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Rapport

A Computable General Equilibrium Model for Tanzania

Documentation of the Model, the 1990 – Social Accounting Matrix and Calibration

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Abstract

Ragnhild Balsvik and Anne Brendemoen

A Computable General Equilibrium Model for Tanzania
Documentation of the Model, the 1990 - Social Accoounting Matrix and Calibration

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This report documents a Computable General Equilibrium model for the economy of Tanzania, the Social Accounting Matrix underlying the model, and the calibration of model parameters. The model is developed to account for effects of land degradation processes; this report does, however, only deal with the pure economic part of the model, treating land degradation as an exogenous variable in the agricultural production functions. The model describing the land degradation processes is developed at the Agricultural University of Norway.

The CGE model presented here is quite standard; producers maximise profits subject to Cobb-Douglas production functions, households maximise utility and distribute expenditure according to a linear expenditure system. The model exhibits two way trade assuming imperfect substitution between domestically produced and imported varieties of each good, and between production for the domestic market and export. Prices are endogenous and adjust to obtain market equilibria. Economic growth occurs through growth in the stock of capital, which is determined by savings, exogenous technological progress, and declines in the land degradation processes.

The model is calibrated to produce the Social Accounting Matrix with all prices equal to unity. The Tanzanian Bureau of Statistics provides a number of publications on economic data. Tanzania is however still in the process of developing National Accounting procedures, and the data available are often somewhat inconsistent as different sources often give different figures for what should be the same issue. Much of the official data are based on information from an input-output study from 1976. Furthermore, apart from the agricultural sectors, we have found no gross production figures. The construction of the Social Accounting Matrix has accordingly been a stepwise procedure, based on several somewhat arbitrary and rough assumptions.

Keywords: Development economics, Environmental economics, Computable general equilibrium models, Tanzania

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Contents

1 Introduction*

This report documents the structure and calibration of a computable general equilibrium (CGE) model for the economy of Tanzania. The purpose of the model is to study the links between economic policy measures, agricultural technologies, soil quality and productivity losses due to soil mining and soil erosion, and the overall performance of the national economy. The report is a follow up of the report "Modelling structural adjustment policy and land degradation in Tanzania" (Aune et al.,1994), which gives details on the background for the present project.

Tanzania ranges as one of the poorest countries of the world; a country where agricultural production provides employment, subsistence and income for the majority of the population. Approximately 83 percent of Tanzania's economically active population are participating as smallholders, agro-pastoralists and pastoralists in the agricultural sector. Agriculture's contribution to GDP in Tanzania in 1991 was 61 percent (of which 10 percent is due to livestock breeding). Agricultural products serve as major intermediate inputs in the food-, beverages- and textile industries. Furthermore, in 1990 more than half of Tanzania's export revenue was from agricultural products. Exports is the basis for imports of investment goods like machinery and transport equipment, of which Tanzania is highly dependent. The dominance of agricultural production in Tanzania's national economy suggests that sustainable development within this sector is a prerequisite for sustainable overall economic growth in the long term.

A basic principle of sustainable land use is that input of nutrients should be equal to or higher than the output. One of the main nutrient inputs to an agricultural system is from fertilisers. The main loss of nutrients from the system occurs through the harvested product and by soil erosion. Calculations indicate that nutrient depletion is taking place in Tanzania (Stoorvogel and Smalling, 1990), suggesting that agricultural productivity will decline in the long term. Aune et al., (1994) discusses the present status and causes behind land degradation problems in Tanzania.

The speed and magnitude of decline in land productivity, or land degradation, depend on the cultivated crop, soil properties and whether any measures are adopted to stop or modify the process. Changes in cropping patterns and agricultural techniques will for instance affect land degradation. The Economic Recovery Programme developed by the government of Tanzania and the IMF/World Bank and carried out from 1986 and onwards, offers a profound change in the focus of agricultural and macroeconomic policies. The Programme includes measures like deregulation of agricultural producer prices, dissolving of marketing monopolies for food crops, elimination of input subsidies, increased focus on land tenure and credit market policies, and devaluation of the overvalued Tanzanian Shilling. Experiences with the Economic Recovery Programme so far suggest that the policy changes indeed affect farmer's economic decisions regarding the selection of crops, and thus land degradation and productivity. Whether production techniques in general, and the use of fertilisers in particular will change as well, is too early to tell. It is however likely that input of fertilisers, which at present is extremely low in Tanzania, will increase as further rigidities in the market are being removed (see Aune et al. for a discussion of possible and actual outcomes of the Economic Recovery Programme on this issue).

Surprisingly few studies can serve as guidelines for political decisions on land management other than specific actions at the farm level. These actions are limited to technology changes by means of information about potential gains within the existing economic framework. While land degradation is generally regarded as costly, more precise estimates of

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these costs have not been identified. The costs facing the individual farmer, measured in losses in yields, may be quite obvious. The true costs of land degradation are however more subtle. Declining yields will for instance normally cause prices to increase in order to restore real income among the producers. In an economy like Tanzania, where agricultural production is a substantial part of GDP, this may have severe effects on real incomes and by that also on the demand for all goods and the standard of living in the rural population. Accounting for effects like these, requires a model where land degradation and the national economy is fully integrated.

Within a CGE model framework, effects of a vide range of policy measures may be analyzed. Applications of CGE models in economic and environmental analysis have several advantages compared to more partial models. The full effect of any economic or environmental policy includes indirect, input-output effects as well as the more obvious direct ones. Analysis based on CGE models point out indirect relations among economic variables, and among economic and environmental issues. One example is effects of price policies on agricultural inputs like fertilisers. Subsidising fertilisers will increase the productivity in agricultural sectors and modify land degradation processes, which will further increase the productivity in the sectors. Income will rise among the rural population and demand for consumer goods will increase, which in a general equilibrium model will give rise to increased production of all goods. Furthermore, subsidies on fertilisers and increased productivity will most likely cause agricultural prices to decline relative to other prices, and the demand for these products for consumption, exports and intermediate inputs to increase. Changes in relative prices will further affect not only the level, but also the composition of production and final demand, which again may cause changes in for instance the rate of land degradation. What may seem like a marginal policy change may in other words, through general equilibrium effects, cause profound changes in the overall performance of the economy. Other examples are effects of trade- and exchange rate policies, income policy, and taxation policy in general. The overall effects of such measures are most clearly established by the means of a large scale macroeconomic model.

A model of impacts on land productivity from land use patterns and farming techniques is developed at the Agricultural University of Norway and is documented in Aune et al., (1994). In the present report, the economic part of the CGE model is documented. In chapter 2, the list of model sectors and commodities is presented; chapter 3 gives details on the model equations; chapter 4 documents the Social Accounting Matrix and additional calibrations.

2. Commodities and sectors

We will assume that each sector produces a single commodity. Furthermore, each commodity is produced in one sector only. This implies that our list of production sectors equals that of goods.

