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DEFORESTATION IN THE PHILIPPINES: A CGE MODELLING APPROACH[*]

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I. Introduction

The Philippines was once a country abundant in forest resources. In 1920, 64 per cent of the total land area was forested. In 1994, this figure was reduced to 13.5 per cent. Virgin forests accounted to less than one million hectares or approximately three per cent of total land area in 1988[1]. Despite the massive forest loss, the Philippine government has failed to transform the profits from its forestry exports into economic development[2].

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[1]The Philippine government maintains that forestlands should comprise 40 per cent of the total land area in the country. At present, in the official statistics, classified and unclassified forestlands stood at 50 per cent of total land area. These lands are not necessarily forested lands. They were classified as forest as they have slopes of 18 per cent and above.

[2] In 1969, the forestry sector is the country's top export earner accounting for 33 per cent of total export earnings. In 1994, wood-based products constitute 3.5 per cent of total export earnings.

In the past, as the various forestry related legislation would suggest, the perception towards forest resources is purely for timber production that is, the forests' primal purpose is to supply timber. This implies that other forest products and services[3] are by products only and have diminished possibilities (Glück 1987). As the natural resource base of the country becomes fragile, the Philippine government has advocated the sustainable use of the country's natural resources. In 1991, the Philippine government in cooperation with the Finnish International Development Agency and the Asian Development Bank formulated the Master Plan for Forestry Development.

This study aims to analyse the long-run general equilibrium effects and effectiveness in reducing deforestation of some of the recommendations of the Master Plan such as the increase in the stumpage tax rate, selective logging and the setting up of protected areas. It also examines the effects on the Philippine economy of selected parameters of deforestation as cited in the literature. The remainder of the paper is organised as follows: Section II provides a brief discussion on the causes of deforestation as identified in the literature. Section III describes and summarises the Master Plan for Forestry Development while the general features of the Philippine CGE model is discussed in section IV. Section V presents the preliminary results while Section VI summarises the major findings.

[3] In recent times, the non-timber benefits derived from forestlands have generated interests in the research community. In this paper, non-timber benefits are approximated by a legislated minimum harvest age in forestry. There are CGE models that included both timber and non-timber values of forests in their analysis (Thompson, van Kooten & Vertinsky 1997; Snyder & Bhattacharyya 1990).

II. Background

Deforestation is the process of felling of trees, which results in the destruction of forest areas. When the occurrence is minimal, justified by agricultural expansion and urbanisation, without being destructive, deforestation is an integral part of the economic process. However, if it is occurring in an uncontrolled destructive fashion, stopping deforestation for the purpose of preserving biodiversity, meeting present and future demands for forest products and reducing carbon dioxide emission, is a challenging and worthwhile endeavour[4].

2.1 Definition

The available definitions of deforestation in the literature are quite intriguing. On one hand, the Food and Agriculture Organisation (FAO) defines deforestation as a change in land-use with the depletion of tree crown cover to less than 10 per cent (Brown & Pearce 1994, p. 8). On the other hand, Myers (in Brown & Pearce 1994) defines deforestation as the complete destruction of forest cover through clearing for agriculture of whatever sort (cattle ranching, smallholder agriculture whether planned or spontaneous, and large scale commodity crop production through, e.g., rubber and oil palm plantations). The definition used by the Philippine Department of Environment and Natural Resources (DENR) generally follows that of FAO[5].

Definitions between countries may differ depending on the size of the original (virgin) forest area and the native vegetation. However, FAO's definition as well as Myers' is misleading. On one hand, Myers' definition implies that not a tree remains and that the land is given over to permanent non-forest purposes. This definition rules out the possible contribution of logging activities in the creation of denuded secondary forests. Nevertheless, Myers (in Brown & Pearce 1994, p.28) mentioned the incident of over-logging as practised in the Dipterocarp forests of Southeast Asia[6]. On the other hand, the definition by FAO[7] seems to be questionable. Is there a scientific study stating that 10 per cent crown cover is enough for trees to regenerate by themselves or that 10 per cent is enough provided there are reforestation programs to be undertaken? In any case, clearly, there appears to be an overemphasis on the contribution of agriculturalists toward deforestation, whereas loggers' contribution is under emphasised.

2.2 Parameters of Deforestation

There has been considerable work on deforestation in the literature. Angelsen and Kaimowitz (1999) reviewed more than 140 economic models analysing the causes of tropical deforestation. The authors developed a conceptual

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[4]Myers (1993) claimed that with the current trend of deforestation in less developed countries (LDCs), the carbon stock on forests contribute roughly about 30 percent of all anthropogenic emissions of carbon dioxide.

[5]Forest is 'an area of one hectare or more which is at least 10 per cent stocked with forest trees (including seedlings and saplings), wild palm, bamboo or brush. Narrow strips of land bearing forest, industrial tree plantation and tree farms were also included provided the strips of land are at least 60 meters wide and all of them are one hectare or more in size' (Philippine Forestry Statistics Yearbook 1995).

[6]Over-logging results in severely depleted forest biomass due to very heavy and unduly negligent logging, where the remaining cannot survive.

[7]This definition should be compared to FAO's definition of degradation. Degradation refers to the 'changes within the forest class (from closed to open forest), which negatively affect the site or stand, and in particular, lower the production capacity'. It seems that FAO's differentation of the two processes makes room for logging activities to be considered as resulting in degradation instead of deforestation.

framework in order to understand clearly the issues surrounding the problem of deforestation. They divided the causes of deforestation into three major groups (i.e., sources of deforestation, immediate causes of deforestation and the underlying causes of deforestation.

Sources of Deforestation

The agents of deforestation identified in the literature can vary between countries. The common agents identified are shifting cultivators, agriculturists and loggers. In Brazil, cattle ranchers and squatters are the major source of deforestation (Persson & Munashinghe 1995; Persson 1994) while loggers followed by shifting cultivators, in the Philippines (Kummer 1992). In Indonesia, the transmigration programs as well as the inefficient logging technology resulted in diminished forest areas (Dee 1991). The actions taken by these agents are considered to be the sources of deforestation.

The present study identifies the agents of deforestation as loggers, farmers, miners and real estate developers. This sectoral aggregation reflects the pattern of land use in the Philippines. Land classification starts in the delineation of forestlands from agricultural lands. Agricultural lands are in effect residuals of forestlands where other land uses are generally from the former and not the latter.

It is evident in the literature that there is disagreement on which policies encourage deforestation. The literature on deforestation offers, more often than not, ambiguous findings for example, trade liberalisation may or may not exacerbate deforestation (Angelsen & Kaimowitz 1999; Xie, Vincent & Panayotou 1996). The following discussion provides a brief summary on the immediate and underlying causes of deforestation.

Immediate Causes of Deforestation

There are a few variables that fall under this classification. These variables affect the decision of the agents of deforestation (e.g., institutions, infrastructure, markets and technology). As mentioned earlier, majority of these variables offers ambiguous results. For example, substantial evidence suggests that higher agricultural output prices stimulate forest clearing. On the theoretical level however, higher agricultural wages does not increase deforestation when farmers have other employment opportunity outside the forestry sector (Johansson & Löfgren 1985). Models that assumed subsistence behaviour find less deforestation when agricultural prices are higher, while models that assume profit maximising behaviour show the opposite (Angelsen & Kaimowitz 1999).

