerns.

Table 11. Economic returns and rent from alternative uses of pastureland in cancelled PLA, selected sites, 1999.

| LAND USE | Net/ Annualized Income and Rent per hectare in pesos (10% discount rate) | | | | | |
|---|---|---|---|---|---|---|
| | CLASS A | | CLASS B | | CLASS C | |
| | Net Income | Economic Rent | Net Income | Economic Rent | Net Income | Economic Rent |
| Agriculture | | | | | | |
| Corn | 9,300 | 4,740 | 6,494 | 2,967 | 4,700 | 1,550 |
| Palay | 12,256 | 9,633 | 10,030 | 7,627 | 6,200 | 3,800 |
| Reforestation | 12,263 | 9,565 | 8,354 | 5,759 | 5,815 | 3,478 |
| Agroforestry | 37,546 | 28,759 | 29,430 | 21,762 | 22,102 | 15,016 |
| Pasture | 1,253 | 882 | 913 | 553 | 631 | 345 |

## 5.0 SUMMARY AND CONCLUSIONS

The joint ERDB-ENRAP project has shown that there is room for reform in the existing pricing schemes of natural resources in the country. The very low fee of ₱15-20/ha for the use of grassland resources may have well contributed to the inefficient utilization of this resource and to its current high level of degradation. The study has shown that the then existing rate was way below what the government should get in terms of rent for the use of the grassland resources. Using 1998 prices, the rent should have been P358 for Class C, P484 for Class B, and P542 for Class A. In consideration of the results of the consultative meetings with the ranchers, the Secretary has approved a rate of P200 to P500 per hectare per year, to be implemented on a staggered basis over five years.

The revision in the rent was made under a profit-sharing scheme and incorporated the grant of incentives for the adoption of improved pasture practices and soil conservation measures. It is also expected that the government will extend technical assistance to the ranchers to make their operations more efficient.

The process that led to the signing of DAO 99-36 was long and intense. The ranchers had enjoyed long years of rent appropriation and as expected, were not readily inclined to give that up. As rational individuals, however, many of them see the logic of sharing part of this rent to the government, with the hope that part of what they will share to the government will come back in terms of better extension services. The DENR field personnel expressed concerns about their capability to implement the various provisions in the DAO given their limited budget for field visits and the lack of personnel with technical training in pasture management. It was made clear that they would need some training and additional resources to be able to carry out the responsibilities called for in the implementation of the revised pricing schemes. These training will have to be given to them in the first few years of the implementation of DAO 99-36.

The study on the valuation of land degradation and rehabilitation has shown that the cost of degradation (measured in terms of foregone production) is substantial, particularly in the case of Class A, this having the highest yield-soil loss coefficient of -0.21. For this particular class, the productivity of land is still relatively higher, hence, the loss in productivity due to soil loss every year is highest at ₱2,134/ha. The losses and the yield-soil loss coefficients are smaller in Classes B and C where the extent of soil degradation is relatively more serious.

The extent of soil degradation can also be inferred from the higher cost of restoration for classes B and C, more particularly in the latter. The cost of pasture improvement, for example, is only ₱597.35/ha for Class A while it is ₱2,793.19/ha for Class C. The same pattern was seen in other forms of land rehabilitation. It would seem therefore that the highest payoff could be realized from rehabilitation efforts for Classes A and B.

What can be done for pasture areas where rehabilitation does not seem to pay and those whose leases have been cancelled? As indicated in the previous discussions, there are many areas falling in any of these two types of situations. For these areas, and even for those currently getting positive net returns from pasture as a land use, the returns from alternative uses of the land were estimated. It was shown that returns from agroforestry and reforestation, assuming no constraints on capital requirements, are the most rewarding with the highest net benefit. Consequently, these land uses will also give the government the highest rent. If rent maximization is the goal of the government, then, it would pay to convert grasslands from pasture to other land uses, without sacrificing the environment. For food security, however, it may be necessary to retain some of these grasslands as pastureland.

## References


Agpaoa, A., et al. 1975. *Manual of Reforestation and Erosion Control for the Philippines.* West Germany: German Agency for Technical Cooperation, Ltd.