Commodity/Sector list

1. Cotton
2. Coffee
3. Tea
4. Tobacco
5. Cashew
6. Cassava
7. Maize
8. Rice
9. Sorghum
10. Beans
11. Other crops and cereals
12. Livestock
13. Forestry, Fishing and Hunting
14. Food and Beverages industries
15. Textiles
16. Other manufacturing sectors, Mining and Quarrying
17. Constructions
18. Electricity
19. Transport and Communication
20. Other private services

Some level of aggregation is necessary in a macroeconomic model of this type, aiming at describing the impact of land degradation on agricultural production. The 11 agricultural sectors are suitable for approaching the various technological and ecological dimensions; the sector list is consistent with the one used in the 1976 input-output matrix developed for Tanzania (Komba and Wagao, 1986). As it stands, the commodity/sector list is an aggregate of the sector defenition in the 1976 input-output matrix, with the exception that we treat cassava and sorghum separately in our model, whereas these two crops are included in "other crops" in the 1976-matrix.

The sectors 13-Forestry, Fishing and Hunting, 17-Constructions, 19-Transport and Communication and 20-Other private services, are Tanzanian National Account sectors or aggregates of NA sectors (Bureau of Statistics, 1993a). The industrial sectors 14-16 are sub-sectors of the NA sector "Manufacturing". We have chosen to disaggregate the manufacturing sector in order to compute general equilibrium effects of changes in the supply of agricultural products which are important intermediate inputs in the sectors 15-Textiles and 14-Food and Beverages. Furthermore, our sector 18-Electricity, is a subsector of the NR sector "Electricity and Water". We have treated electricity separately to facilitate future use of the model for fuel/energy analyses.

Only two of our model commodities will be classified as investments goods. One is the good produced in sector 17-Constructions (buildings etc.). The second is the good produced in sector 16-Other manufacturing industries, Mining and Quarrying, and is an aggregate of capital goods like machinery and vehicles, plus all capital classified in statistical publications as "other". In principal, all commodities can be imported and exported, used as intermediates in production, or as public and private consumption. All sectors are assumed to be private. A number of parastatal enterprises still exists in practically all sectors, but these are at present being privatised.

3. Model structure

The model is a fairly standard, static, computable general equilibrium-model for an open economy. The general model structure, refered to as an "elasticity structuralist CGE-model", is discussed in Robinson (1989). The core of the model is the Social Accounting Matrix (SAM) documented in the next chapter. Around this core are the relations describing the behaviour of the different sectors of the economy. Our choices on how to model this behaviour are limited by the available data, discussed below and in Aune et al. (1994). We make the assumption that producers maximise profits and households maximise utility. Quantities are endogenous, as are relative prices which adjust to obtain market equilibria (except for in the labour market). The exogenous exchange rate serves as the numeraire.

As information regarding labour supply in Tanzania is scarce, we do not intend to model the labour market in any detail. One option is then to treat labour supply as exogenous and nominal wages as endogenous. In this framework, wages will adjust to secure equilibrium in the labour market as well. Our choice is however to treat nominal wages as exogenous; the labour market will not necessarily be in equilibrium. Furthermore, the model does not include any assets. For a discussion of the choice of a CGE modelling framework and its appropriateness for the present and future Tanzanian economy, see Aune et al., (1994).

In the equations below, the subscript j runs over the complete list of commodities/sectors (j=1-20), if nothing else is stated.

3.1 Production and factor demand

Agricultural gross production (X_j, j=*1-11*) is produced according to Cobb-Douglas, constant returns to scale production functions, subject to exogenous, factor neutral technological changes (B_j). All agricultural sectors are assumed to use labour (L_j), fertilisers (F_j) and material inputs other than fertilisers (M_j). Material inputs are applied in fixed proportions to output. The sectors 2-Coffee, 3-Tea, 4-Tobacco, 5-Cashew and 7-Maize use real capital (K_j) as well. The production function for these sectors is given by

$$(1)\quad X_j = B_j S_j L_j^{\alpha_j} K_j^{\beta_j} F_j^{1-\alpha_j-\beta_j},$$

$$(2)\quad M_j = X_j \sum_i a_{ij},$$

where j= 2-5,7, α_j is the cost share of labour and β_j is the cost share of capital. a_{ij} is the fixed input-output coefficient; the fixed inputs of good i per unit output of good j.

Agricultural production is affected by land degradation processes. The variable S_j accounts for changes in productivity per unit arable land due to changes in soil quality. In the complete model, S_j is a function of the use of fertilisers and volume of production. The model describing the determination of the S_j - variables is described in Aune et al. (1994). In this report, it will be treated as exogenous.

Investments in the agricultural sectors are assumed to be in fixed proportions to total investments, which we will return to in paragraph 3.5. To the individual farmer, the stock of capital is fixed, and only inputs of labour and fertilisers are freely determined by the producers. We do however need to define the price of real capital which is a fixed coefficient aggregate of the price of the commodities 16-Manufacturing and 17-Constructions, as these are the only goods in our model delivered for investment purposes;

$$(3)\quad PK_j = \sum_s PC_s\, b_{sj},$$

where s=16,17. PC_j is the composite price og commodity j, defined in equation (14) below. b_{sj} is a fixed coefficient measuring the share of commodity s of sector j's investments.

The farmers apply labour and fertilisers to maximise profits. The first order conditions to the maximisation problem is given by[1]

$$(4)\quad W_j L_j = X_j \alpha_j (P_j - \Sigma_i a_{ij} PC_i),$$

$$(5)\quad PC_{16}(1 + TF_j) F_j = X_j(1 - \alpha_j - \beta_j)(P_j - \Sigma_i a_{ij} PC_i),$$

where j=2-5,7, W_j is the exogenous wage rate, P_j is the producer price on gross production defined in equation (17) and PC_{16} is the price of the composite commodity 16-Manufacturing, which is fertilisers when delivered to the agricultural sectors. The sales tax rate TF_i is included to allow the model user to differentiate subsidies or taxes on fertilisers between the sectors. PC_i is the composite price of other intermediate inputs.

In the agricultural sectors 1-Cotton, 6-Cassava, 8-Rice, 9-Sorghum, 10-Beans and 11-Other crops and cereals, the use of real capital is very low, or non-existent. We assume there is no capital in these sectors, which gives the production function

$$(6)\quad X_j = B_j S_j L_j^{\alpha_j} F_j^{1-\alpha_j},$$

where j=1,6,8-11. The use of intermediate inputs other than fertilisers is as given by (2), and the first order conditions determining demand for labour and fertilisers by (4) and (5) (with $\beta_j = 0$).