Similarly, the effects of higher prices of agricultural inputs and credit on deforestation are also ambiguous. On the one hand, in the case of fertiliser prices, a higher price may lead farmers to adopt more extensive production systems, which use more land and less fertiliser. On the other hand, higher fertiliser prices make agriculture less profitable and can lead to a reduction on the amount of land devoted to crops. In the same way, technological progress in agriculture can encourage or discourage deforestation. It depends if the technology is labour and capital intensive. If technology is labour or capital saving, then excess labour and capital can be employed in deforestation activities. Conversely, labour or capital intensive technologies may lead to the reduction of deforestation.

Insecure property rights contribute toward deforestation in the sense that if deforestation is a form of securing ones' tenure to a piece of land then there may be incentives to clear land in order to squeeze out the competitor (Angelsen & Kaimowitz 1999). Insecure property rights may also lead to overexploitation of the resource. Along side with the issue on property rights, the effect of timber prices on deforestation has received much attention. It is argued that higher timber prices, on the one hand, can increase deforestation by making logging activities profitable. On the other hand, it can reduce deforestation, as forestland becomes more valuable in the face of higher timber prices. On the basis of the former, some countries resort to export taxes on log. An export tax by definition is a tax "levied on home-produced goods that are destined for export and not for home consumption" (Appleyard 1996). The imposition of an export tax results in a reduction in the domestic price as producers expand domestic sales by lowering the domestic price of the good to avoid paying the tax. Manurung and Buongiorno (1997) found out that in the case of Indonesia, the imposition of a log ban encouraged wood processing and resulted in a higher value added for the wood processing industry[8]. While, in the case of Malaysia, the log-export restrictions stimulated growth and employment in the processing industries and reduced domestic prices, which led to high economic costs and losses in the producer surplus, respectively (Barbier, Bockstael, Burgess & Strand 1995).

[8] An export log ban is synonymous to an infinite export tax on logs.

Nevertheless, there appears to be a consensus among the economic models that higher wages and the availability of off-farm employment decrease pressure on forestlands while accessibility and road construction increase deforestation (Angelsen & Kaimowitz 1999).

Underlying Causes of Deforestation

The agents' decision is influenced indirectly by macroeconomic variables such as population pressures, income level and economic growth, technological change, exchange rate regime, trade liberalisation and external debt.

Poverty and population growth had been linked to the problem of deforestation. On one hand, there are several multi-country regression models, which show a positive correlation between population density and deforestation. However, many of their results are spurious. The problem lies on the data employed in these regression models. The source of data is usually the FAO Forest Resource Assessments, which use population data to construct data on deforestation (Kummer & Sham 1994, in Brown & Pearce 1994). Using such data in a regression analysis with one as the independent variable and the other as the dependent variable will show a strong correlation between the two variables. Angelsen and Kaimowitz (1999) found out that the weak relationship between population growth and forest clearing implies that other variables such as road construction, government policies, off-farm employment opportunities among others provide the incentive for deforestation rather than population growth per se. People migrate to forested areas because clearing forest for agriculture is economically attractive.

Therefore, the size of the population in those areas cannot be considered as an independent variable in deforestation (regression) models.

On the other hand, the argument that advocates poverty results in natural resource degradation implies that affluence protects the environment. It may be the case that high national income and economic growth encourage environment protection via the improvement of off-farm employment opportunities, allocation of resources for developing environmentally friendly technologies and preference for environmental protection. However, it may be the case that deforestation is increased by stimulating demand for agricultural and forestry products, notwithstanding the demand for leisure activities such as golf courses[9]. Moreover, as logging is considered to be a capital-intensive activity[10], the availability of capital in the form of infrastructure and heavy machinery increases the area under logging.

There is no strong short- or medium-term relationship between economic growth rates and average per capita national income (Angelsen & Kaimowitz 1999). Hence, the association between higher income and more deforestation does not necessarily imply that higher economic growth rates induce deforestation. Some studies argue that at certain income levels deforestation declined or even reversed. This refers to 'forest transition' hypotheses and the environmental Kuznetz curve for deforestation[11].

[9] The conversion of agricultural lands to non-agricultural uses may lead to more forestlands converted into agricultural plantation.

[10] This implies that people need some form of capital to engage in large-scale logging. The more mechanised the activity the faster is the rate of extraction. Hence, the argument that poverty promotes deforestation is inconsistent with the fact that logging is a capital-intensive activity. Unless we assumed that logging does not result in deforestation.

Technological change has indirect effects on product, labour, and factor markets. It is expected that technologies that increase supply and lower prices should reduce the pressures to clear forestland. Labour-intensive technologies will raise rural wages and should dampen at least the deforestation associated with the increased profitability of agriculture, if not reverse it. However, the literature reviewed by Angelsen and Kaimowitz (1999) suggested both possibilities, that is technological progress can either lead to more deforestation or less.

Trade liberalisation and devaluation of the domestic currency are also identified as policies to induce deforestation. An overvalued exchange rate is considered to be good for forest protection in the sense that a devaluation leads to an improvement in the terms of trade of agriculture. This result in a higher agricultural price received by farmers, which increases deforestation. In addition, in the face of devaluation, exports of logs and exports in general become profitable. Moreover, trade liberalisation policies designed to increase the terms of trade in favour of agriculture may have short- or medium-term recessionary consequences that reduce urban food demand. This could lead to lower, rather than higher, agricultural prices and at the same time a recession might also lower urban employment, putting downward pressure on rural

[11] It states that at a higher level of income, beyond a certain level, deforestation is reduced while at low levels of income, an income increase will accelerate the rate of deforestation.

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wages and consequently result in deforestation (Angelsen & Kaimowitz 1999).

Despite the apparent encouragement of deforestation with trade liberalisation Xie, Vincent and Panatoyou (1996) claimed that trade policies can be used to reduce deforestation such as the reduction in import tariffs on all goods and export taxes on labour-intensive manufactured goods. Hence, due to the importance of trade in the global economy, the relationship between trade and timber production has received much attention in the literature. Some studies showed that the effect of trade policies on timber management and forest protection is small (Barbier, Bockstael, Burgess & Strand 1995; Nollkaemper 1996; Perroni & Wigle 1994). Furthermore, Anderson and Drake-Brockman (1994) advocated for the enhancement of environmental controls as well as minimising the use of trade restrictions to protect the environment.

In this paper, the long-run effects of seven policy variables on deforestation and on the economy in general as discussed above are examined. They are as follows: lower discount rate in forestry, population growth, technological change in forestry and removal of industry assistance in forestry, removal of industry assistance in agriculture and the uniform removal of assistance to all sectors.

There are a few CGE models that put emphasis on the forestry sector (Bruce 1988; Dee 1991; Persson & Munasinghe 1995; Persson 1994; Thiele & Wiebelt 1994; Thompson, van Kooten & Vertinsky 1997; Wiebelt 1995; Xie, Vincent & Panayotou 1996). There are also quite a few CGE models constructed for the Philippines. However, none of these models looked at the possible relationship among the land-using sectors of the economy. Forestry, most often than not in the case of the Philippine CGE models, is aggregated into the agricultural sector while the real estate sector is included in the services sector.

III. Master Plan for Forestry Development

The Master Plan is "a nationwide and aggregate blueprint for the development of the forestry sector across a 25-year horizon". The planning period is from 1991 to 2015. The goals and objectives of the plan are quite benevolent and ambitious. It aims to conserve, properly manage forest resources and ensure wood supply. It also hopes to promote social justice, equity and employment generation.

<u>Institutional Development</u>

The Master Plan has called for some changes in the policy and legal framework concerning forestry in the country. At present, there is a plethora of legislation pertaining to forestry. The Plan argues that there is a need to review these existing policies to enable the enactment of appropriate laws. The Plan also advocates the improvement of the capability of DENR in implementing the Master Plan's objectives. Research and Development in forestry is also given emphasis. At the same time, forestry education, training and extension are utilised to upgrade the knowledge in forestry. Furthermore, monitoring and evaluation throughout the project is necessary to ensure that the different programs are being implemented in accordance to their respective goals.

