

# INTER-INDUSTRY LINKAGES OF FORESTRY AND FOREST INDUSTRY SECTORS IN THE TANZANIAN ECONOMY

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TOIMIALOJEN VÄLISET YHTEYDET TANSANIAN METSÄ- JA PUUTALOUDESSA

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Sawmilling & Carpentry, Forestry & Hunting and Food Grains are the economic sectors of Tanzania compared by means of the total input-output coefficient. The coefficient measures the value of direct and indirect demand in the economy caused by a demand worth one monetary unit on the sector in focus. Forestry sector has the weakest linkage to other sectors. The derived coefficients are 1.693 for Sawmilling & Carpentry, 1.183 for Food Grain and 1.167 for Forestry & Hunting respectively.

## 1. INTRODUCTION

Development efforts of poor countries are always constrained by the scarcity of investible funds. When the scarce financial resources must be allocated for the maximum national benefit, clear-cut decision criteria are needed.

On micro level Net Discounted Revenue, Internal Rate of Return and Financial Benefit-Cost ratio are most frequently used for priority ranking of investment projects. At the macro level the public authority designs policies and guidelines for private and public investors with national and regional development objectives in mind. Economic Benefit-

Cost analysis is one of the quantitative methods used for rationalizing the decision-making process.

Another tool for assessing direct and indirect impacts of different investment alternatives is Input-Output analysis. The objective of this study is to compare the total economic impact consisting of direct and indirect effects of the Forestry and Forest Industry sector with a sample of other sectors in the Tanzanian economy. The comparison is based on An Input-Output Table for Tanzania, 1969 (Pillai 1973).

## 2. MATERIAL AND METHOD

### 2.1. Input-Output analysis

Input-output analysis contains normally three different tables: input-output table, direct coefficients table and total direct and

indirect coefficients table (Chenery and Clark 1959, Schuster 1980). A simple input-output table contains the inter-industry matrix and sectors for primary inputs, final demand and total output. Table 1 gives a simplified hy-

Table 1. A hypothetical input-output table.

Producing sectors	Purchasing sectors				Final demand	Total output
	A	B	C	D		
A	20	30	35	5	10	100
B	15	0	25	20	15	75
C	10	15	20	15	30	90
D	40	25	5	20	30	120
Primary inputs	15	5	5	60	85	
	100	75	90	120		385

Source: Riihinen 1976.

pothetical example of an input-output table in which the economy consists of four sectors; A stands for service, B for forestry, C for industry and D for agriculture sector respectively. In the inter-industry matrix e.g. the row B depicts the destination of the output from industry or sector B. The columns (e.g. C) tell the origin of the inputs/rawmaterials, services and primary inputs, for the output of the respective sector (C). So the output of a sector can be either used as an input for an other sector or it can be absorbed by the final demand and vanish. Primary inputs are not produced by any of the sectors but come from outside: labour, public services, imports and capital consumption.

The direct coefficients table can be derived from the interindustry matrix, which was a part of the input-output table as described above and in Table 1. Take column B which stands for forestry sector. The columns total, the sum of all row elements in the inter-industry matrix (70) plus the respective primary input (5) add up to 75. This column total is made equal to one and the respective column elements are derived. The derived coefficients in columns B of Table 2 tell how much inputs from other sectors must be purchased in order to produce one shilling value of forestry products.

Outputs from various sectors are used as inputs by other sectors. Take an example where the demand of forestry products increases by one million shillings. Forestry sector must buy inputs from machine suppliers, transport services, etc. Machine suppliers must buy additional inputs to produce the

Table 2. Direct coefficients table.

	A	B	C	D
A	0.20	0.40	0.39	0.04
B	0.15	0.00	0.28	0.17
C	0.10	0.20	0.22	0.13
D	0.40	0.33	0.06	0.17
Primary inputs	0.15	0.07	0.06	0.50
Total	1.00	1.00	1.00	1.00

Table 3. Total coefficient table.

	A	B	C	D
A	1.97	1.28	1.49	0.59
B	0.69	1.64	0.98	0.52
C	0.64	0.81	1.93	0.50
D	1.27	1.33	1.25	1.73
Total	4.57	5.06	5.65	3.34

needed machines. The chain (linkage) effect continues several rounds, and the total output increment in the whole economic system is more than the one million shillings. The total coefficient table measuring the impacts, often called Leontief Inverse Matrix (Table 3), is derived from the direct coefficients table:

$$(I - A)^{-1}$$

where I = identity matrix (diagonal element = 1, all others = 0)

A = the direct coefficients table, excluding primary inputs

The column total in the Leontief Inverse Matrix tells the total economic impact of a one shilling increment in the final demand. The Leontief Inverse Matrix obtained from the direct coefficients matrix in Table 2 is presented in Table 3. In this hypothetical example an increment of one shilling in the final demand of forestry products increases the total income of society by shs. 5.06.