Alderfer, R.B. and R.R. Robinson. 1947. "Runoff from pastures in relation to grazing intensity and soil compaction." *American Soc. Agron. Journal.* p. 39.

Aresta, R.B., R.B. Casauay and H.C. Imatong. 1996. "Herbage Yield of *Stylosanthes guianensis* CIAT-184 Under Different Levels of NPK and Clipping Intervals," pp. 1-15.

Attaviroj, P. 1990. "Soil erosion and land degradation in the Northern Thai uplands. *Dryland Management: Economics Case Studies.* J.A. Dixon, D.E. James and P.B. Sherman (eds.) London: Earthscan Publication Ltd. pp. 18-33.

Austria, G. M. "administration of forest rangelands in the Philippines: A policy option." *The Philippine Lumberman.* January - February 1994. pp. 9-12.

Baggayan. Rogelio L. Jr. 1997. "Managing our grassland ecosystem for livestock production", *Canopy International.* Nov-Dec.

Barlowe, R. 1972. *Land Resource Economics: The Economics of Real Property.* Second Edition. Englewoods Cliffs, N. J. Prentice-Hall, Inc.

Bishop, J. and J. Allen. 1989. "The on-site costs of soil erosion in Mali." Environment Working Paper No. 21.

Bondoc O. 1995. "Improving cattle productivity in extensive grasslands." Paper presented during the First National Grassland Congress of the Philippines. Sept 26-28, 1995. Strengthening Research and Development for Sustainable Management of Grasslands. ERDB, College, Laguna.

Cabanayan, O.C.1981. "Performance of different legumes for range improvement in Pangasinan." pp. 4-6, 36-40.

Calub, A. D. 1995. "Livestock in agroforestry systems." Paper presented during the First National Grassland Congress of the Philippines. Sept 26-28, 1995. Strengthening Research and Development for Sustainable Management of Grasslands. ERDB, College Laguna.

Castillo, F. T. 1993. "Yield performance of five erect-growing forage grasses." Unpublished. BS Agriculture thesis, Quirino State College, Diffun, Quirino.

Concepcion, R.N. and E. D. Samar. "Grassland: Development attributes, limitations and potentials." Paper submitted for the First National Grassland Congress. September 26-28, 1995. Los Baños, Laguna.

Daño, A. M. 1993. "Hydrology of grassland watershed: effects of no burning and reforestation." College, Laguna: ERDB.

De la Cruz, L.U. and A. C. Luna. 1992. "Effects of *Acacia auriculiformis* and *Gmelina arborea* on Soil and Microclimate of a Degraded Grassland in Nueva Ecija, Philippines." JIRCAS International Symposium Series 1. pp. 46-54.

Duffey, E., et al. "Grassland ecology and wildlife management." pp. 175-207.

Ecuacion, A. O. 1985. "The influence of six-year old ipil-ipil stand on interception, surface runoff and soil loss." Musuan, Bukidnon: Central Mindanao University. pp. 1-12, 47-48.

Ffolliott, P.F. 1990. *Manual on Watershed Instrumentation and Measurements*. A publication of ASEAN-US Watershed Project. College, Laguna, Philippines.

Foronda, S. U., R. C. Serrano and A. R. Maglinao.1995. "State of the art and science of technology research and development on watershed." Paper presented in the Multi-Sectoral Forum on Watershed Management held at SEARCA, College, Laguna. October 4-6, 1998. pp. 1-30.

Francisco, H. A. 1986. *The Economics of Soil Erosion and Conservation: The Case of the Magat Watershed.* University of the Philippines at Los Baños, College, Laguna.

Fresco, L.O., et al. 1990. "Land evaluation and farming systems analysis for land use planning. FAO Guidelines: Working Document." FAO, Rome. p. 207.

Gadrinab, A.B. 1989. "Erosion costs, streamflow and sedimentation of Muleta and Manupali Watersheds, Bukidnon, Philippines." Unpublished. Master of Science in Forestry (Watershed), thesis. Central Mindanao University, Musuan, Bukidnon.