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Investment Costs of the Master Plan

Any program involves financing. Although the financial consideration is only one of the important factors that can affect the effectiveness of any program, ensuring that there are enough funds for each component is vital. The total cost of the Master Plan primary development programs is estimated to be P192.6 billion or A$7.7 billion (A$1 = P25) over the 25-year period. The government share is 22.5 percent while the private sectors' share is around 32.3 percent. The remaining 45.2 percent will be financed through foreign donors.

Policies Derived

To date, there are six policies derived from the Master Plan. They are as follows:

(a) Recognition and operationalisation of access by common people to the natural resources;

(b) Ban on logging of the virgin Dipterocarp forests and in critical areas such as those with slopes higher than 50 percent and with elevations higher than 1000 meters;

(c) Increase in economic rent (stumpage price) to 25 percent of the market price of wood from natural forests;

(d) Creation of a national protected areas system;

(e) Rationalisation of the forest industries and;

(f) Strengthening of support institutions.

The Master Plan has finally recognised the rights of the common people to use forest resources. The government has decided not to renew existing timber license agreements (TLA) with logging concessionaires. Under the Master PLan, all TLAs are only valid until 2012. This shows the present commitment of the government towards community based forestry.

The Master Plan is huge in scope hence, in this paper only three policies implemented to conserve the Philippine forests are examined (i.e., selective logging, stumpage taxes and set-aside areas).

Selective logging

Selective logging is generally practised in old growth forests in contrast to clear-cutting, which is implemented in plantation forests. The theoretical implication of the two cutting techniques will not be discussed in this paper. The selective logging technique is employed to ensure environmental services of forests or non-timber values of forest areas. In the case of the Philippines, old growth forests is still the main source of timber. The establishments of plantation forests have not been successful in the past two decades. Hence, the effects of selective logging on the forestry sector as well as the non-forestry sectors in the economy can be significant.

To simulate selective logging or increasing selectivity in the logging regime, we make use of the *MINAGE* variable, the minimum age at which

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trees can be harvested. This logging technique can guarantee the supply of timber in the future along with other growth enhancing technique such as thinning. The minimum age requirement can also be used to ensure a certain volume of timber left standing in the area, which in turn assists in natural regeneration, maintains biodiversity and other environmental services provided by forests.

The expected result of increasing the minimum age at which trees can be harvested given a fixed level of log exports (i.e., export log ban) is an increase in the price of domestically produced forest products (Dee 1991). The harvestable volume of timber per hectare per rotation is reduced. Given that the cost per hectare per rotation is constant, with reduced harvest, the cost per unit is higher causing the price of logs to increase.

Stumpage taxes

Forest charges in the past were very minimal in comparison to the revenue derived from timber production (World Bank 1989). As a result, the Master Plan increased forest charges to 25 per cent of the market price of logs. A tax on log output is the same as increasing the cost of production. However, the tax on forestry (logging) can be either ad valorem or lump sum. It can be a tax on forestland or tax on forest revenue. Johansson and Löfgren (1985) discussed in detail the theoretical implications of the different taxes as applied in forestry. Boscolo and Vincent (1998) examined the effects of different types of royalties. The study concluded that per-tree royalties are more effective in encouraging compliance with minimum diameter cutting limits however, they tend to be less effective as revenue instruments. In this study, we treat the stumpage tax as a tax on forest revenue per hectare. When treated as a tax on net revenue (proportional profit tax), stumpage taxes are expected to have no effect on the (Faustmann) rotation period subjected to some simplifying assumptions such as constant-returns to scale and fixed timber prices (Johansson & Löfgren 1985, p. 96). Dee (1991) found out that a tax on forest output lengthens the rotation period. This is intuitively true, with fixed cost per harvest per rotation, an additional output tax increases logging costs. Increasing the rotation period resulted in bigger trees, more timber harvest and lower harvest costs.

Set Aside Areas (National Parks)

The Philippines has delineated protected areas through the legislation of the National Integrated Protected Area System (NIPAS). In 1996, the area designated as national parks is 1.3 million hectares, which is 13 per cent of total timberland. The Philippine Agenda 21 specified concrete targets i.e., the delineation of 2.5 million hectares of productive forest for 1998-2005.

With increased set aside area for national parks, the tendency of the forest sector is to reduce the rotation period and the volume harvested per hectare per rotation (Dee 1991). In addition however, the outcome for annual output depends on the extent to which the smaller harvests are offset by the greater frequency of harvest.

It is accepted that forest areas have multiple uses that are not confined to timber production. Forestlands offer services such as recreational, carbon sequestration, biodiversity and soil erosion prevention. Although timber

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production has been the primarily recognised benefit from forest areas, there are a few studies that emphasised on non-timber values (Lasco 1988; van Kooten, Binkley & Delcourt 1995).

IV. The General Features of the Model

This study treats deforestation as a land use problem. It incorporates varying land use, i.e., agriculture, forestry, mining and commercial/recreational purposes. It departs from studies, which only look at either the conversion between forestry and agriculture or between agriculture and non-agricultural use. The conversion of agricultural land into non-agricultural use might have significant effects on the future of Philippine forestry. For simplicity, when comparing different land usage, it is assumed that non-agricultural use pertains to real estate, forestry and mining. The land requirements of say, manufacturing industries and commercial services are provided by the real estate sector.

The model is a static computable general equilibrium (CGE) model of an open small economy. It draws heavily from ORANI, the multisectoral CGE model for Australia and ORANI-G[12]. To incorporate the unique characteristics of the Philippine economy, the model also draws from two Philippine CGE models (i.e., Bautista 1986; Habito 1986, 1989). As regards to modelling the forestry sector, the forestry sub-model constructed by Dee (1991) is adopted. The model gives a representation of each industry's demands for labour, capital, land and various material inputs from both domestic and imported sources. These industries are assumed to maximise profit (or minimise cost) subject to constant returns to scale production functions. The relationship between input and output in each industry is given by a Leontief production function and the aggregation of domestic and imported intermediate inputs is described by a constant-elasticity of substitution (CES) production function. The aggregation of factors of production as well as the aggregation of the different types of labour is also described by CES production functions.

Unlike ORANI and Dee (1991) which only have a single representative consumer, this model has three consumer groups and 10 income groups based on the 1990 Social Accounting Matrix (SAM). Consumers maximise utility and demand is defined by the Stone-Geary linear expenditure system. Consumers are assumed to maximise utility subject to their income levels. Total real consumer expenditure is in turn strictly proportional to total real household disposable income.

There are two domestically mobile factors of production i.e., labour and land. Labour is disaggregated into 10 occupation-classification. Land can be treated as mobile to the extent that its use can vary. It is assumed that after logging companies have cleared and abandoned the area, the land becomes idle. Local communities seize this opportunity and establish agricultural plantations. These people may or may not have any knowledge of farming. As agricultural lands are converted into non-agricultural use[13], the

[12] ORANI-G is a generic version of ORANI developed by Horridge, Parmenter & Pearson (1997).

[13] This conversion is subject to one specific characteristic of the area, that is flatness. Most agricultural lands (in the low lands) are flat. This resulted in the competing nature of land usage between agriculture and real estate development. In addition, the road network along agricultural lands increases their attractiveness for development.

