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Office of International Cooperation and Development
Forest Service, Forestry Support Program and
Southeastern Forest Experiment Station



Supported and funded by
Bureau for Science and Technology
Agency for International Development

Southeastern Center for Forest Economics Research

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to Import Substitution of Softwood Lumber in Jamaica

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Working Paper No. 34

FPEI Working Paper Series
June, 1988

The SCFER Institutions
USDA Forest Service Southeastern Forest Experiment Station
North Carolina State University Duke University

Welker, John C. 1988. Application of a Dynamic Investment Scheduling Model to Import Substitution of Softwood Lumber in Jamaica. Southeastern Center for Forest Economics Research, Research Triangle Park, NC. FPEI Working Paper No. 34, 12pp.

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This working paper summarizes a Ph.D. dissertation of the same title at North Carolina State University. The conclusions and recommendations are presented first. Subsequent sections are organized by the economic or political agent to which the results are likely to be most relevant. In these sections, the most salient points are underlined. The endnotes cite the dissertation sections, figures, and tables which correspond to the statements made in this working paper.

GENERAL CONCLUSIONS AND RECOMMENDATIONS

1. Given a 5% real interest rate (i.e. net of inflation), Jamaica should become self-sufficient in pine lumber production. At a 9% real interest rate it may be preferable to rely all or in part on imports, particularly if the value of wood by-products from import-grade lumber production continues to be low.
2. Factors which could increase Jamaica's dependency on pine lumber imports are: inadequate strength properties of domestically-produced lumber, difficulty in using government lands for pine management due to allocation for wilderness and recreation uses as well as agricultural crop plantings on erosion-prone lands.
3. Factors which could reduce imports and raise incomes are: pine management on privately-held fallow lands and greater values for wood by-products from import-grade lumber production.
4. The April 1986 tariff is clearly suboptimal for welfare maximization if market prices are used to value inputs and outputs. However, welfare is greater with the tariff if economic shadow prices are used.
5. Regardless of the set of prices used, the current sales agreement between FIDCO and the JCTC is suboptimal for welfare maximization.
6. Blue Mountain coffee is by far the most profitable land use in the study area. Increasing production beyond current Coffee Industry Board expansion plans would increase domestic incomes.
7. It is more profitable for coffee expansion to take place on roaded lands currently in agricultural or fallow use, rather than on existing pine lands. Coordination of road construction activities between FIDCO and the Coffee Industry Development Company (CIDCO) will increase total income.
8. If one fails to consider the cost of soil erosion, domestic agriculture is more profitable than pine management. However, with present production techniques only about 1500 hectares in the study area can be farmed without excessive rates of erosion.

INTRODUCTION

The land base of the study is approximately 99,000 hectares in eastern Jamaica which have soils and climate suitable for Caribbean pine (Pinus caribaea var. hondurensis). The attached Figure 5 from the dissertation is a map of the study area. The "districts" are land classes which are relatively homogeneous with respect to topography, distance from lumber processing facilities, and site productivity.

Approximately 36% of the lands are owned by the government; the remainder are owned by private individuals or organizations. Land uses in 1986 were: pine management (15%); agricultural crops (11%); Blue Mountain Coffee (3%); Lowland Coffee (3%); commercially valuable hardwood forest (3%); and unimproved pasture, bush fallow, rinate forest (65%). Lands are generally unsuitable for intensive use due to steep slopes and erosion risk. Without special measures for erosion control, only about 2% of the lands are suitable for agricultural crops.²

Since 1966 Jamaica has consumed about 55,000 cubic meters of import-grade pine lumber annually, mostly imports from the United States and Central America. However, by 1985 domestic production represented 24% of total consumption.³ This was largely from FIDCO production based on plantations established on government-owned lands. The study considers the "opportunity cost" of producing pine lumber by calculating the expected land rents for each of the current uses. The land-use and import-substitution effects of government policies with respect to tariffs, domestic pricing, land-use restrictions, and coffee expansion are also examined.

The study methodology comprises three parts:

- (1) Various microcomputer programs to summarize the time streams of physical inputs and outputs, costs, and revenues for each type of land use;
- (2) A microcomputer-based linear program for determining the optimal long-run targets with respect to land-use, lumber imports, and domestic production; and
- (3) A dynamic linear program used to calculate the optimal time paths of land use, lumber imports, inputs, and domestic outputs toward the set of long-run targets.