The non-agricultural sectors (j=12-20) use labour, real capital and intermediates as inputs. Gross production is a constant returns to scale Cobb-Douglas function of labour and real capital, given that inputs of materials is applied in fixed proportions to output;

$$(7)\quad X_j = B_j L_j^{\alpha_j} K_j^{1-\alpha_j},$$

$$(8)\quad M_j = X_j \Sigma_i a_{ij},$$

where j=12-20, i=1-20.

Input of labour and real capital are determined by profit maximisation, giving the first order conditions

$$(9)\quad W_j L_j = X_j \alpha_j (P_j - \Sigma_i a_{ij} PC_i).$$

$$(10)\quad PK_j (R + \delta_j) K_j = X_j (1 - \alpha_j)(P_j - \Sigma_i a_{ij} PC_i).$$

We define the left hand side of (10) as the user cost of capital, where PK_j is the price of real capital, R is the rate of return to capital and δ_j is the depreciation rate of real capital. The price of real capital is given by (3).

3.2 Import and export

Tanzania may be classified as a small open economy, where several goods are subject to international trade. Although trade may be extensive, the small economy assumption implies that the country still is without influence upon the international markets, and that world market prices are unaffected by Tanzanian actions. Accordingly, Tanzanian traders are assumed to be price takers at the world market; commodities can be bought and sold at constant world prices;

$$(11)\quad PI_j = PW_j ER (1 + TI_j),$$

where PI_j is the price of imports in the domestic market, PW_j is the world market price, TI_j is the import tax and ER the exchange rate. The price on exports is determined similarly;

$$(12)\quad PA_j (1 + TA_j) = PW_j ER,$$

where PA_j is the export price that faces the producer and TA_j denotes the export tariff that adds to the producer price when the good faces the markets abroad.

To mirror observed phenomena and at the same time avoid that the price-taking-assumption will lead to extreme specialization whenever the price ratio between the world price and domestic price changes, product differentiation is assumed (see for instance de Melo and Robinson (1989)). This

1 Profits (Π) is given by

$$(I)\quad \Pi_j = P_j B_j S_j L^{\alpha_j} K^{\beta_j} F_j^{1-\alpha_j-\beta_j} - W_j L_j - PK_j (R + \delta_j) K_j - F_j (1 + TF_j) PC_{16} - X_j \Sigma_i a_{ij} PC_i,$$

where R is the rate of return and δ_j the rate of depreciation of capital. Maximising (I) with respect to L_j and F_j and substituting X_j from (1) in the first order conditions give the demand for labour and fertilisers in (4) and (5) respectively.

treatment of trade is widely used in CGE modelling. It implies that imports and domestically consumed goods are assumed to be imperfect substitutes (the Armington assumption), as are exports and goods sold at the domestic market. Product differentiation may occur due to differences in quality or costs associated with entering foreign markets, and is particulary suitable in models with large commodity aggregates.

On the import side, product differentiation leads to the introduction of composite goods (XC_j), which are aggregates of domestic and imported varieties of each good (denoted by XD_j and I_j respectively). The price ratio between the two varieties determines the ratio between imported and domestically produced goods. Following the Armington assumption, the aggregation function is a CES formulation;

$$(13)\quad XC_j = Q_j\,[q_j\,I_j^{-\tau_j} + (1-q_j)\,XD^{-\tau_j}]^{-\frac{1}{\tau_j}},$$

where Q_j is a shift variable, q_j is the share parameter and τ_j indicates the elasticity of substitution, ε_j;

$$\varepsilon_j = \frac{1}{1+\tau_j}.$$

The smaller the elasticity of substitution, the "less tradable" is the good.

Given the prices on the two varieties, the value of the composite good is defined by

$$(14)\quad PC_j\,XC_j = PD_j\,XD_j + PI_j\,I_j.$$

The buyers of the goods seek to minimise the cost of purchasing a given quantity, given by (14). Minimising (14), subject to the aggregation function (13) gives the first order conditions determining the ratio of imports to domestic production;

$$(15)\quad \frac{I_j}{XD_j} = \left[\frac{PD_j}{PI_j}\,\frac{q_j}{(1-q_j)}\right]^{\varepsilon_j}.$$

On the export side, output of each good is supplied to the domestic or foreign market. Goods are allocated to exports (A_j) and domestic markets according to a constant elasticity of transformation (CET) function;

$$(16)\quad X_j = H_j\,[h_j A_j^{\rho_j} + (1-h_j)\,XD_j^{\rho_j}]^{\frac{1}{\rho_j}},$$

where H_j is a shift variable and h_j is the share parameter. ρ_j indicates the elasticity of transformation;

$$\Omega_j = \frac{1}{\rho_j - 1}.$$

The elasticity Ω_j measures the responsiveness of the ratio between exports and domestic sales to changes in the marginal rate of transformation.

The net value of sale is

$$(17)\quad P_j\,X_j = PD_j(1-TS_j)\,XD_j + PA_j\,A_j.$$

The producers choose the ratio of exports to domestic supply that maximises the total value of sale in the two markets, given by (17). Maximising (17) subject to (16) gives the first order condition determining the ratio of exports to domestic sales;

$$(18)\quad \frac{A_j}{XD_j} = \left[\frac{PA_j}{PD_j\,(1-TS_j)}\,\frac{(1-h_j)}{h_j}\right]^{\Omega_j}.$$

The smaller the elasticity of transformation, the more imperfect substitutes are the exported and domestically produced goods. The parameters are calibrated to produce the initial quantities as they appear in the SAM. This is documented in paragraph 4.4.5.

3.3 Private income and consumption

Private income consists of wages and returns to capital, plus possible profits in the agricultural sectors 2-5,7 that use real capital; as gross investments in these sectors are assumed to be in fixed proportions to total investments, the use of capital is not necessarily optimal and the zero-profit condition does not necessarily hold. Furthermore, as we have assumed that all sectors of production are private, possible returns to capital within the public enterprises is included in these private sectors. We do, however, allow the public sector to employ labour for public administration etc. Total private income thus consists of wages and returns to capital in all sectors of production plus wages in the public sector plus profits in the agricultural sectors that use real capital. Disposable private income (Y) is given by

$$(19)\quad \begin{aligned} Y = (1-TY)\Big[&\Sigma_m W_m L_m + W_G L_G + \Sigma_i PK_i R\cdot K_i \\ &+ \Sigma_k\,(X_k\,(P_k - \textstyle\sum_j a_{jk} PC_j) - PC_{16} F_k - \delta_k K_k)\Big], \end{aligned}$$

where m=1,6,8-20; i=12-20; k = 2-5,7; j = 1-20. $W_G L_G$ is income earned by public employees and TY is the income tax rate.