Girt, J. 1990. "Land degradation costs in Canada: a recent assessment." *Dryland Management: Economics Case Studies.* J.A. Dixon, D.E. James and P.B. Sherman (eds.) London: Earthscan Publication Ltd. pp. 294-303.

Hartwick, J. and N. Olewiler. "The valuation and use of land and water." Chapter 3. *The Economics of Natural Resource Use*. Second Edition. 1998.

IIED. 1994. *Economic Valuation of Tropical Forest Land Use Options: A Review of Methodology and Applications.* International Institute for Environment and Development (IIED).

Jasmin, B. B. 1976. "Grassland uses: effects on surface runoff and sediment yield." Sylvatrop, *Phil. Forest Research Journal* 1(2). pp. 156-164.

Kim, S. and J. A. Dixon. 1986. "Economic valuation of environmental quality aspects of upland agricultural projects in Korea". *Economic Valuation Techniques for the Environment: A Case Study Workbook*. J. A. Dixon and M. M. Hufschmidth (eds). pp. 63-81.

Kumar, S. 1992. "Ecology of degraded vegetation and its recovery in the Indian arid zone". *JIRCAS International Symposium Series 1*. pp. 27-37.

Lal, R. (undated). "Prospects for the development of sustainable agriculture on sloping lands." International Symposium on Development of Slopelands Agriculture. Shikoku National Agricultural Experiment Station and Food and Fertilizer Technology Center. Department of Agronomy, The Ohio State University, Columbus, Ohio.

Lina, J. Jr. and F. Nuque. 1996. "Plans and programs for grassland areas in Laguna." Paper presented during the Second National Grassland Congress of the Philippines, Sept 24-26, 1996. ERDB, UP Los Banos, Laguna, Philippines: Unifying Various Disciplines and Interests for Grassland Resource Conservation and Development.

Magcale, D. M. and W. Galinada. 1996. "Grassland-based upland farms: study on fire occurrence in Isabela." Paper presented during the Second National Grassland Congress of the Philippines, Sept 24-26, 1996. ERDB, UP at Los Banos, Laguna, Philippines: Unifying Various Disciplines and Interests for Grassland Resource Conservation and Development.

Mathur, R.S. 1978. *Methodological Studies for Analysis and Planning of Non-wood Outputs of Forestry*. FAO. Andre Mayer Research Fellow. State University of New York.

Malvas, J. Jr. 1995. "Existing policies and current uses of Philippine grasslands." Paper presented during the First National Grassland Congress of the Philippines. Sept 26-28, 1995. Strengthening Research and Development for Sustainable Management of Grasslands. ERDB, College, Laguna.

Mishra, S. and A. K. Santra. 1996. "Effect of overpopulated livestock on watershed and future strategies to save the area". *Asian Livestock*. Vol. XXI. No.4. Bangkok, Thailand: FAO Regional Office. pp. 37-40.

Moog, F. A. and A. C. Castillo. "Approaches to grassland development for livestock production." *Proceedings of the First National Grassland Congress of the Philippines*. September 26-28, 1995. ERDB, College, Laguna. pp. 48-53.

Mott, G.O. "Measuring forage quantity and forage quality in grazing trials". *Forage Evaluation in the 80's: The Legacy of Dr. H. L. "Curly" Lucas*. Symposium. pp. 3-8.

Onodera, H. 1992. "Effect of degradation of forest land on erosion and infiltration Capacity of Soil." JIRCAS International Symposium Series 1. pp. 55-63.

Padilla, N. and W. Medrano. 1996. "A Sustainable grazing management strategy in the grasslands". Paper presented during the Second National Grassland Congress of the Philippines, Sept 24-26, 1996. ERDB, UP Los Banos, Laguna, Philippines: Unifying Various Disciplines and Interests for Grassland Resource Conservation and Development.

Palis, R.G. 1977. "Soil erosion under different cover crops." Unpublished. M.S. Thesis in Soil Science. University of the Philippines Los Baños, College, Laguna.