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presence of abandoned forestland poses to be an alternative source of farm income. This implies that land use changes from forestry to agricultural use then from agricultural use to non-agricultural use. The conversion from *agricultural to forestry* use can be treated as the establishment of plantation areas. Nonetheless, this type of conversion is rare due to the fact that reforestation programs, which include the establishment of plantation forestry, occur in areas classified as forestland[14]. The supply of labour, capital and land are assumed to be fixed and exogenously given. Capital is treated as an industry-specific factor of production. Furthermore, for factor markets to clear, these supplies must equal the demands for these factors.

There is a government sector and a foreign sector. The government derives its income from direct and indirect taxes and ownership of forestland. A fixed exchange rate is assumed since it approximates the managed float exchange rate regime, which has dominated the Philippine foreign exchange market in the past. The economy is assumed to be a price taker in the world market. The domestic producer price of a tradable good is then equal to the world price of an identical good. The domestic user price of a good produced in the non-tradable sector is given by the domestic producer price plus taxes. The Armington assumption is applied to imports where imported goods are differentiated from their domestic counterparts, which makes their prices differ. The difference between the domestic supply and demand for a good is assumed to be equal to net export of that good to ensure that the market for that good will clear. Zero pure profits conditions are specified for each industry to allow non-industry specific inputs to move between industries while also determining the rental prices of factors that are industry-specific.

[14]Forest areas in the Philippines are not necessarily forested.

Special treatment in terms of modelling is conferred to the forestry sector. The standard input demand and zero profit equations are replaced by a set of steady state production relationships adopted from Dee (1991). The non-land input bundle of the forestry sector combines each intermediate input and a composite of capital and labour in fixed proportions. Dee's forest model is employed since the equations allow for selective logging to be simulated as well as the other programs in the Forestry Master Plan. The sub-forestry model assumes that restrictions on the minimum size of trees are enforceable and binding, as they can be determined ex post. Set-aside programs can be achieved through delineation of forestlands to be protected from any logging or economic activities. In order to maximise the discounted value of the net returns from forestry, rotation periods are allowed to adjust. It also assumes that non-land inputs into forestry are fixed per rotation and so allows for economies of scale in forestry.

Data Sources

The theoretical model structure is calibrated to a consistent data set for the year 1990. The basic source of data is the input-output (I/O) table. It is supplemented by the 1990 social accounting matrix (SAM), Philippine statistical yearbook 1994 and the 1995 forestry statistical yearbook. The 1990 I/O table aggregated the economy into 59 producing sectors and 59 commodities. From this aggregation, in order to show the relationship among land-using sectors, the economy is further aggregated into 8 producing sectors

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and 9 commodities. The producing sectors are agriculture, forestry, mining, manufacturing, wood and paper manufacturing, construction, real estate services and other services. All the sectors produced a single product except for agriculture, which produces agricultural crops and services as well as livestock, poultry and fishery. The personal consumption expenditure matrix in the 1990 SAM is used to derived each household's group consumption of the 9 commodities. Data on forestry is mainly from the 1995 forestry statistical yearbook.

Economic Environment of the Simulations

One of the advantages of the Johansen approach is that the choice of closure (endogenous and exogenous variables) is flexible. A standard closure of the ORANI model is listed in the Greenbook ORANI (Dixon et al. 1982). Similarly, ORANI-G (Horridge, Parmenter & Pearson 1997) has two standard closures: short-run and long run. In a ORANI-G standard closure, the following variables are treated as exogenous;

(a) Components of real GDP from the supply side
(b) Components of real GDP from the expenditure side
(c) Export shifters
(d) All sales taxes except on exports
(e) The numeraire- nominal exchange rate
(f) The number of households and their consumption preferences
(g) Shifter of exogenous investment

Standard short-run and long run closures differ only in (a) and (b) above. Sectoral land, technological change variables, ‘other’ cost tickets and real demands for inventories by commodities are exogenous for both closures. In a short-run closure, on the supply side both sectoral capital and real wage shift variables are exogenous whereas in a long-run closure, the sectoral rates of return of capital and total labour employment are exogenous. On the expenditure side, real private consumption, real investment and government expenditure are exogenous in a short-run closure while in a long run closure, the balance of trade as a ratio of GDP, economy wide rate of return and the shifter variable that links government demand to households are exogenous. As the present model is not dealing with technical change, the variables related to technical changes in production and consumption are held fixed.

Since the model has an appended steady-state sub-model for forestry, the model simulations are conducted using a long-run closure. Simulations were also conducted when log export restrictions are imposed and when it is not. Hence, with forest exports fixed, the ratio of the balance of trade to GDP (delB) is treated as an endogenous variable, which is replaced in the exogenous list by the shift variable, f3tot_h, the ratio of total household consumption to GDP. The shift variable suggests that the nominal total private consumption move with GDP expenditure. When forest export is not fixed, delB (instead of f3tot_h) and the ratio of each household group’s consumption to GDP (f3tot) are exogenous, nominal private (household) consumption does not move with GDP. Moreover, to capture land use issues, there are two land mobility scenarios implemented (i.e., sectoral land is mobile and immobile). When we say that land is immobile, that is between agricultural land and forestland. It is assumed that the government can implement successfully its policies on land use. Hence, in any other case

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sectoral land is mobile among the four land-using sectors (i.e., agriculture, forestry, mining, and real estate). This assumption is not so restrictive since the Philippine government (at present) has only two defined land uses (i.e., alienable and disposable (A&D)[15] land and forestland).

V. Simulation Analysis

There are 10 policy simulations conducted in this paper (See Annex). Three of which are derived from the Master Plan for Forestry Development (i.e., selective logging, stumpage tax and set-aside areas). The remaining seven variables are derived from the literature, four of which are identified as variables used to either increase or decrease deforestation and the last three are the trade policy variables.

Results Comparison with Ban and No Ban

The model constructed by Dee (1991) for Indonesia has fixed the log exports in order to simulate a log export ban. The present model has the level of log exports endogenous. To examine the difference when log exports are either fixed or not in the simulations, in the succeeding discussion, we compared the results for the Philippines when the variable MINAGE is increased by 4.4 per cent using two closures (i.e., with log ban and no log ban). The experiment is to increase the minimum harvest age of trees, leaving a volume of timber per hectare, which is higher than that of prior to the implementation of the policy.

[15] Type of land use other than forestry.

Dee (1991) showed that with land mobile between forestry and agriculture, a five per cent increase in the minimum harvest age of trees resulted in higher domestic price of forest product and lower output. The price increase is large relative to the size of output contraction. Output will not contract as much as the price due to the ban on log exports. Theoretically, the export ban would result in higher domestic supply of logs, which in turn lowers the price of logs in the domestic market. There is a demand for domestic log products in the form of the wood processing industries. Output contracts primarily because the increase in the minimum harvest age requires the forest sector to wait for trees to grow larger before they can be harvested. Hence, the volume of timber harvested per hectare per rotation falls. However, the decline in the harvest volume per hectare per rotation does not necessarily translate into a one-to-one decline in the annual output of forestry. There are two reasons for this. On one hand, the rotation periods can be shortened and on the other hand, the area of land devoted to forestry can increase. The forest sector engages in smaller but more frequent harvests, which increases the employment of forestland. The first-order condition for (Faustmann) optimal rotations in the forestry sub-model suggests that the optimal rotation period depends among other things on how the forestry net revenue changes relative to its first derivative in the face of a shock. The ability of forestry to attract land away from agriculture resulted in the forestry net revenue and its partial derivative with respect to the volume of timber to increase. The increase in net revenue also depends on input prices. With harvesting costs assumed to be fixed per hectare per rotation, a shortening in the rotation period means that annual non-land inputs into forestry increase even on a per hectare basis. Nonetheless, the increase in annual non-land

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input costs were not sufficient to fully offset the increase in the output prices. Hence, forestry net revenues and the stock value of forestland increase, providing the price signal to attract the additional land into forestry.