Total private expenditure (E) is assumed to be a constant part of disposable income;

$$(20)\quad E = cY\,,$$

where c is the marginal propensity to consume. Private expenditure is allocated between the commodities according to a linear expenditure system (LES)[2]

$$(21)\quad PC_j\,C_j = PC_j\,\gamma_j + \kappa_j\,(E - \Sigma_i\,PC_i\,\gamma_i)\,.$$

Calibration of the parameters in (21) is documented in paragraph 4.4.4. We follow the tradition of interpreting the γ-parameters as minimum, or subsistence, quantities; $PC_j\gamma_j$ is the minimum expenditure on commodity j and $\Sigma_i PC_i\gamma_i$ the total minimum expenditure of which no substitution is possible. The κ-parameters add to unity, and may thus be interpreted as constant budget shares, applied on non-subsistence expenditure. Expenditure on each good accordingly consists of a subsistence part and a non-subsistance part.

3.4 The public sector

Government revenue is determined by revenues from taxes on income and sales, and tariffs on import and export;

$$\begin{aligned}(22)\quad GR = {} & \Sigma_j\,(TS_j PD_j XD_j + TA_j PA_j A_j + TI_j PW_j I_j ER) \\ & + TY\Big[\Sigma_m W_m L_m + W_G L_G + \Sigma_i PK_i R \cdot K_i \\ & + \Sigma_k\,(X_k\,(P_k - \textstyle\sum_j a_{jk} PC_j) - PC_{16} F_k - \delta_k K_k)\Big] \\ & + \Sigma_s TF_s PC_{16} F_s\end{aligned}\,,$$

where j=1-20; m=1,6,8-20; i=12-20 k=2-5,7; s=1-11. The revenue is divided between exogenous nominal government consumption (C_G) and the residual, endogenous government savings (S_G);

$$(23)\quad GR = C_G + S_G\,.$$

The exogenous government consumption consists of purchases of labour ($W_G L_G$) and material inputs from sector j (M_{Gj});

$$(24)\quad gC_G = W_G\,L_G\,,$$

$$(25)\quad PC_j\,M_{Gj} = a_{Gj}\,(1 - g)\,C_G\,,$$

where g is the cost share of labour in government consumption and a_{Gj} the share of total government demand for intermediates directed at sector j.

3.5 Investments

Total nominal net investments (J), are determined by the requirement that savings equal net investments;

$$(26)\quad J = (1 - c)\,Y + S_G + Z \cdot ER - \Sigma_j CS_j\,,$$

where Z is exogenous transfers from abroad, which equals the balance of trade deficit. Government savings may in this framework be interpreted as an investment specific, lump sum transfer from the public to the private sector. CS_j is change in stocks.

A fixed part (m_i) of total net investments is allocated to each agricultural sector that uses capital;

$$(27)\quad m_i J = (DK_i - \delta_i K_{i,t})PK_i\,,$$

where i = 2-5,7, DK_i is gross investments in real terms and $\delta_i K_{i,t}$ is this years depreciation. The right hand side of (27) is thus net investments in sector i.

The stock of capital at the end of the year, ($K_{i,t+1}$) in the agricultural sectors will equal the stock at the beginning of the year ($K_{i,t}$), less depreciation, plus net investments;

$$(28)\quad K_{i,t+1} = DK_i + (1 - \delta_i)\,K_{i,t}\,.$$

2 The LES (see for instance Deaton and Muellbauer (1987)) is derived from the assumption that households maximize utility, given a Stone-Geary specification;

(I) $U(C_{1,\ldots,}C_j) = \Sigma_j \kappa_j \ln(C_j - \gamma_j)$

and a budget constraint;

(II) $\Sigma_j PC_j C_j = E$

Maximising (I) subject to (II) gives the LES.

Demand for real capital in the non-agricultural sectors is determined by profit maximisation and is given by (10). Gross investments in real terms is thus the required stock of capital at the end of the year less the stock at the beginning of the year, plus replacement demand due to depreciation;

$$(29)\ DK_j = K_{j,t+1} - (1 - \delta_j)\, K_{j,t}\ ,$$

where j= 12-20. In this framework, the rate of return to capital will adjust to secure equilibrium of savings and non-agricultural net investments, given by

$$(30)\ J\,(1 - \Sigma_i m_i) = \Sigma_j\,(DK_j - \delta K_{j,t})\,PK_j\ .$$

where i=2-5,7 and j=12-20.

3.6 Equilibrium of domestic demand and supply

Finally, for each composite commodity, supply has to equal total demand, which will also secure that the balance of trade deficit equals the exogenous foreign transfers. For commodity 16-Manufacturing, which is defined as fertilisers when used in the agricultural sectors, and which is used as investments, consumption and intermediates other than fertilisers as well, the equilibrium condition is

$$(31)\quad \begin{aligned} XC_{16} &= \Sigma_i a_{16i}\, X_i + \Sigma_k\, F_k + M_{G16} \\ &+ C_{16} + \Sigma_j b_{16j}\, DK_j + CS_{16}\ , \end{aligned}$$

where i=12-20, j=2-5,7,12-20 and k=1-11.

For commodity 17-Constructions, which is used for investments, intermediates and consumption, equilibrium is given by

$$(32)\ XC_{17} = \Sigma_i a_{17i} X_i + M_{G17} + C_{17} + \Sigma_j b_{17j} DK_j + CS_{17}\ ,$$

where i=1-20, j=2-5,7,12-20.

For the other commodities, that are not used as either investment goods or fertilisers, the equilibrium condition is

$$(33)\ XC_i = \Sigma_j a_{ij} X_j + M_{Gi} + C_i + CS_i\ ,$$

where i=1-15, 18-20, j=1-20.

Within this modelling framework, the long term growth potential of the economy will largely be determined by the growth in the capital stock determined by savings, exogenous technological progress, exogenous wage rates and the magnitude of land degradation processes (which is exogenous in this model, but largely determined by the price of fertilisers in the complete model).

The model includes 340 independent equations to determine the 340 endogenous variables below:

A_j	Export	(20)
C_j	Private consumption	(20)
DK_j	Demand for real investments, j=2-5,7,12-20	(14)
GR	Government revenue	(1)
E	Total private expenditure	(1)
F_j	Use of fertilisers, j=1-11	(11)
I_j	Imports	(20)
J	Total nominal investments	(1)
$K_{j,t+1}$	Demand for real capital, j=2-5,7,12-20	(14)
L_G	Government demand for labour	(1)
L_j	Demand for labour	(20)
M_j	Demand for intermediate inputs	(20)
M_{Gj}	Government demand for intermediate inputs	(20)
P_j	Composite gross production price	(20)
PA_j	Producer's export price	(20)
PC_j	Composite price of domestic and imported commodities	(20)
PD_j	Domestic market price	(20)
PI_j	Import price	(20)
PK_j	Price of real capital, j=2-5,7,12-20	(14)
R	Rate of return to real capital	(1)
S_G	Government savings	(1)
X_j	Gross production	(20)
XC_j	Composite good	(20)
XD_j	Gross production sold at the domestic market	(20)
Y	Private disposable income	(1)
		=340