Both linear programs assume that the objective is to maximize the discounted income from the land resource subject to a set of fiscal policies and political constraints. The dynamic linear program calculates the optimal harvest age of existing pine plantations and the optimal harvest ages and planting dates of future plantations.

PLANTATION-BASED PINE LUMBER PRODUCTION

(1) Land Rents from Pine Management

Land rents from pine management are highest in Districts A, C, F, and B. They are lowest in Districts D and E. Factors considered in this valuation are site productivity, distance from the FIDCO sawmill, and topography. District A has a relatively short haul distance to the sawmill and a moderate site index (42 km. and SI= 23.8). District C is the most distant (105 km.) but has the highest average site index (29.2). District F also has long transport distances (100 km.) but topographic conditions permit skidder harvesting.

The harvest age which maximizes the land rent varies significantly among districts as a result of both site factors and relative input and output prices. Poorer quality sites (Districts D and E) have longer optimal harvest ages (about 23 years) than better sites. Optimal harvest age is less (about 18 years) in District F and C, with skidder harvesting and high site productivity, respectively.

(2) Road Construction and Maintenance

Road construction and maintenance activities account for about 4% of total discounted lumber costs. The importance of roading activities for subsequent profitability is much greater than its proportion of total cost. Plantation management and harvesting costs could be reduced if pine stands were in larger contiguous blocks. Strategic plans with respect to site selection, land use, and land acquisition should be coordinated with road network planning. This is especially true given the difficulties of developing road networks in steep terrain.

(3) Plantation Silviculture and Management

Plantation silviculture represents about 13% of total discounted lumber costs. Site selection and regeneration are the most important management activities with respect to influencing profitability. Land rents are most sensitive to site index, tree stocking, and harvesting topography.

The base case results indicate that about 17,000 hectares in the study area should be allocated to pine management in the long run. Results using economic shadow prices indicate 22,000 hectares. Due to land acquisition difficulties encountered by FIDCO in the past, the study assumes that pine management will only be practiced on government lands. Purchase of private lands by FIDCO or encouragement of pine management in Districts A, C, and F would have the greatest impact toward increasing domestic lumber supply and income.

(4) Harvesting and Transport

Harvesting costs are about 32% of total discounted lumber cost. Skidder harvesting is about one-third the cost of skyline harvesting. To a large extent these costs are determined by road construction and plantation management decisions and outcomes. Skyline harvesting cost is most sensitive to sawlog volume per hectare; whereas, skidder harvesting cost is more influenced by sawlog volume per tree. This suggests that land rents might be increased by varying stand density according to the harvesting system.

FIDCO harvesting data show substantial variation in average monthly crew productivity. For the skyline system the range is from 0.7 to 2.2 cubic meters of sawlogs per crew hour. This suggests that detailed harvesting systems studies would be profitable. The skyline system should receive particular attention since the percent of sawlog volume from this system will increase from about 50% now to 70% in 1988, and 80% in 1992.

FIDCO profits can be increased by modifying log merchandising rules according to site and stand characteristics. Since transport costs vary among districts, the merchandising rules should vary according to the marginal cost of raw material transport. Small sawlogs cannot "pay their way" at long transport distances. The current FIDCO policy of producing posts only in periods of high demand is an example of following this marginal cost principle.

(5) Lumber Processing

The optimal annual levels of lumber imports, domestic production, and capacity utilization are presented below. Self-sufficiency is achieved by 1996 in this base case scenario.

Years	Import-grade Imports	Lumber Domestic	Number of Shifts	Capacity Sawmill	Expansion Kilns
	(thous. cubic meters)			(percent)	
'86-'87	41	9	One	0	0
'88-'89	39	10	One	0	0
'90-'91	31	18	Two	0	57
'92-'93	18	30	Three	0	68
'94-'95	14	34	Three	16	12
'96-'99	0	47	Three	43	40
'00-'03	0	46	Three	0	0
'04-'07	0	52	Three	0	10
'08-'23	0	51	Three	0	0

This schedule indicates a major sawmill expansion between 1994 and 1999. The incremental nature of both kiln and sawmill capacity expansion over several years is an artifact of the methodology rather than indicative of the optimally feasible expansion path.