Table 1: Comparison of results for with and without the ban on log exports (in % Change)

Forestry Policies	Land is Mobile	
Selected Variables	With Ban	W/O Ban
Minage	**4.4**	**4.4**
X0com	-2.81	-6.03
X0dom	-2.95	-3.82
P0com	13.13	12.88
X1lnd	0.69	-2.49
Activity Level	0.43	-2.92
Harvest/ha/rotation	-3.23	-3.18
Rotation Period	0.26	0.44
Production Cost	10.27	10.10
Net Revenue	1.63	1.36
PD Net Revenue wrt Age	13.13	12.88

To test the reliability of the model, we compare the model results when the export ban is imposed and land is mobile to that of Dee (1991). The important forestry variables affected (i.e., output, forestland, rotation period and harvest level) have the same sign as that of Dee (1991) except for the rotation period. Recall that an increase in minimum harvest age implies that logging companies have to wait for the trees to grow larger. This shortens the rotation period exogenously. In effect this reduces the opportunity costs in forestry by making earlier future harvests possible. As a result, the age where the actual harvest occurs increased hence on the balance, the rotation period is lengthened. In general, the change in the volume of timber harvested per hectare per rotation is the result of two offsetting factors. On one hand, for any given minimum age, larger harvest per rotation is caused by the lengthening of the rotation period. On the other hand, the harvestable timber volume is reduced when the minimum harvest age is increased.

Nevertheless, the rotation period only increased by 0.3 per cent when land is mobile and 0.4 per cent when land is immobile. The harvest per hectare per rotation decreased by 3.23 and 3.18 per cent, respectively. With land mobility, the reduction did not translate to the same percentage decline in the annual output of forestry, which is 2.81 per cent. The decline in the timber harvest was offset by the increase in the rotation period and the additional land devoted to forestry. In the case of land mobility, the forestry output declined by more than 6 per cent. The relatively huge decline is brought about by the reduction in the use of forestland.

The succeeding simulation results are derived using two land mobility scenarios (i.e., land is sectorally mobile and land between agriculture and forestry is immobile) and when there is no export ban imposed. With selective logging, set-aside areas and the reduction in the discount rate the target is to achieve a specified increase in the volume of standing timber, which is set at 41.4 million cubic meters, equivalent to one year's worth of deforestation at the rates experienced during 1981-1990. In the model, this is

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equivalent to a 5.6 per cent increase in the volume of timber. In terms of the set-aside area, 5.2 per cent of land under forestry should be put aside as national parks. The general equilibrium results of the remaining seven policy variables are also discussed. The stumpage tax is increased by 25 per cent while the export tax is increased by 100 per cent to approximate an export log ban. The population growth rate is increased by three per cent and the technological coefficient for the primary factors in forestry is increased by 10 per cent[16]. The import tariff rates for agriculture, forestry and across sectors is reduced by 10 per cent.

Tables 2 and 3 show the macroeconomic results when land is sectorally mobile and immobile between agriculture and forestry, respectively (See annex). Tables 2A and 3A show various prices in the economy given the two land mobility considerations.

Macroeconomic Results

The forestry sector contributes more than one per cent of gross domestic product (GDP) in 1990. It is expected that the reduction in the supply of logs brought about by any of the policy variables in question will be small. Given that land between agriculture and forestry is mobile, reducing the discount rate in forestry increased GDP by 0.28 per cent while all the other policies resulted in a decline in GDP as shown in Table 2. The reduction in the discount rate in forestry coupled by an unrestricted land use policy reduced the uncertainty in timber production. In the case of land immobility between agriculture and forestry, the imposition of an export tax on logs resulted in a slight rise in GNP (i.e., 0.02 per cent). The results also suggest that when land is immobile, the reduction in the tariff rates across sectors is the most attractive policy. In general, the removal of distortion in the economy in terms of trade liberalisation appeared to be beneficial to the economy as a whole to the extent that it recorded the highest improvement in GDP regardless of land mobility condition.

The apparent importance of more secure property rights is consistent with the nature of forest ownership as well as land ownership in the Philippines. The presence of risk and uncertainty in forestry imposes a higher discount rate on logging activities relative to the other producing sectors in the economy. Logging concessions are 25-year licences and these licences can be renewed for another 25 years. Prior to 1970, the concession is only given for a period of one to four years. Ackerman (1994) argued that in order to achieve forest conservation objectives, the interest rate must stay below a critical level. It follows that reducing the discount rate applied in forestry lowers the uncertainty attached to logging activities hence, more rational and efficient production decisions can be employed. In addition, land mobility allows the market to determine the rental price of land. This also reduces risk and uncertainty in contrast with ad hoc land classification process. For example, the land reform program in the Philippines resulted in the premature conversion of agricultural land to non-agricultural uses. The land reform program artificially reduced the price of agricultural land, as the Philippine government purchased these lands at a price much lower than the market price of land. In order to avoid coverage under the land reform program,

[16] This is to simulate an increase in the composite labour-capital input of the forestry sector.

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landowners resorted to premature conversion of agricultural lands into non-agricultural use.

Effects on Sectoral Production and Employment

Tables 4 and 6 present the percentage deviations from the baseline of sectoral employment and production when land is mobile and Tables 5 and 7 when land is immobile. Comparing Tables 4 and 5, it clear that except for the reduction in the discount rate in forestry and the establishment of set-aside areas for national parks, the direction of the changes for the eight industries is the same for all the ten simulations. The reduction in the discount rate in forestry has a positive effect on the level of sectoral employment. Moreover, the sectors that depend on forestry for intermediate inputs also experienced an increase in their employment levels (i.e., wood and paper manufacturing and construction sectors). In contrast when land is immobile, the forestry, wood and paper manufacturing and construction sectors experienced a decline in employment. The establishment of set-aside areas appears to have a positive effect on the forest sector when land is immobile. That is, when the government can strictly implement its land use policy.

In the remaining simulations regardless of land mobility, the direction of changes is the same. The selective logging program (i.e., increase in the minimum harvest age) resulted in higher employment in the forestry sector however, employment in sectors dependent on log inputs that is wood and paper and construction declined. The decline in the level of employment in the real estate sector is brought about by the decline in the construction sector. As expected the increase in the stumpage tax and export tax on logs resulted in the decline in forestry employment. The increase in the use primary factors in forestry led to a positive effect on employment while the removal of assistance in all sectors as well as in forestry and agriculture resulted has a negative effect. The removal of industry assistance as a whole only benefited the non-tradable sectors except for the real estate sector.