Exogenous

B_j	Factor neutral technological change
C_G	Nominal government consumption
CS_j	Change in stocks
ER	Exchange rate
H_j	Shift variable in the export transformation function
$K_{j,t}$	Stock of capital, beginning of the year, j=2-5,7,12-20
PW_j	World market price
Q_j	Shift variable in the import substitution function
S_j	Land degradation variable
Z	Foreign transfers
TA_j	Export tax rate
TF_j	Fertiliser tax rate, j=1-11
TI_j	Import tax rate

TS_j Sales tax rate
TY Income tax rate
W_j Wage rate
W_G Wage rate public sector

Parameters
a_{Gj} Government intermediate consumption coefficient
a_{ij} Input-output coefficient
b_{ij} Investment by origin-investment by destination coefficient, i=16,17, j=2-5,7,12-20
c Marginal propensity to consume
g Cost share of labour in government consumption
h_j Export share
m_j Agricultural sector j's share of investments, j=2-5,7
q_j Import share
α_j Cost share of labour
β_j Cost share of real capital, j=2-5,7
κ_j Budget shares, non-subsistence private consumption
γ_j Subsistence quantities, private consumption
δ_j Depreciation rate of real capital, j=2-5,7,12-20
τ_j Constant elasticity of substitution parameter
ε_j Elasticity of import substitution
ρ_j Constant elasticity of transformation parameter
Ω_j Elasticity of export transformation

Appendix 1 lists the model equations, variables and parameters. The model calibrated to produce the Social Accounting Matrix outlined in the next chapter, with all prices equal to unity. Base year values for the exogenous variables and the default values for the parameters are also listed in Appendix 1[3]. As a compromise between our intentions of capturing the relevant structure of the economy as it appears after recent economic reforms and the available data, we choose 1990 as the model base year. In doing so, we will be able to utilize data for the agricultural sectors that are as recent as possible, while at the same time accepting that the treatment of the other sectors of the economy must be based on somewhat outdated assumptions. As previously noted, the agricultural sector is by far the largest sector in Tanzania and accounts for roughly 60 percent of Gross Domestic Product. For our purpose of incorporating land degradation into a general equilibrium framework, it is important to capture the latest developments in the agricultural sectors.

3 The model will be programmed in GAMS. For this purpose, some simplifications in the above model structure and alterations in the forthcoming base year values may be required.

4. The 1990-Social Accounting Matrix for Tanzania

In this chapter, we provide a rough outline of the data background, the assumptions and the shortcuts we have used in order to arrive at our 1990-Social Accounting Matrix (SAM) for Tanzania. The SAM that will serve as the core of the model discussed in the previous chapter is basically a disaggregation of total gross production (output) in the economy; a disaggregation into gross production of different sectors, and an overview of the use of gross production from each sector (final deliveries).

In Tanzania, like in most other developing countries, a significant part of output is devoted to non-marketed, rural consumption. Furthermore, extensive interventions by the government during the 70's and 80's gave rise to market failures and supply shortfalls, and the development of a parallel, informal economy. Informal markets include agricultural and small scale production, transport and distribution activities, as well as illegal operations bypassing trading, finance and other exchange restrictions. The World Bank (1991) estimates the informal economy to be around 30 percent of formal GDP at factor costs. Agrawal et al. (1993) suggests that of exports, only half of actual export volumes are recorded. Recent economic reforms has decreased the importance of the informal economy, although it may still be substantial. We do however restrict our efforts to develop a SAM to the formal part of the Tanzanian economy, and base our SAM on official Tanzanian statistics, which we believe has not been adjusted to take account for the informal economy.

Our main sources of information are statistics from the Bureau of Statistics (BS) and the Planning Commission in Tanzania. The National Accounts (BS, 1993a), the Foreign Trade Statistics (BS, 1993b), the Survey of Industries (BS, 1988) and the 1976 input-output table (Komba and Wagao, 1986) are the most important documents for our use. Moreover, for the agricultural sectors we have production figures for years until 1993 and information about input use for a period ending in 1990/91. The National Accounts are available also for more recent years than 1990, while the most recent industrial survey, which provides us with information about the structure of the industrial sectors, is from 1988. When it comes to information about intermediate deliveries between sectors of the economy, our only source is the input-coefficients from the 1976 input-output table.

There are several problems in constructing a SAM suitable for our model. One is that we do not know total gross production of the economy. Gross production figures are available only from production statistics for the agricultural sectors. Second, our level of aggregation differ in most cases from the ones in the official Tanzanian statistics. This is hardly a problem when the information available is more detailed than what is required by the model. In our case however, this is rarely the case, as the official statistics often operate with very large aggregates (the 1976 input-output table not included). Our construction of the SAM has accordingly been a stepwise procedure, based on several rough assumptions. In the following outline of our gradual steps towards filling out the SAM, we start with the supply side of the economy.

4.1 Domestic supply

4.1.1 Gross Domestic Product at factor cost by sector

The National Accounts distributes Gross Domestic Product at factor costs[3] at a sectoral level. Gross Domestic Product (GDP) is divided between 9 sectors, while our model has 20. Sector 9 in the National Accounts, Public administration and services, is not treated as a production sector at all in over model,

4 Gross Domestic Product at factor costs is equal to gross production, less taxes, less the cost of material inputs. In our model, sectoral GDP at factor costs corresponds to the term term $P_jX_j - \Sigma_i a_{ij}PC_iX_j - (1 + TF_j)F_jPC_{16}$ for the agricultural sectors and $P_jX_j - \Sigma_i a_{ij}PC_iX_j$ for the non-agricultural sectors. GDP at factor costs is often referred to as value added. The term GDP at market prices equals GDP at factors costs plus indirect taxes.

Table 1. National Account GDP, 1990. Mill. Tanzanian Shilling

National Account sector	Factor cost GDP. Mill. Tsh.	Corresponding model sector
1. Agriculture, Forestry, Fishing and Hunting	233 804	1-13
2. Mining and Quarrying	4 815	16
3. Manufacturing	18 301	14, 15, 16
4. Electricity and Water	7 438	18, 20
5. Construction	23 053	17
6. Wholesale and Retail trade, Hotels and Restaurants	55 815	20
7. Finance, Insurance, Real estate and Business services	24 124	20
8. Transport and Communication	36 248	19
9. Public administration and services	32 456	
Imputed bank service charges	-25 117	
Total	410 930	

essentially we treat this as a consumption sector only, to which we vill return later. As can be seen from Tabel 1, only sectors 17-Constructions, 19-Transport and Communication and 20-Other private services correspond directly with the sectoral division in the National Accounts. For the rest of the sectors we have to use some additional information in order to split GDP into 20 sectors.