Large sawlog volumes coming from District C (about 50% of the long-run volume) indicate that profits could be increased by locating new sawmill capacity nearer to this district. The optimal location of new sawmill facilities is outside the scope of this study. The assumption is that all capacity expansion will take place in Twickenham Park. If capacity expansion occurs at another location, the optimal levels and inter-temporal distribution of domestic production and imports will be different.

FIDCO sawmill studies to more accurately determine the relationship between lumber grade recovery and sawmill productivity would probable be profitable. This study used sawmill productivity studies from other locations to extrapolate monthly sawmill data from FIDCO.¹⁰

(6) Marketing

The greatest source of revenue is the sale of import-grade pine lumber. Within this broad use class there exist several lumber size and quality grades with differing production costs and end-use values. The current sales agreement between FIDCO and JCTC provides little incentive for FIDCO to allocate production to those lumber grades with the highest net values to society (end-use value - production cost).¹¹

Sawdust, slabs, edgings, and shavings comprise about 65% of sawlog volume. If by-products are not valued at an amount at least equal to the energy equivalent value from previous studies, then domestic pine lumber production should be less than in the base case results. If higher-valued uses are found for residue and inferior lumber grades (7% of sawlog volume), domestic production of import-grade lumber should be greater. The current substitution of short-length prime lumber (about 4% of sawlog volume) for import-grade lumber is an example of how marketing can improve both consumer welfare and profits.

COFFEE PRODUCTION

Blue Mountain coffee production has higher land rents than any other use; Lowland coffee is the second highest. Using CIDCO production data and a 5% interest rate, land

rents for either Blue Mountain or Lowland coffee do not vary significantly for "crop cycles" between 22 and 33 years.¹²

Base case results indicate that Blue Mountain coffee land use in the study area will rise from 1800 to 3600 from 1985 to 1990; Lowland coffee management will increase to 2900 hectares. Land allocated to both types of coffee is constrained by production quotas and expansion plans of the CIB and CIDCO.

Given limited investment funds, expansion plans should be revised in favor of increased Blue Mountain and "High Mountain" coffee and less Lowland coffee. Even considering a fall in Blue Mountain coffee prices with expanded production to High Mountain coffee areas, the results suggest that welfare would be greater if the expansion targets were increased. Using the study methodology, the price effects of different coffee production strategies and expansion plans could be evaluated by including demand functions for coffee.¹³

Greater coordination of road planning and construction by FIDCO and CIDCO should increase social welfare as well as profits of both organizations. When roading costs are considered, study results show that social welfare is greater if expansion takes place on agricultural or fallow land rather than land being managed for pine. The main reason is greater road density and higher road standards for pine harvesting. Coffee expansion where pine harvesting roads exist is a waste of road assets. Land transfer policies which consider the opportunity costs of both existing road networks and harvesting immature pine stands prevent mis-allocation of scarce resources.

DOMESTIC AGRICULTURAL CROPS

Private land rents from domestic crop production are higher than for pine management but lower than for coffee production. However, private land rents exclude the social costs of soil erosion and poorer water quality with crop management on steep slopes. Only about 1500 hectares of the current 7000 hectares managed for agriculture is classified as having slopes with acceptable rates of erosion with agricultural management.¹⁴

Domestic crop production on erosion-prone lands will probably continue and possibly expand given the current financial incentives for small farmers to continue current practices. The political economy of Jamaica is such that it is unlikely that creation and enforcement of land-use restrictions is a feasible solution to this complex problem. It was outside the scope of the study to suggest specific

solutions; however, the results suggest some possible strategies. Private land rents using existing agricultural practices serve as a basis for judging the difficulty of gaining farmer's acceptance of practices with tolerable levels of soil loss. In the absence of policing actions or subsidies, new practices will only be adopted if they can be demonstrated to have higher private land rents.

Agricultural inter-cropping on pine lands for the first two years of the rotation could provide substantial benefits to both FIDCO and small farmers. With 20,000 hectares managed for pine lumber production on a 20-year rotation, a maximum of 2,000 hectares would be available annually by intercropping pine stands one to two years of age. This would require substantial cooperation and coordination of plans between FIDCO, small farmers, and agricultural extension agents. However, the potential gains would probably exceed the costs for each group.

LUMBER IMPORTS AND PRICING POLICY

The study examines the welfare effects of both the April 1986 tariffs on pine lumber imports and the pricing agreement between the JCTC and FIDCO for the sale of domestically produced import-grade pine lumber.¹⁵ These policies are examined using both market prices and "economic shadow prices". The latter prices take into account price distortions which occur in Jamaica.¹⁶ The economic shadow price of foreign exchange is about twenty-five percent higher than the financial price.