Table 4. %Change in Sectoral Employment when Land is Mobile

	Minage	Tstump	FFor	FV	q	a1prim2	t4	t0imp19	t0imp12	t0imp3
Agri	0.009	0.030	0.061	-0.007	0.509	-0.034	0.015	-1.282	-0.698	0.001
Logs	0.580	-3.687	11.322	0.040	-0.064	10.585	-6.746	-2.288	0.254	-2.142
Mining	0.067	0.018	-0.407	0.032	0.112	0.044	0.110	-6.076	0.540	0.030
Manuf	0.059	0.011	-0.329	0.032	0.172	0.038	0.053	-2.685	0.408	0.012
WoodPaper	-0.454	-0.023	1.269	-0.187	0.004	-0.676	0.069	-0.531	0.332	0.112
Constr	-0.125	-0.018	0.226	-0.040	-0.231	-0.175	0.009	0.848	0.180	0.011
Commland	-0.036	0.029	0.059	-0.010	-1.137	-0.095	-0.018	-2.024	0.061	-0.012
Services	0.005	0.013	-0.127	0.007	-0.224	-0.038	0.039	2.067	0.291	0.013

Table 5: %Change in Sectoral Employment when Land is Immobile

	Minage	Tstump	FFor	FV	q	a1prim2	t4	t0imp19	t0imp12	t0imp3
Agri	0.012	0.024	0.167	-0.021	0.510	-0.025	0.028	-1.281	-0.698	0.004
Logs	0.362	-3.863	-23.574	7.059	-0.062	9.962	-8.611	-2.274	0.249	-2.071
Mining	0.052	0.050	0.348	0.334	0.113	0.012	0.096	-6.077	0.540	0.019
Manuf	0.043	0.043	0.325	0.160	0.170	0.002	0.024	-2.693	0.412	0.001
WoodPaper	-0.346	-0.213	-1.857	-2.084	0.010	-0.431	0.342	-0.510	0.318	0.171
Constr	-0.100	-0.060	-0.520	-0.393	-0.228	-0.120	0.066	0.857	0.176	0.023
Commland	-0.029	0.021	0.128	0.116	-1.133	-0.081	-0.009	-2.015	0.057	-0.009

Services	0.003	0.021	0.136	-0.007	-0.225	-0.044	0.039	2.065	0.291	0.010

Similarly, the direction of the output changes were the same regardless of land mobility consideration except for the first four simulations as shown in Tables 6 and 7.

Table 6: %Change in Sectoral Production when Land is Mobile

	Minage	Tstump	FFor	FV	q	a1prim2	t4	t0imp19	t0imp12	t0imp3
Agri	0.043	-0.019	-0.751	0.062	0.985	0.010	0.114	-2.154	-1.324	0.031
Logs	-6.027	-1.149	38.534	-2.745	-0.133	-8.429	-6.515	-0.611	0.367	-2.046
Mining	0.005	-0.035	-0.697	0.046	0.093	-0.016	0.156	-3.194	0.580	0.052
Manuf	-0.037	-0.003	-0.103	-0.003	0.166	-0.092	0.054	0.786	0.435	0.021
WoodPaper	-0.524	-0.033	1.436	-0.212	0.000	-0.770	0.069	2.031	0.352	0.119
Constr	-0.183	-0.026	0.364	-0.061	-0.235	-0.253	0.009	2.986	0.196	0.016
Commland	-0.115	-0.003	0.029	-0.021	-1.148	-0.192	0.008	-0.239	0.091	0.003
Services	-0.063	0.005	0.045	-0.019	-0.227	-0.133	0.040	3.471	0.307	0.019

The implementation of the selective logging policy has a negative effect on the level of output in general as well as the stumpage tax in forestry. The combination of a lower discount rate and mobile land resulted in an increase in output levels compared to that when land is immobile and discount rate is lower. Maintaining a set-aside area for national forests resulted in a lower decline in forestry's output when land is mobile than when land is immobile between agriculture and forestry.

Table 7: %Change in Sectoral Production when Land is Immobile

	Minage	Tstump	FFor	FV	q	A1prim2	t4	t0imp19	t0imp12	t0imp3
Agri	0.016	0.042	0.282	-0.076	0.977	-0.056	0.059	-2.174	-1.314	0.009
Logs	-4.733	-3.903	-26.089	-19.406	-0.034	-5.672	-4.487	-0.260	0.145	-1.064
Mining	-0.011	0.007	-0.021	2.880	0.128	-0.057	0.134	-3.112	0.550	0.035
Manuf	-0.032	-0.007	-0.104	-0.218	0.165	-0.081	0.072	0.784	0.436	0.021
WoodPaper	-0.401	-0.249	-2.168	-2.356	0.007	-0.492	0.376	2.057	0.335	0.185
Constr	-0.146	-0.090	-0.780	-0.622	-0.231	-0.170	0.094	2.998	0.190	0.035
Commland	-0.099	-0.025	-0.272	1.235	-1.125	-0.157	0.039	-0.182	0.069	0.010
Services	-0.050	-0.014	-0.169	-0.297	-0.227	-0.103	0.077	3.473	0.306	0.025

The increase in the primary factor input in forestry led to the decline in sectoral production while the agricultural sector experienced a slight improvement in its output level brought about mainly by land mobility between agriculture and forestry. An increase in the population level regardless of land mobility conditions resulted in more agricultural output. There are also sectors other than agriculture, which experienced the same magnitude of change in their outputs regardless of the land mobility condition (i.e., manufacturing, construction, real estate and services). When land is immobile, the export tax on forestry did not reduce output as much as when land is mobile. The reduction in the import tariffs across all the sectors resulted in the decline in sectoral output for all the land-using sectors in the model.

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The export levels of the agriculture and forestry sectors are shown in Table 8. The forestry sector's export increased significantly with lower discount rates given that land between agriculture and forestry is mobile. The reduction in discount rate reduced the opportunity cost of delaying the harvest. This allows trees to grow bigger and results in larger harvest per hectare per rotation. The agricultural sector experienced improvement in its level of exports when import tariffs on agricultural goods were reduced regardless of land mobility condition. This suggests that the agricultural sector is heavily dependent on imported goods for their domestic production. When land use regulations are implemented properly by the Philippine government, the forestry exports increased when the import tariffs in the sector are reduced.

Table 8: %Change in Sectoral Exports

	Minage	Tstump	FFor	FV	q	A1prim2	t4	t0imp19	t0imp12	t0imp3
Mobile										
Agri	1.698	-0.221	-9.141	1.044	-1.688	2.547	0.681	-15.864	7.467	0.057
Forestry	-48.728	-4.726	435.27	-23.741	-0.545	-61.851	-99.99	-3.681	0.931	1.091
Immobile										
Agri	1.157	0.808	6.831	4.773	-1.779	1.265	-0.545	-16.10	7.604	-0.288
Forestry	-39.379	-27.744	-143.28	-99.09	0.342	-43.486	-99.99	-0.606	-1.074	10.026

Income Distribution

Tables 9 and 10 show the income distribution changes when land is mobile and immobile, respectively. The direction of the changes is the same except for the forestry discount rate reduction and the 100 per cent increase in the export tax on logs. Moreover, regardless of the land mobility condition, the removal of assistance for all sectors, for the agricultural sector and the forestry sector produced very similar results.

Table 9: %Change in Household Income when Land is Mobile

	Minage	Tstump	FFor	FV	Q	a1prim2	t4	t0imp19	t0imp12	t0imp3
HH1	-0.013	-0.004	0.041	-0.005	0.025	-0.011	-0.005	0.237	-0.032	0.000
HH2	-0.021	-0.006	0.065	-0.008	0.039	-0.019	-0.008	0.390	-0.050	0.000
HH3	-0.025	-0.007	0.078	-0.009	0.043	-0.024	-0.009	0.482	-0.056	0.000
HH4	-0.031	-0.009	0.093	-0.011	0.049	-0.030	-0.010	0.593	-0.063	0.000
HH5	-0.034	-0.009	0.099	-0.012	0.047	-0.034	-0.010	0.670	-0.059	0.000
HH6	-0.039	-0.010	0.107	-0.014	0.041	-0.042	-0.009	0.790	-0.052	0.001
HH7	-0.042	-0.010	0.107	-0.015	0.029	-0.048	-0.008	0.881	-0.035	0.002
HH8	-0.047	-0.010	0.111	-0.016	0.016	-0.057	-0.006	1.023	-0.016	0.003
HH9	-0.059	-0.012	0.128	-0.020	-0.003	-0.077	-0.003	1.336	0.011	0.006
HH10	-0.085	-0.054	0.420	-0.036	-0.133	0.008	-0.118	2.561	0.322	-0.014

Nonetheless, the removal of assistance across sectors has resulted in the increase in household income for all household groups where the eight, ninth and tenth deciles benefited the most. The highest income decile also experienced a positive effect on their income levels when tariffs on agricultural imports were reduced. The reduction in the import tariffs on the forestry sector had a minimal effect on all income groups with a negative effect on the income of the highest decile. It follows that the highest income decile received favourable concession when the forest sector is protected.