## 2.2. The Tanzanian input-output table

The only comprehensive Input-Output analysis for the Tanzanian economy was done by Pillai (1973). The study based on 1969 data of mainland Tanzania, excluded Zanzibar. Nine major industries were defined which were subdivided into 44 production sectors. The agriculture sector was divided into 13 commodity groups, including fishing (12) and forestry and hunting (13). Other sectors are based on activity grouping. Sectors 16-28 are manufacturing industry sectors. The small scale and household processing are contained in sectors 29-31. Public administration and other services are covered by sectors 41-44. Sector 45 contains unspecified production.

Compilation of an input-output table re-

quires a large body of primary data pertaining mainly to the purchases and disposals of each producing sector. In the study of the national accounts of mainland Tanzania a large volume of data was assembled. These data were used as the main source of information for the input-output table construction. The existing essential data gaps were filled through ad-hoc sample surveys and enquiries.

The input-output study presents the input-output table and the direct coefficients table.

The Leontief Inverse Matrix, the direct and indirect coefficients table, has not been worked out as Pillai (1973) did not have computer at his disposal at the time of compilation.

## 3. INTER-INDUSTRY LINKAGES OF FORESTRY AND FOREST INDUSTRY SECTORS

### 3.1. Derivation of the Leontief Inverse Matrix

The derivation was completed with a computerized subroutine for matrix algebra. In order to accommodate the required 45x45 matrices in the computer memory each matrix element was specified with four decimals only. When dealing with small coefficients, the precision of the results may have suffered slightly.

The direct coefficient matrix excluding the primary input coefficients was subtracted from an identity matrix and the inverse of the resulting matrix was obtained. This inverse matrix is the Leontief Inverse Matrix or the total coefficients table.

It was not necessary to reproduce the whole matrix for this study. Table 4 contains for three selected sectors the direct coefficients obtained from Pillai (1973) and the total coefficient resulting from the above computer run. For comparison one agriculture sector, Food Grains, was included. The forestry and forest industry sectors are Forestry & Hunting and Sawmilling & Carpentry respectively.

The column sum for the total coefficient

measures the total economic impact caused by a one shilling increment in the final demand of the sector concerned. Now, if the final demand of forestry sector increases by 1000.00 shs. the total increased income to the nation would be 1167.00 shs.

Many sectors of the original table were omitted in table 4. Only the sectors having interaction with the sectors in focus were included.

### 3.2. Comparisons

Before discussing the different sectors in terms of relative measures like coefficients, their absolute size is depicted using Gross Domestic Product (GDP) in 1969 at factor cost as a yardstick:

Sector	GDP mill.shs.
Food Grains	636.9
Forestry & Hunting	254.3
Sawmilling & Carpentry	28.1

Table 4. Direct and total coefficients for three Tanzanian economic sectors.

Sectors	9. Food Grains		Coefficients 13. Forestry & Hunting		22. Sawmilling & Carpentry	
	Direct	Total	Direct	Total	Direct	Total
1. Seed						
Cotton	-	-	-	0.001	-	0.001
8. Pyrethrum	-	-	-	-	-	0.001
9. Food Grain	0.037	1.039	-	-	-	-
10. Other Crops & Byproducts	-	-	-	0.001	0.020	0.022
13. Forestry & Hunting	-	-	-	1.001	0.050	0.052
15. Other Mining <sup>1)</sup>	-	-	-	-	0.003	0.004
19. Cotton Gining	-	-	-	0.001	-	0.001
20. Textile & Wearing Apparel	0.001	0.002	0.006	0.007	0.003	0.007
22. Sawmilling & Carpentry	-	0.001	-	-	-	1.002
23. Printing & Paper	-	-	-	-	0.006	0.007
24. Chemicals, Petroleum & Rubber Products	-	0.002	-	0.002	0.014	0.022
25. Metallic & Nonmetallic Products	-	0.001	-	0.001	0.040	0.046
26. Railway Workshops	-	0.001	-	0.001	-	0.003
27. Automobile Assembling & Repairs	-	0.002	-	0.003	0.010	0.019
28. Other Manufactures	-	0.001	-	0.001	0.010	0.015
31. Other Small-Scale Industries	0.002	0.003	0.006	0.006	-	0.002
32. Electricity & Water Supply	-	0.001	-	0.001	0.011	0.017
33. Construction	-	0.001	-	0.002	0.003	0.009
34. Whole Sale & Retail Trade	0.076	0.083	0.040	0.046	0.224	0.255
35. Hotels & Restaurants	-	0.001	-	0.001	0.003	0.006
36. Transport	0.033	0.045	0.076	0.086	0.122	0.170
37. Communications	-	0.001	-	0.001	0.002	0.005
38. Banking & Insurance	-	0.004	-	0.003	0.006	0.019
40. Business Services	-	0.001	-	-	0.002	0.005
42. Education	-	-	-	-	-	0.001
44. Other Services	-	0.001	-	-	-	0.002
Primary Inputs	0.851	-	0.872	-	0.471	-
Total	1.000	1.190	1.000	1.165	1.000	1.693