The primary sectors 1-13:
The thirteen primary sectors in our model are aggregated into sector 1 of the National Accounts. In table 10.1 of the National Accounts the primary sector is however divided so that we are able to find GDP in our model sector 13-Forestry, Fishing and Hunting. Since the National Accounts does not disaggregate agriculture and livestock, we are unable to find GDP in the agricultural sectors 1-11 and 12-Livestock at this stage.

Industries:
In order to divide the National Accounts (NA) sectors 2 and 3 into the three industrial sectors of our model, we have made use of The Survey of Industrial Production 1988 (BS, 1988). We assume that the relative GDP-shares are the same in 1988 and 1990. By using Table 4 of the industrial survey we find that sector 14-Food and Beverages and sector 15-Textiles accounts for 30 percent and 16 percent, respectively, of GDP in "manufacturing". The remaining 54 percent of "manufacturing"- GDP, together with the industrial survey figure for GDP in the mining sector, is allocated to the model sector 16-Manufacturing.

It should be noted that the industrial survey states all numbers at market prices while the GDP figures for the industrial sectors in the National Accounts are at factor prices. Our estimation method implies that we assume that each sector's share of GDP in the industries is the same whether measured at market prices or at factor cost. In other words, we assume that indirect taxes accounts for the same share of factor cost-GDP in each of the industrial sectors.

The total GDP figure for industries in the industrial survey is only 74 percent of the corresponding figure in the NA for 1988. This is probably due to the fact that the industrial survey only counts enterprises with more than 10 persons employed. The assumptions we have used to derive the 1990 figures for the three industrial sectors imply that we also assume that the relative under-counting of industries is the same for all industrial sectors. The NA estimates of GDP in the industrial sectors are based on the industrial surveys with adjustments for establishments with less than 10 persons employed, which again is based on the 1976 input-output studies and a survey of small scale enterprises in 1978.[5] These adjustments are, however, not necessarily the same in all parts of industry.

Sector 18-Electricity
Water and electricity in sector 4 of the National Accounts is allocated to different sectors in our model. We separate electricity into sector 18, while water is allocated to sector 20-Other private services. From the industrial survey we find that GDP in electricity is 2 956 mill. Tanzanian Shilling (Tsh.) (market prices, 1988). In the National Accounts, water and electricity contributed 4 628 mill. Tsh. to GDP at factor cost in 1988. We first assume no indirect taxes on electricity and water, which implies that GDP at factor costs equals GDP at market prices. Second, we assume there is no under-counting of

Table 2. Model sector GDP at factor cost. Mill. Tsh.

	Factor cost GDP
1-12. Agriculture and Livestock	218 671
13. Forestry, Fishing and Hunting	15 133
14. Food and Beverages	5 490
15. Textiles	2 928
16. Manufacturing	14 698
17. Constructions	23 053
18. Electricity	4 760
19. Transport and Communication	36 242
20. Other private services	82 616
Total	403 592

5 Tanzania Economic Trends: A Quarterly Review of the Economy, vol.4, no.1, 1991,p.79 (Economic Research Bureau, 1991). A major drawback with the NA in Tanzania is that many estimates are based on the (outdated) 1976 input-output table which is the latest input-output study of the Tanzanian economy.

the electricity sector (this is not unreasonable because all electricity is provided by public enterprises and thus the figures are probably based on the accounts of these public utilities). We may now use the industrial survey figure for GDP in electricity production to calculate this sector's share of the water and electricity aggregate in the NA, which was 64 percent in 1988. The same ratio between water and electricity is assumed for 1990 and we get GDP in electricity of 4 760 mill. Tsh. and in water supply of 2 678 mill. Tsh.

To conclude, we have GDP at factor cost by model sector as displayed in Table 2. The discrepancy of our total GDP at factor cost figure and the National Accounts total, comprises of GDP in Public administration and services and Imputed bank service charges.

4.1.2 Gross Domestic Product at market prices by sector

In order to arrive at market price GDP we have to add indirect taxes to the factor cost figures. Our first task is then to calculate indirect taxes for each sector. Table 5 in the National Accounts states that total indirect taxes were 94 280 mill. Tsh. in 1990. There is no indication in the National Accounts of how indirect taxes are distributed among sectors, or of what the sources of indirect tax revenue are. From The Economic Survey 1991 (Planning Commission, 1992) Table 18: Trends in Government Finance, we find that for the fiscal year 90/91, tax revenue was 101 065 mill. Tsh. in current prices. With income taxes and other taxes (which we assume to be direct taxes of some kind) summing to 41 765 mill. Tsh., the remaining tax revenue of 59 300 mill. Tsh. is due to indirect taxes. This does not correspond very well with the NA's net figure for indirect taxes of 94 280 mill. Tsh. We stick to the NA's *level* of indirect taxes and assume that the *allocation* of the indirect taxes in the Economic Survey between customs duties (37 percent) and domestic sales taxes (63 percent) is representative for the sources of indirect tax revenue in the NA 1990. This implies that net indirect taxes of 94 280 mill. Tsh. are comprised of 34 884 mill. Tsh. in customs duties and 59 396 mill. Tsh. in domestic sales taxes. To get the GDP at market prices, the sales taxes has to be allocated to the correct model commodities.

Table 3. GDP at factor cost, sales taxes and GDP at market prices. Mill. Tsh.

	GDP at factor cost	Sales tax	GDP at market price
14. Food and Beverages	5 490	14 106	19 596
15. Textiles	2 928	7 524	10 452
16. Manufacturing	14 698	37 766	52 464

From our scant information about the structure of sales taxes, it seems that such taxes are mainly levied on commodity sales. Agricultural products seem largely to escape sales taxes in Tanzania. Sugar products are the most important exception, but as sugar accounts for a very small share of agricultural production we can ignore this indirect tax. Thus it seems reasonable to distribute the sales taxes to sectors 14-Food and Beverages, 15-Textiles and 16-Manufacturing[6]. Sales tax revenue is allocated between these sectors in proportion to their GDP at factor cost.

With our distribution of sales taxes, sectors 14-Food and Beverages, 15-Textiles, and 16-Manufacturing have market price GDP that differ from GDP at factor costs. GDP at factor costs, sales taxes and GDP at market prices are as displayed in Table 3. For the other sectors of our model we assume there is no difference between the two GDP values.

4.1.3 Gross production by model sector

For the agricultural sectors 1-11 we have production statistics which provide us with gross production for each sector. For the rest of the sectors we have to make assumptions about the share of gross production which is accounted for by GDP at market prices.

From the industrial survey; Table 4, we can calculate value added as share of gross output in each of our three industrial sectors and the electricity sector for 1988. We assume these shares are the same in 1990.

