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Source: *Land Economics*, Vol. 77, No. 2, Tropical Deforestation and Land Use (May, 2001), pp. 241-249
Published by: University of Wisconsin Press
Stable URL: http://www.jstor.org/stable/3147092
Accessed: 15-08-2017 17:35 UTC

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Land Use Impacts of Agricultural Intensification and Fuelwood Taxation in Uganda

Bernard Bashaasha, David S. Kraybill, and Douglas D. Southgate

ABSTRACT. *The market and land-use impacts of agricultural intensification and fuelwood taxation in Uganda have been estimated using a computable general equilibrium model. Across-the-board yield growth causes total agricultural output to rise and commodity prices to fall. Forest area increases, as does land planted to cash crops. But other uses of rural natural resources decline, including the area planted to food crops. Taxing raw material inputs to fuelwood production leads to an increase in price and a decrease in consumption and production. However, forest area does not expand. Instead, it contracts a little.* (JEL Q11, Q23)

I. INTRODUCTION

As in many other parts of the developing world, deforestation in Uganda has reached an advanced cumulative stage. From 7.10 million hectares one hundred years ago, tree cover has declined markedly—to 1.35 million hectares (World Bank 1993), or 7% of the national territory, as of the early 1990s. Habitat loss has coincided with agriculture's geographic expansion as well as depletive fuelwood extraction. The total area planted to crops rose from 3.25 million hectares in 1980 to 4.60 million hectares in 1993 (World Bank 1993). At present, annual consumption of fuelwood, which is favored by the vast majority of urban and rural households as well as industrial enterprises, amounts to 18.3 million cubic meters. This exceeds sustainable output, which is estimated to be 15.6 million cubic meters, by 20% (MNR 1994).

Agriculture's geographic expansion and increasing fuelwood collection are both linked to population growth, which is currently averaging 2.8% per annum in Uganda. The demographic impulse for land use conversion, in particular, is strong because agricultural yields are low. Because investment needed to boost productivity has long been lacking, wide gaps exist between output-per-hectare on experimental plots (a measure of potential yields) and what the average Ugandan farmer actually harvests. To cite three examples, actual yields as a percentage of potential levels are 51% for maize, 68% for soybeans, and 55% for sunflowers (OSU, 1993). With productivity low, the agricultural sector has been obliged to meet burgeoning commodity demands almost exclusively by using more land for farming and ranching.

During the past ten years, yield-enhancing investment has started to occur. For example, the National Agricultural Research Organization (NARO) was created in 1992 and its budget has grown substantially, from $7.27 million in 1993/94 to $15.48 million in 1996/97. However, the increased productivity that improved science and technology make possible might actually accelerate agricultural land clearing. Among others, Kaimowitz and Angelsen (1998) contend that the land use impacts of agricultural intensification are ambiguous. It is to be expected, for example, that higher yields will result in deforestation if commodity demand is price-elastic. This would certainly be the case for a small nation that sells much of its output in global markets in which it is a price-taker. But if demand is inelastic, as it is for many food items, some landowners are bound to

Land Economics • May 2001 • 77 (2): 241–249
ISSN 0023-7639 © 2001 by the Board of Regents of the University of Wisconsin System

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Research funding provided by the Rockefeller Foundation. Salaries and research support provided by state and federal funds appropriated to the Ohio Agricultural Research and Development Center, The Ohio State University.

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find their earnings adversely affected by technological change, the revenue losses associated with lower prices outweighing what is gained in the form of lower costs and higher output. Over the long run, these farmers switch real estate and other assets out of agriculture. Southgate (1998) points out that this consequence of intensification tends to be especially pronounced near agriculture's extensive margins. Regression analyses carried out by Barbier and Burgess (1997) indicate that, as a rule, the relationship between yields and forest loss is, indeed, negative.