<sup>1</sup> Mines other than diamond

The total GDP for agriculture including domestic and cash crops and animal husbandry was 2097.6 mill. shs. The total coefficients measure the backward linkages of the sectors concerned. The general impression is that industrial sectors have stronger backward linkages than primary production such as agriculture and forestry. Agriculture involves more inputs originating from human efforts than forestry; accordingly the agriculture coefficient should be higher. Table 4 confirms the *ex ante* assumptions. The strength of backward linkages is measured by the column sum of the total coefficients; Sawmilling & Carpentry has the highest column sum and Forestry & Hunting the lowest.

Producer prices were used for valuation of inter-industry flows of commodities, materials and services. This partially explains why the two most important sectors providing inputs to the three sectors in focus are 34 Whole Sale and Retail Trade and 36 Transport.

They score the highest total coefficients in all three cases. Trade and Transport play a

crucial role when inputs are forwarded from their respective place of production to the place of consumption. Those two sectors rank high according to their share in the GDP. Whole Sale & Retail Trade sector is number one and Transport number five. The aggregated GDP for agriculture sectors, as given above, has definitely the largest value followed by Wholesale & Retail Trade, Real Estate and Transport in descending order.

The relatively weak backward linkage from Sawmilling & Carpentry to Forestry & Hunting sector is unusual. Whole Sale & Retail Trade and Transport sectors have higher total coefficients and Metallic & Nonmetallic Products sector is almost as important as the sector providing raw material to the forest industry sector. The artificially low stumpage prices and royalty rates applied might provide an explanation. Another interesting character of Sawmilling & Carpentry is the weak backward linkage to the sector itself. The sector does not directly use at all its own produce as inputs unlike the other sectors.

#### 4. CONCLUDING REMARKS

The contribution of forestry alone to the national economy is very modest, less than three percent of Gross Domestic Product (Jaakko Pöyry 1980). Extensive natural forests and 18 forest plantations provide an opportunity to expand forest industries. Although the total coefficient of forestry sector is rather low, when combined with sawmilling and other forest industries, its development impact can be considerable. The utility of input-output table is in the consideration of direct and indirect impacts caused by the expansion of demand. Often only the direct coefficient is recognized. The total coefficient is always equal to or most often higher than the direct coefficient (Table 4).

The input-output structure of an economy at the macro level is quite stable, the coefficients change slowly. Pillai (1973) recommended the establishment of a new input-output table quinquennially. More than a decade has elapsed since the existing input-output table was produced.

In this input-output table imports were included in the primary inputs. Since then the national industrial policy has favoured import substituting industries. This adds to the need to revise the input-output table for Tanzania.

The ongoing joint effort of the University of Dar es Salaam and Bureau of Statistics for compiling new input-output tables is certainly appreciated. A more detailed sectorial break-down will be applied: approximately 70 sectors are identified. The study is awaiting final touches and is planned to be published in 1984. The data base for the study is 1976.

Unfortunately the study is out-of-date before it comes out from press. It is strongly recommended that concerted efforts are made to secure a prompt compilation of input-output tables as soon as the relevant up-to-date data are available. Otherwise the utility of the whole effort becomes questionable.

## 5. REFERENCE

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## SELOSTE

### TOIMIALOJEN VÄLISET YHTEYDET TANSANIAN METSÄ- JA PUUTALOUESSA

Tutkimuksessa verrataan Tansanian saha- ja puusepänteollisuutta, metsästystä ja kalastusta sekä viljanviljelyä panos-tuotos-kertoimien avulla. Kerroin mittaa kulloinkin tarkasteltavana olevan sektorin yhden rahayksikön arvoisen kysynnän aikaansaaman välittömän ja välillisen kysynnän arvoa kansantaloudessa.

Metsätaloudella on heikoin vaikutus muihin toimialoihin. Estimoidut kertoimet ovat saha- ja puusepänteollisuudessa 1.693 ja viljanviljelyssä 1.183. Metsätalouden ja metsästyksen vastaava kerroin on 1.167.