The CIF price of import-grade pine lumber (in constant Jamaican dollars) rose about 1.6% per year between 1965 and 1985. The study estimates that future real price increases will be about 1.2% per year. The April 1986 tariff on lumber imports increased the price to lumber distributors by about 22% and decreased demand by the same amount. Study results show that the tariff may be a simple means of maximizing welfare if economic shadow prices are theoretically appropriate but fiscally difficult to apply.

Without domestic production both total and per-capita lumber consumption is projected to decline due to both real price increases and falling per-capita incomes. Even with 100% domestic production, consumption will continue to decline as a result of the combined influence of the April 1986 tariff and the current JCTC/FIDCO sales agreement.

Domestic consumption and social welfare can both be increased if the existing JCTC/FIDCO sales agreement is revised. A preferable agreement would be for FIDCO to

receive the CIF price for its output rather than the tariff-protected price and for JCTC to sell both imported and domestic lumber to distributors in competitive auctions.¹⁷ These auctions would allow prices to reflect consumer's willingness to pay for different grades of lumber. The reduction in FIDCO's and JCTC's long-run profits would be less than the gain to consumers.

The base case results indicate that domestic production will eventually substitute for all imports. Exporters to Jamaica may have a comparative advantage in producing pine lumber of large dimensions for structural uses. Such an advantage may increase the level of imports, particularly if auctions allow lumber distributors to exhibit their preferences for different lumber grades.

LAND-USE POLICY ON GOVERNMENT LANDS

This study did not consider the value and cost of allocating land to wilderness or recreation. An advantage of the methodology is that it can be used to consider the opportunity cost of alternative land-use restrictions in terms of lost income and foreign exchange. Watershed issues were recognized by excluding an estimated 30,000 hectares in the study area from management because of excessive slopes and proximity to streams. Also, pine stands in the Kingston watershed (400 ha.) were excluded from the analysis.

The results indicate that good coordination of land-use plans between FIDCO, CIDCO, the Forestry Department, and the Commissioner of Lands is essential for income maximization. This is particularly true with respect to road construction plans for forestry and coffee uses. The opportunity cost of prohibiting coffee and pine management on certain government lands can be reduced if the government can clearly indicate its intentions. If government policy fluctuates or is unpredictable, foreign exchange and other costs of leaving land for wilderness and recreation uses will be greater.

FOOTNOTES

- 1 See chapter 3 for a description of the study area. The 99,000 hectares includes about 33,000 hectares which were excluded from the analysis because of excessive slopes and their proximity to streams and watercourses.
- 2 See Figure 6, 7, and 9.
- 3 Figure 1 gives imports and domestic production of import-grade lumber. The definitions of the various wood products used in this study are found in Table 6.
- 4 Figures 15 to 20 in Chapter 5 illustrate the effects of various site factors and management actions on the "Faustmann soil expectation value". This value multiplied by the (interest rate / 100) gives the expected annual land rent.
- 5 The detailed cost and production information for pine, coffee, and agricultural crop production are given in Appendix B. The relevant information for road construction is in Table B4, Table B5, and Figure B5.
- 6 See Figure 17 and 18 in Chapter 5 and Figures B1 and B2 in Appendix B.
- 7 Table E2 in Appendix E gives the land-use paths over time. The detailed planting rates by district are contained in the FORPLAN computer output.
- 8 The volumes and productivity for each system are illustrated in Figures 33 and 34 of Chapter 6. Table B6 gives the equations used to relate harvesting productivity to stand characteristics. These relationships are illustrated in Figures B11 to B15.
- 9 See Figures 31 and 32 as well as the comments on page 144 of Chapter 6. Figures B16 and B17 illustrate how different processing cost components vary with capacity utilization levels.
- 10 See Figures B19 to B23.
- 11 "Import-grade lumber" is #2 Common or better by Southern Pine Inspection bureau standards. All other sawlog volume is classified as "wood by-products" from its production.
- 12 The "crop cycle" is the time between plantings. Coffee production assumptions are given on page 221 in Appendix B. Also, see Figure B21.