For the remaining sectors we have to use value added shares from the 1976 input-output table. Most of the remaining sectors in our model correspond to several sectors in the input-output table, each with different value added shares. When it comes to sector 12-Livestock, we still do not have a GDP figure for this sector. Based on the value added shares in the 1976 input-output table, we assume both for sector 12-Livestock and 13-Forestry, Fishing and Hunting that value added accounts for 90 percent of gross output.

From the National Accounts, Tables 3, 11 and 12, we are able to disaggregate sector 20-Other private

6 This assumption is based on a table listing sales tax by input-output sector for the period 1976-1985, in: Revised National Accounts of Tanzania: Results of the National Accounts Project, implemented on behalf of the Statistical Office of the European Communities, (Stäglin and Kumba, 1992).

Table 4. Gross production. Mill. Tsh.

	GDP as share of gross production	Gross production
1. Cotton		7 114
2. Coffee		5 873
3. Tea		1 232
4. Tobacco		995
5. Cashew		1 308
6. Cassava		9 396
7. Maize		26 895
8. Rice		9 139
9. Sorghum		10 579
11. Other crops and cereals		129 970
12. Livestock	0.9	
13. Forestry, Fishing and Hunting	0.9	16 814
14. Food and Beverages	0.25	78 384
15. Textiles	0.17	66 817
16. Other Manufacturing, Mining and Quarrying	0.23	228 104
17. Constructions	0.4	57 118
18. Electricity	0.62	7 677
19. Transport and Communication	0.75	48 323
20. Other private services	0.44	185 902

services into the sub-sectors found in the input-output table. We have not succeded in finding any indication regarding the composition of sector 19-Transport and Communication. It seems reasonable that transport is the larger part of the aggregate; we simply assume that transport accounts for 75 percent of GDP in that sector. By combining GDP of each sub-sector with their respective value added shares from the input-output table we arrive at gross output in sectors 17-Constructions, 19-Transport and Communication and 20-Other private services. Our gross production estimates are summarised in Table 4.

Total GDP less GDP in sector 12-Other crops and cereals in 1990 accounts for 56 percent of estimated total gross production in Table 4 below (where GDP in sector 12-Other crops and cereals is not yet found). Since we do not have a total gross output figure from other sources, it is difficult to know whether our estimate is reasonable or not. From a document of revised GDP figures we have gross output figures from 1976 to 1985.[7] If we compare the 1985 gross output figure with GDP that year, gross output is about 40 percent larger than GDP. This indicates that we may have overestimated gross output. However, as our estimates are based on official statistics as well (with the exception of the GDP share in 13-Forestry, fishing and hunting), we will not attempt to adjust our gross production figures.

4.1.4 Imports

Data on imports are found in the Foreign Trade Statistics, 1990 (FTS) (BS, 1993b). The FTS commodity import figure of 199 260 mill. Tsh. is much lower than the National Account's figure for total imports of 280 840 mill. Tsh. The National Account only splits imports into merchandise (262 544 mill. Tsh.) and other (18 296 mill. Tsh.). We assume that "other" is imports of services and allocate this to sector 20-Other private services. There is still a large discrepancy between the FTS total commodity import-figure and total merchandise imports in the National Accounts. We adjust the commodity import figures from the FTS proportionally upwards so that the sum of total imports equals the figure in the National Accounts. In addition, we disregard the 10 mill. Tsh imports of maize and add this to imports of 11-Other crops and cereals. By combining information from FTS: Table 20 (Direct imports by commodity), and Table 26 (Importation of selected commodities), we have arrived at the distribution of imports exhibited in Table 5 (2-numbered codes refer to FTS Table 20 and other codes refer to FTS Table 26).

Table 5. Imports. Mill. Tsh.

Commodity	FTS codes	Imports FTS	Imports NA
4. Tobacco	12	31	41
7. Maize	044	10	
8. Rice	042	418	551
11. Other crops	(04-044-042) +05+06+07+(08-081.4)+(09-099.061-099.092 -112.309)+22	4 337	5 728
12. Livestock	00+01+02+21	851	1 121
13. Forestry, fishing, hunting	03+24	282	372
14. Food and beverages	11+29+41+42+43+ 081.4+099.061+ 099.092+112.309	2 851	3 756
15. Textiles	26+65+84	5 420	7 141
16. Other industries and mining	The rest of Table 20	185 060	243 834
20. Other private services			18 296
Total		199 260	280 840

7 See footnote 5.

Table 6. Export. Mill. Tsh.

Commodity	FTS codes	Export FTS	Export NA	Export in domestic prices
1. Cotton	81.30+263.10	14 824	13 886	1 250
2. Coffee	Table 12	15 093	14 121	5 783
3. Tea	Table 12	7 326	6 854	341
4. Tobacco	Table 12	2 511	2 349	664
5. Cashew	Table 12	770	720	336
11. Other crops	04+(05-cashew)+(06-61.50)+(07-coffee -tea)+(08-81.30)+ 09+22+(26-263.10)	19 960	18 675	18 675
12. Livestock	00+01+02+21	914	855	855
13. Forestry, fishing, hunting	03+24+291.13+ 292.20+292.40+ 292.92	3 651	3 416	3 416
14. Food and beverages	61.50+11+(121-121.0) +(29-291.13-292.20-292.40-292.92)+41+42+43	1 247	1 168	1 168
15. Textiles	65+84	4 745	4 439	4 439
16. Other industries and mining	The rest of Table 4	10 103	9 452	9 452
19. Transport and communication			14 000	14 000
20. Other private services			13 522	13 522
Total		81 162	103 457	73 891
"Export taxes"				29 566
Total				103 457

4.1.5 Exports

Data on commodity exports are found in the FTS, Table 4 (Domestic exports by commodity), Table 12 (Selected major exports by area of destination) and Table 17 (Exports of selected commodities: value). Total exports of 81 162 mill. Tsh. are distributed to their respective sectors in more or less the same way as imports.

As with imports, we have a discrepancy between the export figures in the FTS and the NA, but the figures are indeed more similar. According to the NA, the total exports of goods and services from Tanzania were 103 457 mill. Tsh., this is further divided in merchandise exports (75 935 mill. Tsh.) and other (27 522 mill. Tsh.). The "other" category is assumed to be services. Commodity exports as distributed according to the FTS are adjusted proportionally downwards until the sum equals the corresponding sum in the NA (75 935 mill. Tsh.). These adjustments are shown in the second last column of Table 6. With regard to exports of services, this accounts for 27 percent of exports, which is a rather high share for a developing country. According to Tanzanian Economic Trends, vol.4, no.1, 1991 (Economic Research Bureau, 1991); the provision of commodity transit services to neighbouring landlocked countries is the second largest foreign exchange earner after coffee. Since coffee earns 14 121 mill. Tsh. in foreign exchange, while cotton as the second largest export commodity earns 13 886 mill. Tsh., we allocate 14 000 mill. Tsh. of the NA figure for "other", which we assumed to be export of services, to sector 19-Transport and Communication. The remaining 13 522 mill. Tsh. is then of commodity 20-Other private services.