By no means is deforestation in the face of inelastic commodity demand and agricultural intensification inconceivable. If property rights are attenuated, individuals take advantage of any and every opportunity to seize resources by occupying or harvesting them. Agricultural colonization of unclaimed hinterlands is a case in point. Depletive harvesting of forest products is another. In Uganda, for example, there are no effective restrictions on the harvesting of fuelwood in what are supposedly state forests, over which the government has no effective control. Accordingly, the rent dissipation and resource overexploitation characteristic of open access are prominently on display.

To say the least, then, arresting deforestation in a place like Uganda is a major challenge. This paper addresses two possible remedies. One is agricultural intensification, resulting from improved support for agricultural research and extension. The other is to impose a tax, reflecting resource replacement costs, on the raw material inputs to fuelwood production. Since most Ugandan households are poor and therefore spend large shares of their earnings on food and fuel, either policy initiative is bound to have significant economy-wide impacts. Accordingly, a computable general equilibrium (CGE) model has been used to analyze the effects of improved agricultural technology and fuelwood taxation.

II. THE COMPUTABLE GENERAL EQUILIBRIUM MODEL

Our CGE model, described in detail in Bashaasha (1998), computes a long-run equilibrium based on the assumption that resources, including land, are allocated among different sectors of the economy so as to maximize net social returns. Comparison of different long-run equilibria, each corresponding to a particular policy scenario, does not allow the possibility of path-dependency of adjustment from one equilibrium to another to be investigated. For example, our model cannot be used to determine whether the ultimate land-use impacts of, say, higher agricultural yields might be affected by the specific sequence of responses that households and farmers make to this change.

Like many others, this model has no spatial dimension. Only the aggregate land areas allocated to different uses are examined. In addition, we assume that the aggregate supply of land is fixed and its allocation among different sectors is determined by relative net returns. For example, an increase in agricultural rents, resulting perhaps from higher commodity prices, causes farming to take place where forests would otherwise stand, all else remaining the same of course.

Treating the Ugandan economy's land endowment as fixed is reasonable. No part of the country, other than a few well-guarded parks, is uninhabited; economic activity—at the very least, herding and fuelwood collection—occurs everywhere. In such a setting, expanding the area where the "human footprint" cannot be detected is not a viable option. Instead, environmental goals must be achieved by promoting economic land uses, like forestry, that yield more environmental services than do others, such as agriculture. True, this approach rarely yields instantaneous results. For example, reforestation of land where agriculture is no longer profitable takes time. This sort of lag is not captured, of course, in our CGE model.

The structure of the model relates to the focus on land use, especially the extent of forests. In particular, the Ugandan economy is divided into six sectors. One, which occupies a small part of the national territory, encompasses manufacturing and services, including services provided by government. In addition, there are separate forestry and fuelwood sectors, the latter using negligible amounts of land and drawing raw materials from the former. The remaining sectors are cash crops (including coffee and other ex-

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ports), food crops, and other agriculture (mainly livestock). This disaggregation of the national economy, generally, and its rural parts, specifically, is needed to investigate how policy changes, which affect living standards, affect consumption patterns and ultimately land use.

Households, which supply factors of production and receive income in return, are disaggregated into three categories: rural, urban poor, and urban affluent. In addition to consuming goods and services, households save a portion of their earnings. All these savings are used to purchase investment goods. Government, which collects taxes from industries and households, spends its revenues on goods and services. It is assumed that government savings are fixed at the level recorded in the base year.

Production technology is specified as a nested function that combines primary as well as intermediate inputs. To be specific, a primary input aggregate, which is a Cobb-Douglas function of capital, land, and labor, is combined with intermediate inputs in fixed proportions to produce output. Having convex isoquants and being a good approximation of production processes for which factors are imperfect substitutes, the Cobb-Douglas function can be calibrated using information contained in a social accounting matrix (SAM). This formulation is appropriate for this study since the data needed for econometric estimation of other functional forms are not currently available.