Paningbatan, E. P. 1987. "Soil erosion, problem and control in the Philippines." Paper presented during the Training Workshop on Soil Conservation Measures and Agroforestry. December 9-18. PCARRD, Los Baños, Laguna.

PCARRD, 1982. *The Philippines Recommends for Reforestation. Vol. 2. Upland Crops Conditions*. Technical Bulletin Series No. 49. Los Baños, Laguna. pp. 141-149.

Poudel, P. K. 1979. "Capitalization of environmental benefits into property values: Literature review." General Technical Report RM-69 (Fort Collins, COLO. USDA. Forest Service, Rocky Mountain. Forest and Range Experiment Station)

Sakurai, S., R.S.B. Ragil and L.U. de la Cruz. 1992. "Tree growth and productivity in degraded forest land". *JIRCAS International Symposium Series 1*. pp. 64-71.

Sanchez, P.A., P.L. Woomer and C. A. Palm. 1992. "Agroforestry approaches or rehabilitating degraded lands after tropical deforestation". *JIRCAS International Symposium Series 1*. pp. 108-119.

Sinden, J.A. 1990. "The costs of soil degradation on the northwest slopes of New South Wales, Australia." *Dryland Management: Economics Case Studies*. J.A. Dixon, D. E. James and P. B. Sherman (eds). London: Earthscan Publication Ltd. pp. 282-293.

Srivardhana, R. 1986. "The Nam Pong water resources project in Thailand." adapted by M. M. Hufschmidt. *Economic Valuation Techniques for the Environment: A Case Study Workbook*. J.A. Dixon and M.M. Hufschmidt. (eds.) pp. 141-162.

Udarbe, M.P. 1992. "The impact of tropical forest degradation on the environment". *JIRCAS International Symposium Series 1*. pp. 21-26.

van Kooten G. C. and Bulten, E. 1998. *The Economics of Nature Management: The Conservation and Exploitation of Biological Assets publication forthcoming*.

Velasco, A. B. 1984. "Traditional farmer practices affecting soil erosion and constraints to the adoption of soil conservation." *Soil Erosion Management*: Proceedings of a workshop held at PCARRD, Los Baños, Laguna, Philippines. December 3-5. pp. 21-23. ACIAR Proceedings Series No. 6

Appendix Table 1. Summary of existing grazing leases by province.

| Region | Number of Leases | Areas (ha) |
|---|---|---|
| Cordillera Adm. Region | **60** | **13,245** |
| Abra | 9 | 1,584 |
| Ifugao | 21 | 3,265 |
| Kalinga Apayao | 4 | 1,288 |
| Mt. Province | 26 | 7,108 |
| Region 1 | **23** | **5,097** |
| Ilocos Norte | 7 | 1,793 |
| Ilocos Sur | 4 | 1,584 |
| Pangasinan | 12 | 1,720 |
| Region 2 | **119** | **29,713** |
| Cagayan | 65 | 13,999 |
| Isabela | 41 | 12,425 |
| Quirino | 5 | 799 |
| Nueva Viscaya | 8 | 2,490 |
| Region 3 | **39** | **12,331** |
| Bataan | 2 | 609 |
| NuevaEcija | 11 | 3,470 |
| Tarlac | 5 | 814 |
| Zambales | 21 | 8,204 |
| Region 4 | **65** | **20,844** |
| Marinduque | 3 | 278 |
| Occidental Mindoro | 30 | 11,424 |
| Oriental Mindoro | 13 | 5,537 |
| Palawan | 14 | 3,053 |
| Quezon | 2 | 284 |
| Romblon | 1 | 108 |
| Rizal | 1 | 50 |
| Aurora | 1 | 110 |
| Region 5 | **58** | **17,179** |
| Masbate | 58 | 17,179 |
| Region 6 | **12** | **1,944** |
| Iloilo | 11 | 1,409 |
| Negros Occidental | 1 | 535 |
| Region 7 | **4** | **1,887** |
| Bohol | 1 | 816 |
| Negros Oriental | 3 | 1,071 |
| Region 8 | **1** | **580** |
| Samar | 1 | 580 |
| Region 9 | **1** | **1,720** |
| Zamboanga | 1 | 1,720 |
| Region 10 | **51** | **15,836** |
| Bukidnon | 38 | 12,822 |
| Misamis Oriental | 13 | 3,014 |
| Region 11 | **48** | **22,779** |
| Davao del Norte | 1 | 54 |
| Davao Oriental | 1 | 332 |
| South Cotabato | 46 | 22,393 |
| Region 12 | **9** | **7,032** |
| Maguindanao | 3 | 3,116 |
| North Cotabato | 6 | 3,916 |
| **TOTAL** | **490** | **150,187** |