- 13 Coffee expansion plans are found in the center of Table 10.
- 14 See the top of Table 10 for land capability constraints.
- 15 The price paid by distributors with the tariff is about 22% above the free-trade price.
- 16 The economic shadow prices used in this study are based on a study done by Weiss for the Administrative Staff College in 1984. An explanation of their use is given in Chapter 5, p. 86.
- 17 Other price mechanisms besides auctions might be used to achieve similar aggregate welfare effects. Appendix C discusses the welfare effects of the current pricing policy and suggests one possible alternative.

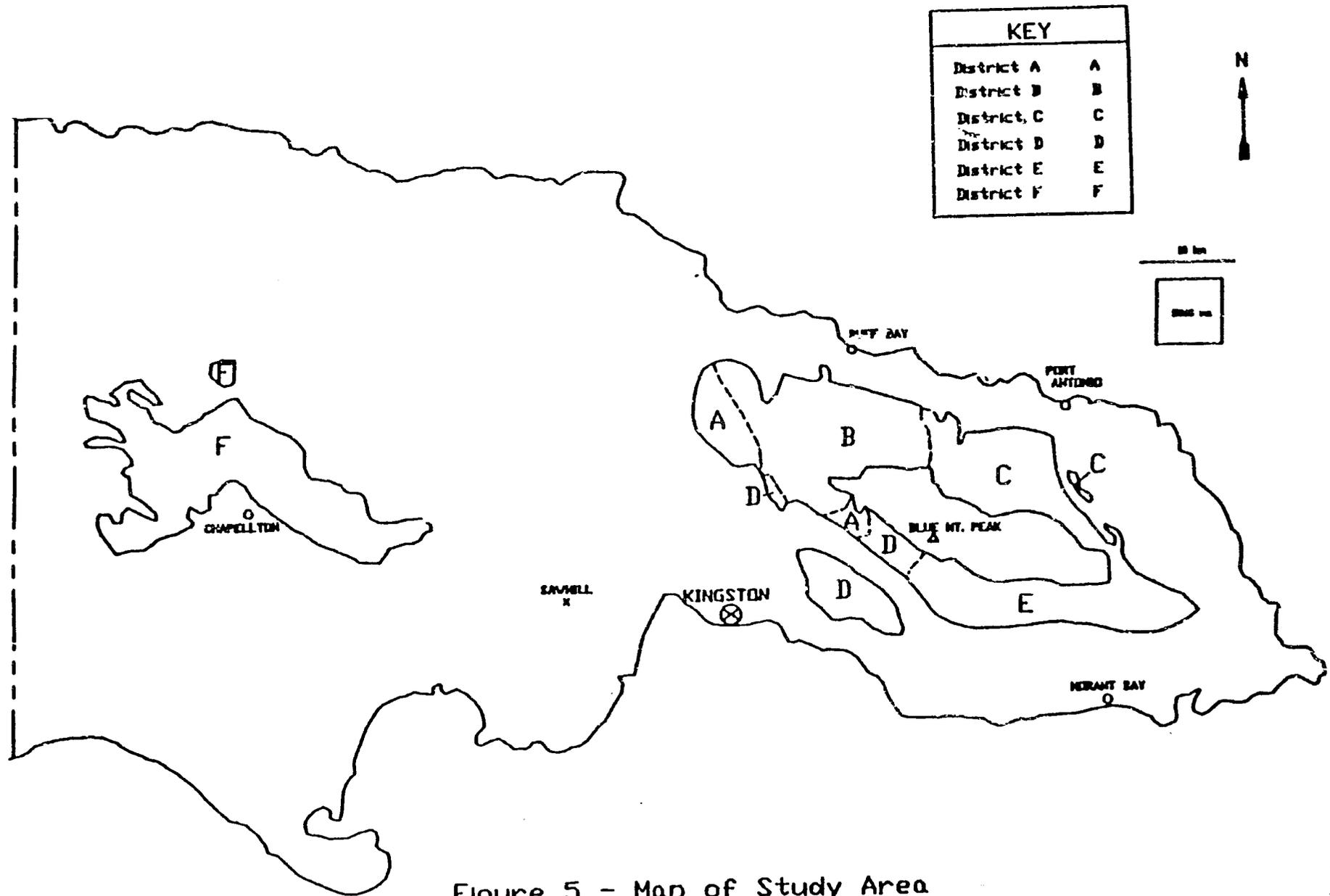


Figure 5 - Map of Study Area

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