In this model, trade flows respond to endogenous changes within Uganda as compared to the rest of a world. Since the country is a very small player in the global economy, international prices for all traded commodities are fixed. As in other CGE models, the Armington (1969) assumption—that imports and domestic goods are imperfect substitutes—is adopted. Likewise, export sales and domestic sales are also treated as imperfect substitutes. Foreign savings (borrowing) are fixed and the foreign sector is brought into equilibrium through movements in a Swan-Salter real exchange rate, which is a ratio of prices for traded and non-traded goods (Salter, 1959).

The model is calibrated to a SAM prepared using data obtained from the Statistics Department (SD) of the Ministry of Finance and Economic Planning (MFEP). The six production sectors were aggregated from the SD's 1992 input-output (I-O) table, which features thirty sectors. The single household sector in the I-O table was disaggregated into three household groups using expenditure and income shares based on two SD household surveys, one carried out in 1990 and the other in 1992 and 1993. Along with the SD's National Income and Product Accounts (NIPAs), these same household surveys were used to fill in the final payments quadrant, which is typically left blank in an I-O table, to transform it into a complete SAM. To ensure accounting consistency in the data, I-O row and column totals were maintained and fourth-quadrant values in the SAM were adjusted to be consistent with these totals.

The category "operating surplus" in the input-output table expresses the returns to entrepreneurship, management, and natural resources. Land was isolated from this category using World Bank (1993) and Ministry of Agriculture, Animal Industry and Fisheries (MAAIF) estimates. The basic source of data for the fuelwood account was MFEP (1993), although personnel of the Forestry Department of the Ministry of Natural Resources (MNR) and more than a dozen landowners and private producers of fuelwood were interviewed to verify the accuracy of information about sales and expenditures. Additional data on biomass energy and insights about forestry and fuelwood were obtained from ESD (1996) and the National Environmental Management Authority (NEMA).

Elasticities of trade substitution between domestic and foreign goods and services do not currently exist for Uganda and could not be estimated due to a lack of data. The trade elasticities are borrowed from other studies, including one carried out in Kenya by Tyler and Akinboade (1992) as well as research in Cameroon by Devarajan, Lewis, and Robinson (1991). Sensitivity analyses showed that the general equilibrium results of the model are fairly stable over a wide range of trade elasticities since Uganda imports and exports relatively little food.

Data on agricultural research spending and information on technology development and dissemination strategies were obtained

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from NARO and annual reports of affiliated institutions. The MNR's Forestry Department was the source of data on forestry production. A national biomass study (ESD 1996) contained useful information on biomass energy in general, and fuelwood supplies in particular. Additional information and insights were obtained from discussions with the following institutions: the Agricultural Secretariat of Bank of Uganda, the Economic Policy Research Center (EPRC), the World Bank country office in Uganda, and MAAIF.

III. RESULTS AND DISCUSSION

Using the CGE model, we have examined the market and land-use impacts resulting both from improved agricultural productivity, which is made possible by recent increases in support for agricultural research and extension, and from a tax on the raw material inputs to fuelwood production. This tax equals resource replacement costs—to be specific, the expense of producing raw materials in a plantation setting.

In particular, two scenarios relating to Hicks-neutral technological change are investigated. The first corresponds to a 3%, one-time productivity increase, as modeled by an upward adjustment in the intercept of the Cobb-Douglas function. The second scenario introduces a 30%, one-time increase of the same intercept. Ugandan production of cash and food crops is currently growing at around 3% annually, so the first scenario is a very conservative approximation of the productivity improvements that the country's farmers and ranchers can achieve. If 3% annual productivity growth were sustained for a little less than ten years, the overall improvement would be 30%, which is what is supposed in the second scenario. In a series of sub-scenarios, productivity growth of 3 or 30% is investigated separately for each of the three parts of the agricultural economy: cash crops, food crops, and other (mainly livestock, as indicated above).