Source: FMB, March 1999

Appendix Table 2. Distribution of the Sample Ranches to the Three Classes of Grazing Lands, 1998

| Climatic Type | Province | Grazing Land Classes | | |
|---|---|---|---|---|
| | | A | B | C |
| I | Palawan | 20 | 20 | 60 |
| | Occ. Mindoro | 17 | 83 | 0 |
| | Zambales | 0 | 100 | 0 |
| | Nueva Ecija | 17 | 83 | 0 |
| III | Bukidnon | 50 | 50 | 0 |
| | Nueva Viscaya | 40 | 40 | 20 |
| | Masbate | 88 | 12 | 0 |
| | Ifugao | 0 | 100 | 0 |
| | Misamis Or. | 0 | 100 | 0 |
| IV | Isabela | 50 | 50 | 0 |
| | Cagayan | 12 | 88 | 0 |
| | S. Cotabato | 100 | 0 | 0 |
| | N. Cotabato | 100 | 0 | 0 |

Cf: Economic Rent Study, 1998. ERDB, DENR.

Appendix Table 3. Valuation of Erosion Losses for Class A, B, C pastures predicted over 10 years.

| CLASS | Year | | | | | | | | | | 1.2 Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | |
| **CLASS A** | | | | | | | | | | | |
| Soil Erosion (kg/ha) | 5,062 | 5,404 | 5,773 | 6,146 | 6,522 | 6,903 | 7,286 | 7,671 | 8,059 | 8,447 | 6,727 |
| Herbage Yield (DM kg/ha) | 4,873 | 4,536 | 4,472 | 4,401 | 4,333 | 4,266 | 4,201 | 4,137 | 4,075 | 4,014 | 4,331 |
| a.u. equivalent | 1.03 | 0.95 | 0.94 | 0.93 | 0.91 | 0.90 | 0.88 | 0.87 | 0.86 | 0.84 | 0.92 |
| Return Value (₱) | 17,242.20 | 16,053.66 | 15,819.30 | 15,568.20 | 15,333.80 | 15,099.40 | 14,865.10 | 14,630.70 | 14,413.10 | 14,195.50 | 15,322.00 |
| Average decline in Return (₱/ha/yr) | - | 1,189.00 | 1,423.20 | 1,674.00 | 1,908.20 | 2,143.00 | 2,377.00 | 2,612.00 | 2,829.00 | 3,047.00 | 2,133.55 |
| Cost of eroded soil (₱/kg) | 3.41 | 2.97 | 2.74 | 2.53 | 2.35 | 2.19 | 2.04 | 1.91 | 1.79 | 1.68 | 2.28 |
| **CLASS B** | | | | | | | | | | | |
| Soil Erosion (kg/ha) | 6,704 | 7,265 | 7,864 | 8,471 | 9,086 | 9,709 | 10,338 | 10,973 | 10,613 | 12,256 | 9,428 |
| Herbage Yield (DM kg/ha) | 3,266 | 3,215 | 3,159 | 3,105 | 3,051 | 2,980 | 2,933 | 2,879 | 2,831 | 2,782 | 3,020 |
| a.u. equivalent | 0.69 | 0.67 | 0.66 | 0.65 | 0.64 | 0.63 | 0.62 | 0.60 | 0.59 | 0.58 | 0.64 |
| Return Value (₱) | 11,550.60 | 11,366.40 | 11,182.30 | 10,981.40 | 10,797.30 | 10,546.20 | 10,378.80 | 10,177.90 | 10,010.50 | 9,843.10 | 10,685.00 |
| Average decline in Return (₱/ha/yr) | - | 184.00 | 368.00 | 569.00 | 753.00 | 1,004.00 | 1,172.00 | 1,373.00 | 1,540.00 | 1,707.00 | 963.30 |
| Cost of eroded soil (₱/kg) | 1.72 | 1.56 | 1.42 | 1.30 | 1.19 | 1.09 | 1.00 | 0.93 | 0.94 | 0.80 | 1.13 |
| **CLASS C** | | | | | | | | | | | |
| Soil Erosion (kg/ha) | 8,283 | 8,921 | 9,612 | 10,314 | 11,026 | 11,784 | 12,479 | 13,217 | 13,961 | 14,711 | 11,427 |
| Herbage Yield (DM kg/ha) | 3,556 | 3,518 | 3,474 | 3,432 | 3,390 | 3,350 | 3,310 | 3,271 | 3,234 | 3,197 | 3,373 |
| a.u. equivalent | 0.75 | 0.74 | 0.73 | 0.72 | 0.72 | 0.71 | 0.70 | 0.69 | 0.68 | 0.67 | 0.65 |
| Return Value (₱) | 12,588.00 | 12,454.50 | 12,287.00 | 12,136.50 | 11,985.80 | 11,851.90 | 11,718.00 | 11,567.40 | 11,450.10 | 11,316.20 | 11,935.00 |
| Average decline in Return (₱/ha/yr) | - | 134.00 | 301.00 | 452.00 | 603.00 | 737.00 | 870.00 | 1,021.00 | 1,138.00 | 1,271.80 | 725.20 |
| Cost of eroded soil (₱/kg) | 1.52 | 1.40 | 1.28 | 1.18 | 1.09 | 1.00 | 0.94 | 0.88 | 0.82 | 0.77 | 1.05 |