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This is also true for the imposition of export tax on logs when land is immobile. The increase in population led to the reduction in the income received by the ninth and tenth income decile while an increase in the primary factors of production in the forestry sector increased the income of the tenth income decile. It is assumed in the model that the highest income group has ownership of all capital.

Table 10: %Change in Household Income when Land is Immobile

	Minage	Tstump	FFor	FV	q	a1prim2	T4	t0imp19	t0imp12	t0imp3
HH1	-0.010	-0.009	-0.071	-0.042	0.025	-0.005	0.000	0.238	-0.033	0.001
HH2	-0.016	-0.015	-0.115	-0.068	0.039	-0.009	0.001	0.392	-0.051	0.002
HH3	-0.020	-0.017	-0.138	-0.083	0.044	-0.012	0.001	0.484	-0.057	0.003
HH4	-0.024	-0.021	-0.166	-0.101	0.050	-0.015	0.002	0.596	-0.064	0.004
HH5	-0.027	-0.022	-0.180	-0.112	0.047	-0.019	0.004	0.673	-0.061	0.004
HH6	-0.031	-0.025	-0.200	-0.129	0.042	-0.024	0.007	0.792	-0.053	0.006
HH7	-0.033	-0.025	-0.208	-0.140	0.030	-0.029	0.010	0.884	-0.036	0.007
HH8	-0.037	-0.027	-0.224	-0.158	0.017	-0.036	0.015	1.026	-0.017	0.009
HH9	-0.047	-0.032	-0.272	-0.201	-0.002	-0.051	0.023	1.339	0.009	0.012
HH10	-0.067	-0.094	-0.701	-0.318	-0.132	0.042	-0.100	2.564	0.320	-0.002

All the forestry policies implemented to increase timber volume resulted in the reduction of household income when land is immobile. When land is mobile, similar results except for the reduction in the discount rate. Notice that the highest income group gained the most when discount rate in forestry is reduced given land between agriculture and forestry is mobile.

Effects on Land Use

Table 11 shows the movement of the demand for land when land is mobile. It is expected that forestland subjected to harvesting will decrease with the imposition of selective logging and the establishment of set-aside areas (i.e., national parks). The reduction in the amount of land is brought about by forest areas being conserve to satisfy sustainability objectives. The imposition of stumpage taxes and the reduction in the discount rate in forestry resulted in more forestland not subjected to harvesting as rotation period increased by 9.7 and 45.42 per cent as shown in Table 12. The stumpage tax reduces the net revenue received by the logging firms hence to compensate for the increased cost the rotation period is extended. Similarly, the reduction in the forestry discount rate reduces the uncertainty in logging, which results in more land under productive timber production.

Table 11: %Change in Use of Land when Land is Mobile

	Minage	Tstump	FFor	FV	q	a1prim2	t4	t0imp19	t0imp12	t0imp3
Agriculture	0.54	-1.13	-12.45	1.24	0.13	1.38	1.3	0.36	-0.17	0.42
Logging	-2.49	5.46	76.68	-5.67	-0.2	-6.31	-6.27	-0.71	0.46	-1.98
Mining	0.59	-1.15	-12.87	1.28	-0.27	1.46	1.39	-4.49	1.07	0.45
Comm Land	0.49	-1.13	-12.45	1.24	-1.51	1.32	1.27	-0.39	0.59	0.41

With population growth, there is an increase in demand for agricultural land and at the same time reduced the land available for the other land-using sectors in the model. This is not surprising since a higher population level requires higher production in agriculture in order to satisfy

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food requirements. Increasing the employment of primary factors in forestry production resulted in the reduction of the demand for forestland. This makes forestry activities more costly thus, creating a bias against forest activity. The removal of assistance in forestry and agriculture both resulted in the reduction in the demand for land for both uses, respectively. Quite surprisingly, the removal of all tariff barriers benefited agriculture in terms of demand for agricultural land while reduced land devoted to the other land-using sectors. The imposition of an export tax reduced land devoted to forestry.

Table 12: Selected Forestry Variables (in %Change)

	Mobile			Immobile		
	Timber Volume	Harvest per Rotation	Rotation Period	Timber Volume	Harvest per Rotation	Rotation Period
Minage	5.64	-3.18	0.44	5.66	-2.46	2.35
Tstump	1.32	2.89	9.7	0.8	1.75	5.82
Ffor	5.62	12.53	45.42	5.68	12.55	43.73
FV	-0.61	-1.32	-4.28	-5.6	-11.89	-35.05
Q	-0.01	-0.03	-0.1	0.01	0.02	0.05
a1prim2	0.45	0.99	3.26	1.17	2.57	8.61
t4	0.05	0.11	0.34	0.91	1.98	6.49
t0imp19	-0.02	-0.05	-0.15	0.05	0.11	0.38
t0imp12	0.02	0.04	0.13	-0.03	-0.06	-0.21
t0imp3	0.01	0.03	0.1	0.22	0.47	1.55

VI. Summary

The paper examined the general equilibrium effects of some of the policies proposed by the Master Plan for Forestry Development. The objective is to look at the effectiveness of such forestry policies on conservation and at the same time analyse the economic effects on the forestry sector as well as on the whole economy. The paper also included seven policy variables found in the literature, which have some influence on the level of deforestation.

The simulation results suggest that property rights issues are important in the case of the Philippines. As commonly found in the literature, problems concerning the use of natural resources are, most often than not, related to the issue of property rights. There is a consensus that when the assignment of property rights are enforced, natural resource degradation can be avoided however, this might not be entirely true in the case of the Philippines. Property rights concerning Philippine forests are rather clear. All forestlands are government-owned and the government has leased these lands to logging concessionaires. However, the duration of the logging concessions is rather short compared to the natural regeneration capacity of forest areas. Hence, given government ownership of all forestlands, this still led to resource degradation in the Philippines. Nonetheless, this does not suggest that the issue of secure property rights is irrelevant to the problem of natural resource degradation. Commitment towards resource conservation and better understanding of the problems in forestry would be more effective in securing the future of forests than concentrating on ownership issues.

The results generally show that the resource policies embodied in the Master Plan for forestry development can be useful tools in achieving a set-aside volume of timber however, with negative effects on GDP. Nonetheless, the reduction in GDP is minimal. Employment of farmers, forest and fisheries workers is improved with selective logging. The imposition of stumpage tax (such as royalty fees) does not meet the target but resulted in an improvement in the volume of timber and extended the rotation period. The establishment of set-aside areas is only effective when the government can enforce its land use policy.