The price currently paid for raw material inputs to fuelwood production, which currently averages Ush 6,818 per ton, only reflects private logging and hauling expenses. None of the costs associated with forest resource depletion are internalized. The best available measure of social cost—private extraction expenditures plus resource depletion costs—is the expense of producing wood on a plantation: Ush 16,168 per ton (Bashaasha 1998; ESD 1996). To examine the impacts of internalizing resource values, we run the CGE model assuming that a tax equal to the difference between social cost and private expenses—Ush 9,350 per ton—is applied, with all the revenues obtained spent on the forestry sector (i.e., the source of raw materials).

Many of the simulations carried out with the CGE model confirm a priori notions about what is required to change land use and to improve economic performance in the countryside. This is certainly true of many of the impacts of higher agricultural productivity. However, some of our findings are counter-intuitive. For example, fuelwood taxation, which is supposed to end the neglect of resource user costs, actually ends up leading to a decline in forest area.

The Impacts of Agricultural Productivity Gains

As is to be expected, technologically neutral improvements in agricultural productivity lead to lower commodity prices as well as increased crop and livestock output. The consequences for land use, in particular the area devoted to farming and ranching versus the area where trees and other natural vegetation remain in place, depend on demand elasticities. If, for example, purchases of a crop are highly sensitive to price changes, then yield growth causes the area planted to that crop to increase. By contrast, planted area declines because of improved productivity if commodity demand is price-inelastic. Results reported in Table 1 show that an increase in productivity in all agricultural sectors leads to lower agricultural prices. This lowers the relative return to factors of production employed in agriculture and induces the reallocation of factors to other sectors of the economy. The decline in relative factor returns in agriculture due to technological change and the freeing of resources for use in other sectors is consistent with observed

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TABLE 1
PRICE, OUTPUT, AND LAND USE CHANGES INDUCED BY AN ACROSS-THE-BOARD INCREASE IN AGRICULTURAL PRODUCTIVITY

	With 3% Productivity Shift	With 30% Productivity Shift
Relative Change (%) in:		
Producer Prices		
Cash Crops	−0.3	−2.3
Food Crops	−1.6	−12.0
Other Agriculture	−1.5	−11.1
Output		
Cash Crops	5.1	52.5
Food Crops	2.9	28.9
Other Agriculture	2.8	27.6
Land Use		
Cash Crops	3.0	26.0
Food Crops	−0.2	−1.3
Other Agriculture	−0.3	−2.5
Forestry	0.1	1.0
Manufacturing & Services	0.1	0.6

long run trends in many countries. The resources freed from agriculture are shifted to other sectors, and incomes rise as a result.

The importance of demand elasticity is revealed in an assessment of the impacts of uniform and technologically neutral productivity gains throughout the agricultural economy. As indicated in Table 1, output rises across the board and there is a general decline in prices. Since practically all food crops and livestock products are consumed domestically, demand for those goods is much less price elastic than is export demand for cash crops. Accordingly, supply increases associated with technological progress have an appreciable effect on prices in the former sectors. Of course, price reductions enhance purchasing power, and therefore cause consumption to rise throughout the economy. In contrast, output from the cash crop sector is destined for foreign markets, in which changes in the volume of coffee, tea, and other Ugandan exports have no significant effect on world prices. Accordingly, technological change at the national level has only a very small effect on prices.

Changes in inter-sectoral resource allocation also reflect differences in demand elasticity. Less land is used to raise domestically consumed food crops and livestock products. Meanwhile, the area planted to cash crops increases dramatically, especially for the case of a 30% productivity gain. Perhaps the most significant result, though, is that tree-covered area does not decline; to the contrary, there is actually a small increase. General technological improvement, then, has a number of desirable consequences. Consumers benefit because the food items they purchase are cheaper and more readily available. Production of coffee, tea, and other commodities in which Uganda holds a comparative advantage expands dramatically. Since those commodities' prices are not much affected, export earnings likewise experience significant growth. Finally, all of this is accomplished without deforestation.