Appendix Table 4. Analysis of the Nutrient Contents of the Soils in Selected Ranchers and their Fertilizer Equivalents by Class, 1998

| Year | Soil Erosion (kg/ ha) | Nutrients eroded | | | Fertilizer Equivalent | | | Fertilizer Costs | | | TOTAL COST (₱/ha) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | C (kg/ha) | N (kg/ha) | P (kg/ha) | OM Nitrogen (Urea kg/ha) | Urea (kg/ha) | Super Phosphate (kg/ha) | Urea For OM N (₱/ha) | Urea For N (₱/ha) | Super Phosphate (₱/ha) | |
| A1 | 5,062 | 284 | 25 | 2 | 54.2 | 54.4 | 7.7 | 379.66 | 381.11 | 57.50 | 818.27 |
| 2 | 5,404 | 294 | 25 | 3 | 56.1 | 56.2 | 8.3 | 392.91 | 393.56 | 62.50 | 848.96 |
| 3 | 5,773 | 304 | 26 | 3 | 58.1 | 58.4 | 9.0 | 406.68 | 409.11 | 67.50 | 883.30 |
| 4 | 6,146 | 313 | 27 | 3 | 59.8 | 60.0 | 9.3 | 418.72 | 420.00 | 70.00 | 908.72 |
| 5 | 6,522 | 321 | 28 | 3 | 61.3 | 61.8 | 9.3 | 429.43 | 432.44 | 70.00 | 931.87 |
| 6 | 6,903 | 329 | 28 | 3 | 62.9 | 62.9 | 10.0 | 440.13 | 440.22 | 75.00 | 955.35 |
| 7 | 7,286 | 336 | 29 | 3 | 64.2 | 64.9 | 10.7 | 449.49 | 454.22 | 80.00 | 983.72 |
| 8 | 7,671 | 342 | 30 | 3 | 65.4 | 66.2 | 10.7 | 457.52 | 463.56 | 80.00 | 1,001.08 |
| 9 | 8,059 | 347 | 30 | 3 | 66.3 | 67.1 | 10.7 | 464.21 | 469.78 | 80.00 | 1,013.99 |
| 10 | 8,447 | 352 | 31 | 3 | 67.3 | 68.4 | 10.7 | 470.90 | 479.11 | 80.00 | 1,030.01 |
| ***MEAN*** | ***6,727*** | ***322*** | ***28*** | ***3*** | ***61.6*** | ***62.0*** | ***9.6*** | ***430.97*** | ***434.31*** | ***72.25*** | ***937.53*** |
| B1 | 6,704 | 403 | 31 | 3 | 77.0 | 68.4 | 10.0 | 539.12 | 479.11 | 75.00 | 1,093.24 |
| 2 | 7,265 | 425 | 33 | 3 | 81.2 | 72.9 | 10.3 | 568.56 | 510.22 | 77.50 | 1,156.28 |
| 3 | 7,864 | 447 | 35 | 3 | 85.4 | 76.7 | 11.3 | 597.99 | 536.67 | 85.00 | 1,219.65 |