With land mobility, the reduction in the discount rate in forestry and the removal of assistance in all sectors as well as the agriculture and forestry sectors have positive effect on GDP. Trade liberalisation might not be environmentally friendly however, it might lead to greater efficiency in resource use. As shown by the simulation results, a general liberalisation resulted in a higher GDP and a very minimal negative effect on the volume of timber. Hence, the paper suggests that the best policy mix is to combine a general trade liberalisation with long-term logging concessions. In the long run, the sustainability of the Philippine forest can be ensured together with the economic development objectives of the country.

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ANNEXES

Policy Variables

Selective logging	Minage	Increased by 4.4%
Stumpage tax	Tstump	Increased by 25%
Discount rate in forestry	Ffor	Decreased by 38% (M), 114% (IM)
Set-aside areas	FV	Increased by 40%
Population growth	Q	Increased by 3%
Technological change in forestry	A1prim2	Increased by 10%
Export tax in forestry	T4	Increased by 100%
Removal of assistance in all sectors	T0imp19	Decreased by 10%
Removal of assistance in agriculture	T0imp12	Decreased by 10%
Removal of assistance in forestry	T0imp3	Decreased by 10%

Table 2: Macroeconomic Results when land is mobile (in %Change)

Variables	Real GDP	Utility HH1	Utility HH2	Utility HH3	HH Cons.	Inv't	Gov't Cons.	Exports	Imports	FFF employed	F3tot_h	Terms of Trade
Minimum age	-0.125	-0.283	-0.175	-0.117	-0.091	-0.182	-0.091	-0.029	-0.028	0.017	0.014	0.014
Stumpage tax	-0.003	0.025	0.016	0.011	0.008	-0.033	0.008	0.005	0.005	-0.025	0.051	0.0005
Discount rate	0.283	0.412	0.302	0.239	0.167	0.375	0.167	0.139	0.074	0.223	-0.021	-0.098
Set-aside area	-0.04	-0.073	-0.049	-0.036	-0.026	-0.061	-0.026	-0.011	-0.007	-0.006	0.003	0.006
Pop. Growth	-0.033	-10.227	-5.912	-3.548	-0.023	-0.092	-0.023	0.066	0.042	0.495	0.017	-0.006
Tech Coefficient	-0.191	-0.474	-0.292	-0.193	-0.151	-0.237	-0.151	-0.082	-0.071	0.121	-0.059	0.023
Export Tax	-0.031	-0.067	-0.041	-0.026	-0.021	0.003	-0.021	-0.022	-0.002	-0.084	-0.004	0.0298
Removal of assistance (all sectors)	1.67	2.653	1.449	0.896	0.745	2.998	0.745	12.043	8.778	-1.286	-4.045	-1.148
Removal of assistance (agri)	0.119	0.263	0.129	0.053	0.057	0.162	0.057	1.093	0.812	-0.673	-0.186	-0.109
Removal of assist. (forestry)	0.0001	-0.018	-0.010	-0.005	-0.004	0.015	-0.004	0.094	0.068	-0.030	-0.016	-0.010

Table 2A: Prices when land is mobile (in %Change)

Variables	CPI	Real wage	Real exchange rate	GDP deflator	Product wage	Timber Prices	Price of Agriculture land	Price of Forestland	Nominal wage
Minimum age	-0.024	-0.197	-0.039	0.039	-0.26	12.884	-1.268	51.027	-0.221
Stumpage tax	0.004	-0.046	-0.005	0.005	-0.047	0.921	2.314	38.376	-0.042
Discount rate	0.179	0.293	0.055	-0.055	0.527	-35.724	29.439	581.986	0.472
Set-aside area	-0.016	-0.057	-0.013	0.013	-0.086	5.343	-2.528	27.406	-0.073
Pop. Growth	-0.006	-0.017	0.009	-0.009	-0.015	0.109	0.741	0.592	-0.024
Tech Coefficient	-0.033	-0.257	-0.060	0.060	-0.349	18.259	-3.075	0.853	-0.289
Export Tax	-0.031	0.021	0.021	-0.021	0.011	-0.430	-2.612	-2.091	-0.010
Removal of assistance (all sectors)	-1.700	6.869	2.522	-2.475	7.557	0.749	1.694	1.471	5.082
Removal of assistance (agriculture)	-0.117	0.179	0.125	-0.124	0.185	-0.185	-0.986	-0.800	0.061
Removal of assistance (forestry)	-0.007	0.029	0.011	-0.011	0.033	-0.217	-0.821	-0.681	0.022

Table 3: Macroeconomic Results when land is immobile (in %Change)

Variables	Real GDP	Utility HH1	Utility HH2	Utility HH3	HH Cons.	Inv't	Gov't Cons.	Exports	Imports	FFF employed	F3tot_h	Terms of Trade
Minimum age	-0.10	-0.235	-0.144	-0.095	-0.074	-0.145	-0.074	-0.025	-0.023	0.017	0.012	0.011
Stumpage tax	-0.04	-0.047	-0.032	-0.025	-0.018	-0.098	-0.018	-0.006	-0.003	-0.033	0.058	0.006
Discount rate	-0.39	-0.521	-0.346	-0.254	-0.187	-0.830	-0.187	-0.027	-0.027	-0.179	0.431	0.039
Set-aside area	-0.40	-0.926	-0.517	-0.272	-0.245	-0.716	-0.245	-0.201	-0.169	0.083	0.018	0.046
Pop. Growth	-0.03	-10.223	-5.909	-3.544	-0.021	-0.089	-0.021	0.064	0.041	0.496	0.016	-0.006
Tech Coefficient	-0.14	-0.374	-0.226	-0.145	-0.116	-0.154	-0.116	-0.071	-0.061	0.121	-0.061	0.017
Export Tax	0.016	0.016	0.016	0.016	0.010	0.087	0.010	-0.011	0.009	-0.097	-0.008	0.028
Removal of assistance (all sectors)	1.68	2.666	1.460	0.907	0.752	3.008	0.752	12.040	8.776	-1.284	-4.046	-1.148
Removal of assistance (agri)	0.115	0.256	0.124	0.048	0.054	0.157	0.054	1.094	0.812	-0.674	-0.186	-0.109
Removal of assist. (forestry)	0.013	0.005	0.006	0.007	0.004	0.034	0.004	0.097	0.070	-0.027	-0.016	-0.012

Table 3A: Prices when land is immobile (in %Change)

Variables	CPI	Real wage	Real exchange rate	GDP deflator	Product wage	Timber Prices	Price of Agriculture land	Price of Forestland	Nominal wage
Minimum age	-0.016	-0.160	-0.031	0.031	-0.208	9.747	-0.152	35.916	-0.177
Stumpage tax	-0.012	-0.107	-0.019	0.019	-0.138	6.382	-0.071	69.655	-0.119
Discount rate	-0.089	-0.915	-0.172	0.173	-1.173	56.565	-0.671	543.585	-1.00
Set-aside area	-0.184	-0.564	-0.162	0.162	-0.91	62.738	-0.789	369.717	-0.748
Pop. Growth	-0.007	-0.012	0.009	-0.009	-0.01	-0.068	-0.305	1.002	-0.019
Tech Coefficient	-0.015	-0.178	-0.041	0.041	-0.233	11.068	-0.242	-31.126	-0.192
Export Tax	-0.017	0.104	0.044	-0.044	0.131	-7.724	0.144	-38.511	0.087
Removal of assistance (all sectors)	-1.700	6.884	2.524	-2.477	7.573	0.122	2.450	-1.679	5.096
Rem.oval of assistance (agriculture)	-0.118	0.172	0.123	-0.123	0.177	0.216	-1.340	1.220	0.054
Removal of assistance (forestry)	-0.002	0.046	0.015	-0.015	0.06	-1.920	0.052	-9.164	0.045