If productivity gains are not experienced in the entire agricultural economy, the impacts may not be universally beneficial. Consider the case of technologically neutral improvement in the cash crop sector, alone. As indicated in Table 2, change of this sort would lead to sizable increases in cash crop production as well as in the resources devoted to that activity. Forest area would not be affected. However, expansion of the cash crop sector would be accomplished at the expense of production and land use in the rest of the agricultural economy. Consequently, domestic prices of food items would rise. Since formal mechanisms for income transfer are very rudimentary in places like Uganda, the adverse welfare impacts associated with this change could easily outweigh the benefits of increased exports.

There are other negative consequences of productivity-enhancing investment targeted exclusively on the cash crop sector. For example, international commodity prices fluctuate, which leads to corresponding variation in the fortunes of an economy, like Uganda's, that specializes in the production and export of one or a few commodities. This sort of difficulty, which this study does not address, is stressed by those concerned about

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TABLE 2
PRICE, OUTPUT, AND LAND USE CHANGES INDUCED BY INCREASED PRODUCTIVITY IN THE CASH CROP SECTOR ALONE

	With 3% Productivity Shift	With 30% Productivity Shift
Relative Change (%) in:		
Producer Prices		
Cash Crops	−0.4	−2.4
Food Crops	1.1	11.4
Other Agriculture	1.1	11.1
Output		
Cash Crops	5.8	61.1
Food Crops	−0.1	−0.5
Other Agriculture	−0.1	−0.5
Land Use		
Cash Crops	3.9	36.1
Food Crops	−0.1	−0.8
Other Agriculture	−0.1	−0.9
Forestry	0.0	−0.2
Manufacturing & Services	−0.2	−1.5

TABLE 3
PRICE, OUTPUT, AND LAND USE CHANGES INDUCED BY INCREASED PRODUCTIVITY IN THE FOOD CROP SECTOR ALONE

	With 3% Productivity Shift	With 30% Productivity Shift
Relative Change (%) in:		
Producer Prices		
Cash Crops	0.0	0.4
Food Crops	−2.7	−20.1
Other Agriculture	0.2	2.3
Output		
Cash Crops	−0.5	−5.0
Food Crops	3.0	29.6
Other Agriculture	0.0	0.0
Land Use		
Cash Crops	−0.7	−7.0
Food Crops	−0.1	−0.5
Other Agriculture	0.0	0.1
Forestry	0.1	0.6
Manufacturing & Services	0.2	1.3

food security and economic development. They would advocate a different sort of sectoral preference, one emphasizing productivity gains in food crops over gains related to exportable commodities. However, this strategy also involves sizable welfare losses and does not save any additional forests.

Reported in Table 3 are the results of simulations of technological improvement in the food crop sector alone. As one should expect, production in that sector goes up dramatically and there is a significant decline in prices. There is a modest reduction in sectoral land use as the returns to food crop production decline relative to returns in other sectors. Land use and output declines in the cash crop sector. Also, forestry and manufacturing and services experience geographic expansion. However, the increase in forest area is no larger than what is observed for across-the-board agricultural productivity improvement (Table 1). Thus, the habitat conservation benefits of a "food first" approach to agricultural development are no greater than those of the non-targeted strategy, which has the additional merit of resulting in increased output of commodities in which Uganda holds a comparative advantage.

Bashaasha (1998) has simulated the effects of other improvements in agricultural productivity. In general, his findings are consistent with those presented here.

The Consequences of Taxing Fuelwood

In this scenario, a tax of Ush 9,350 is collected on every ton of raw materials used to produce fuelwood and tax revenues are spent on investment goods (domestic and imported manufactures) destined for the forestry sector. Since the model is static, this allocation of revenues leads to an increase only in final demand and not in productive capacity of the forestry sector. The simulated impacts of this policy change are at odds with cursory thinking on the subject. In particular, taxing raw material inputs to fuelwood production to internalize resource values does not lead to an

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increase in tree-covered area. Rather, it induces a modest decline.