| 4 | 8,471 | 468 | 36 | 4 | 89.4 | 80.7 | 11.7 | 626.08 | 564.67 | 87.50 | 1,278.25 |
| 5 | 9,086 | 486 | 38 | 4 | 92.9 | 83.8 | 12.7 | 650.16 | 586.44 | 95.00 | 1,331.60 |
| 6 | 9,709 | 503 | 39 | 4 | 96.1 | 87.3 | 12.7 | 672.90 | 611.33 | 95.00 | 1,379.24 |
| 7 | 10,338 | 518 | 40 | 4 | 99.0 | 89.8 | 13.0 | 692.97 | 628.44 | 97.50 | 1,418.91 |
| 8 | 10,973 | 532 | 42 | 4 | 101.7 | 92.4 | 13.7 | 711.70 | 647.11 | 102.50 | 1,461.31 |
| 9 | 11,613 | 543 | 43 | 4 | 103.8 | 95.3 | 14.3 | 726.41 | 667.33 | 107.50 | 1,501.25 |
| 10 | 12,256 | 553 | 44 | 4 | 105.7 | 97.3 | 14.3 | 739.79 | 681.33 | 107.50 | 1,528.62 |
| *MEAN* | *9,428* | *488* | *38* | *4* | *93.2* | *84.5* | *12.4* | *652.57* | *591.27* | *93.00* | *1,336.83* |
| C1 | 8,283 | 459 | 39 | 4 | 87.7 | 87.1 | 13.3 | 614.04 | 609.78 | 100.00 | 1,323.82 |
| 2 | 8,921 | 476 | 41 | 4 | 91.0 | 90.4 | 14.0 | 636.78 | 633.11 | 105.00 | 1,374.89 |
| 3 | 9,612 | 494 | 43 | 4 | 94.4 | 94.4 | 14.3 | 660.86 | 661.11 | 107.50 | 1,429.47 |
| 4 | 10,314 | 509 | 44 | 4 | 97.3 | 97.3 | 14.3 | 680.93 | 681.33 | 107.50 | 1,469.76 |
| 5 | 11,026 | 522 | 45 | 5 | 99.8 | 100.4 | 15.0 | 698.32 | 703.11 | 112.50 | 1,513.93 |
| 6 | 11,748 | 532 | 46 | 5 | 101.7 | 102.2 | 15.0 | 711.70 | 715.56 | 112.50 | 1,539.75 |
| 7 | 12,479 | 541 | 47 | 5 | 103.4 | 104.0 | 15.7 | 723.74 | 728.00 | 117.50 | 1,569.24 |
| 8 | 13,217 | 547 | 48 | 5 | 104.5 | 105.6 | 16.0 | 731.76 | 738.89 | 120.00 | 1,590.65 |
| 9 | 13,961 | 551 | 48 | 5 | 105.3 | 106.7 | 16.0 | 737.12 | 746.67 | 120.00 | 1,603.78 |
| 10 | 14,711 | 553 | 48 | 5 | 105.7 | 107.1 | 16.0 | 739.79 | 749.78 | 120.00 | 1,609.57 |
| ***MEAN*** | ***11,427*** | ***518*** | ***45*** | ***4*** | ***99.1*** | ***99.5*** | ***15.0*** | ***693.50*** | ***696.73*** | ***112.25*** | ***1,502.49*** |