Two market realities underlie this result. First, as the price of fuelwood rises, consumption declines. In part this reflects the diminished purchasing power of households. But there is also a substitution effect, with other goods and services now being relatively cheaper. Second, substitution occurs among inputs to fuelwood production. Higher raw material prices, which are a direct consequence of the tax, induce more use of labor and other non-resource inputs. This raises conversion efficiencies in, for example, the production of charcoal, which is the preferred fuel in urban areas.

The changes in price and production caused by fuelwood taxation reflect the differences between demand and supply elasticities. In the CGE simulation, the market value of fuelwood increases by 22%, which is much less than the relative difference between the tax on raw material inputs (Ush 9,350 per ton) and price before introduction of the tax (Ush 6,818 per ton). The change in equilibrium output is smaller: 14%.

Forest area declines under this scenario because substitution from raw materials to other inputs occurs in the fuelwood sector. With usage of forest products diminished, a small amount of land ends up being diverted to the cash crop sector (Table 4). Bashaasha (1998) has investigated other fuelwood taxation possibilities. Among other things, he finds that the transfer of land from forestry to cash crops is larger if revenues generated by the tax are spent on activities, like technology development and transfer, that make the forestry sector more productive. The lesson to be drawn is straightforward. In that sector, as in other parts of the rural economy, lower output prices combined with enhanced productivity result in diminished land use.

TABLE 4

PRICE, OUTPUT, AND LAND USE CHANGES RESULTING FROM A TAX ON FUELWOOD CONSUMPTION

	Relative Change (%)
Fuelwood Producer Prices	22.0
Fuelwood Output	−13.5
Land Use	
Cash Crops	0.3
Forestry	−0.4
Other Sectors	0.0

Sensitivity Analysis

We conducted sensitivity analysis to determine the effects of trade elasticities on model results, focusing on across-the-board increase in agricultural productivity. The model was re-run several times with trade elasticities that were half or twice the original values. Output and land use results changed significantly only in the cash crop sector, and even there the changes were modest. Results in other sectors differed little. Under a 3% agricultural productivity increase, cash crop output increases by 5.1% when the original (central) values of all trade elasticities are used. In contrast, cash crop output increases by 5.0% when trade elasticities are halved and by 5.8% when they are doubled. Land use in the cash crop sector, which increases by 3.0% when the original (central) trade elasticity values are used, increases by 2.8% when all trade elasticties are halved and by 4.0% when they are doubled.

The model also utilizes factor substitution elasticities and consumption substitution elasticities, and these could affect model results as well. We do not conduct sensitivity analysis on these elasticities, however, since by choosing the Cobb-Douglas functional form, the elasticities of substitution in production and consumption are arbitrarily set at one. While unitary elasticities—implying major responses by producers and consumers to price changes—may be unrealistically high for some developing countries, we believe they are reasonable for Uganda, which has implemented impressive market reforms over the past decade.

IV. CONCLUSIONS

Among agricultural development specialists as well as environmentalists intent on conserving biodiverse habitats, there is a general consensus that finding better ways to produce crops and livestock helps to curb

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deforestation in Africa, Asia, and Latin America. Although quite a lot of evidence exists to support this point of view, the relationship between agricultural productivity growth and habitat conservation turns out to be more complex and ambiguous. Having carried out a thorough review of the existing literature, Kaimowitz and Angelsen (1998) conclude that there are various circumstances under which agricultural development actually accelerates deforestation.

The study presented in this paper corroborates the optimistic view that economic progress in the countryside and habitat conservation tend to be complementary while simultaneously validating some of what is said by those with a more skeptical perspective. An especially encouraging result is that across-the-board productivity gains in the agricultural economy lead to simultaneous increases in cash crops sold to foreigners, food items consumed domestically, and the area covered with natural vegetation. Almost certainly, the additional welfare created by this balanced approach to agricultural development far exceeds what can be gained by stressing technological improvement in a particular sector, be it export or food crops.

Our findings confirm that productivity gains can, indeed, cause forest loss. Raising productivity in the export sector, in which demand elasticity is high, can easily lead to an expansion of cropped area, perhaps at the expense of natural habitats. By contrast, our findings suggest that the improvement in living standards resulting from increased yields and lower prices of food crops causes households to alter consumption patterns. Rather than using all additional purchasing power to buy more food, they increase their spending on other things, such as energy and manufactured items. Land use expands in the sectors that produce the latter goods and services.

It is also reasonable to conclude that raising agricultural productivity is a more efficacious approach to habitat conservation than using fiscal instruments to resolve the problem of neglected resource values. The limited effectiveness of fuelwood taxation ought not to disappoint the Ugandan government. Soon after coming to power, the National Resistance Movement (NRM) imposed a charcoal tax, which can be interpreted as an attempt to force consumers to internalize the user costs associated with forest resource depletion. However, the tax proved to be highly unpopular, provoking public demonstrations that led to its being withdrawn. Our findings suggest that this will not greatly accelerate deforestation in Uganda.

As can be said of any study, the research described in this article has its limitations. Some, like neglect of the stochastic nature of agricultural income, have been mentioned already. Also, data limitations are bound to be severe in an impoverished nation like Uganda, where little funding is available for collecting the sort of information needed to elaborate a CGE model, to estimate the replacement cost of forest resources, and so forth. Uganda emerged from economic chaos barely ten years ago, which means that only now are opportunities to estimate demand elasticities and other model parameters beginning to present themselves.

In future research, it would be appropriate to use a less aggregated model, one that lends itself to the analysis of specific changes in policies and institutions. Another alternative, which should be considered as the necessary data become available, would be to elaborate a dynamic model, which can be used to examine the path-dependency of changes from one economic equilibrium to another.

Nevertheless, studies of the kind we have carried out are useful because they yield important findings that could not be obtained in a partial equilibrium analytical framework. By assessing economy-wide impacts of changes in policy and technology, we hope to have shed light on effective strategies for achieving economic progress and habitat conservation in the countryside. Certainly, our findings add to the empirical base for distinguishing between the circumstances under which agricultural development arrests deforestation and the conditions under which it does not.

References

Armington, P. 1969. "A Theory of Demand for Products Distinguished by Place of Production." *IMF Staff Papers* 16 (1): 159–78.

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Barbier, E., and J. Burgess. 1997. "The Economics of Tropical Forest Land Use." *Land Economics* 73 (May): 174–95.

Bashaasha, B. 1998. "Public Policy and Rural Land Use in Uganda." Ph.D. diss., Ohio State University.

Devarajan, S., J. Lewis, and S. Robinson. 1991. "From Stylized to Applied Models: Building Multisector CGE Models for Policy Analysis." Working Paper No. 616. Department of Agricultural and Resource Economics, University of California, Berkeley.

Energy for Sustainable Development (ESD). 1996. "A Study of Woody Biomass Derived Energy Supplies in Uganda" (Report to MNR).

Kaimowitz, D., and A. Angelsen. 1998. *Economic Models of Tropical Deforestation: A Review.* Bogor, Indonesia: Center for International Forestry Research.

Ministry of Finance and Economic Planning (MFEP). 1993. *Background to the Budget,* 1993–94. Entebbe, Uganda.

Ministry of Natural Resources (MNR). 1994. *State of the Environment Report for Uganda.* Kampala, Uganda.

Ohio State University (OSU). 1993. "Manpower for Agricultural Development Project." (Report to USAID). Columbus, Ohio.

Salter, W. 1959. "Internal and External Balance: The Role of Prices and Expenditure Effects." *Economic Record* 35 (Aug.): 226–38.

Southgate, D. 1998. *Tropical Forest Conservation: An Economic Assessment of the Alternatives in Latin America.* New York: Oxford University Press.

Tyler, G., and O. Akinboade. 1992. "Structural Adjustment and Poverty: A Computable General Equilibrium Model of the Kenyan Economy." *Oxford Agrarian Studies* 20 (1): 283–89.

World Bank. 1993. "Uganda: Agriculture" (Country Study). Washington, D.C.: World Bank.

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