The FTS export figures for the four main export crops: cotton, coffee, tea and tobacco, are far larger than the values of gross output in these sectors. This is probably caused by a difference between world prices and domestic producer prices. For the model, we need exports and gross output measured in the same prices.

For the five major cash crops (cotton, coffee, tea, tobacco and cashew) we have data for the volume of exports (FTS, Table 10) and the unit values of exports (FTS, Table 13). Instead of using the "world prices" of exports from FTS, Table 13, we have calculated the shares of the production volumes that are exported. These export shares multiplied by gross output at market prices give us the value of the five major agricultural exports in domestic producer prices. By using this procedure we get much lower export figures and total exports sum to 73 891 mill. Tsh. instead of the NA figure of 103 457 mill. Tsh. Our low export figure will, cet. par., enlargen total domestic supply, compared to the NA data. The adjusted export figures used in the SAM are listed in the last column of Table 6.

4.1.6 Customs duties

When deriving GDP at market prices, we made some assumption about the distribution of indirect taxes between sales taxes and customs duties, based on the Economic Survey (Planning Commission, 1992). We still have to distribute the customs duties revenue of 34 884 mill. Tsh. between import- and export taxes, and between goods.

Our adjustments of FTS export figures for the major export crops, which we did in order to arrive at exports measured in domestic market prices, resul-

Table 7. Import taxes. Mill. Tsh.

	Imports at domestic prices	Imports at world prices	Import tax revenue
11. Other crops and cereals	5 728	5 162	566
14. Food and Beverages	3 756	3 385	371
15. Textiles	7 141	6 435	706
16. Manufacturing	243 834	219 728	24 106
20. Other private services	18 296	16 487	1 809
Sum import tax revenue			27 558

Table 8. Export taxes. Mill. Tsh.

	Export at domestic prices	Export at world prices	Export tax revenue
1. Cotton	1 250	2 344	1 094
2. Coffee	5 783	10 842	5 059
3. Tea	341	639	298
4. Tobacco	664	1 245	581
5. Cashew	336	630	294
Sum export tax revenue			7 326

ted in a difference of 29 566 mill. Tsh., between our estimated total exports and total exports according to the NA. Initially we tried to treat this as a kind of tax revenue for the public sector. It is well known that the government through its producer pricing policies have taxed the agricultural sector through the marketing boards, in the form of low producer prices relative to export prices. According to the World Bank's economic report on Tanzania, this taxation have at times been as high as 60 percent[8]. Our data for 1990 however, suggests rather extreme tax rates. From Table 6, we see that the export tax for cotton, which we take to be the difference between the figures in the last two columns, amounts to close to one thousand percent. The implicit tax rates on the other crops are in the same range. One reason for the extreme tax rates we get compared to the World Bank estimate is that we have made no adjustments for transportation costs.

Our assumption so far, regarding export taxes (which sum to 29 566 mill. Tsh.), together with our estimate of total customs duties (34 884 mill Tsh.), leave total import taxes to be determined residually (5 318 mill. Tsh.). As imports is 280 840 mill. Tsh., the import tax rate would have to be less than two percent on average. Figures from the Economic Survey however suggests that the average customs level in Tanzania is about 30 percent. To conclude, our low import taxes and high export taxes suggests either errors in our assumptions or large collection errors; most likely both. Instead, we choose to distribute the revenue from customs duties of 34 884 mill. Tsh. proportionally between total imports and our own estimate of total export, at domestic market prices. This leaves 27 558 mill. Tsh. (79 percent) to be allocated between the imported goods and the remaining 7 326 mill. Tsh. (21 percent) to be allocated between the exported goods. The average customs level is then approximately 10 percent.

Table 5 reveals five main imported commodities; Commodity 11-Other crops, the three industrial commodities; 14-Food and Beverages, 15-Textiles and 16-Manufacturing, and 20- Other private services. We assume customs duties are levied only on these imports. By assuming that import taxes and collection shortfalls are the same for these five commodities, we arrive at imports valued at domestic market prices and at world market prices shown in Table 7. As not all imports are assumed to be subject to taxes, the tax level is somewhat higher than the average customs level of 10 percent; the import tax level on the five commodities is 11 percent.

Our new estimate of export taxes is shown in Table 8. We have assumed tax rates and errors to be the same for the five main export crops where we made adjustments for differences between export prices and domestic producer prices. Accordingly we assume that this difference is neglectable for other sectors; that is, we assume no export taxes. The export tax rate on the five commodities is 87 percent, which is still high, but far more reasonable than our previous estimate.

4.2 Intermediate deliveries

Our assumptions regarding how much GDP accounts for of gross production in the non-agricultural sectors 12-20, gives us the amount of input use we should expect in each sector. We take these estimated gross output and input use figures to be "correct" for the remaining efforts to arrive at a complete SAM.

Our only source of information about cross-sectoral links in the economy is the input-output table from 1976 which lists *domestic* input-output coefficients for 72 sectors; domestic deliveries from sector i per unit output from sector j. The table also lists import-coefficients for each sector; inputs of imports (aggregate) per unit output from sector j.

8 Tanzania Economic Report: Towards Sustainable Development in the 1990s.Vol 1, p.61. (World Bank, 1991).

First, with the help of the industrial survey and the disaggregation in the National Accounts, Tables 10, 11 and 12, we are able to estimate 1976-gross output in most of the 72 sectors in the input-output table. This is needed in order to make aggregates of the 72 sectors that fits with the sectors of our model, and by that suitable aggregates of the input-output coefficients. We apply our aggregated coefficients and arrive at an estimates of the use of domestically produced inputs in each of the 20 model sectors. However, the structure of our model requires input coefficients measuring inputs of each *composite* good per unit gross production. We apply the aggregate import coefficients from the 1976 input-output table, and arrive at an estimate for the use of imported inputs in each of the 20 sectors. We use our estimated domestic input figures as weights and distribute the figure for imported inputs proportionally among the domestic inputs.

For the agricultural sectors we have additional information about production technology and input use from the annual reviews of the different crops conducted by the Marketing Development Bureau. These studies indicate the use of fertilisers, agrochemicals, bags, transport, tools, seeds and other; on a per hectare basis for the main crops in the 1990/91 season. It should be noted that these input figures are assessed by the Marketing Development Bureau for the purpose of calculating for instance potential agricultural incomes and yields. The figures are thus probably much higher than the "true" values; when these input figures are multiplied by their appropriate production areas we get a total input figure of 34 367 mill. Tsh. for sector 1-11, while the input use we get by using the 1976 input-output table is only 9 924 mill. Tsh. In the National Accounts it is assumed that intermediate consumption in the agricultural sectors is 10 percent of gross output. This assumption is based on the 1976 input-output table, but due to changing technology and crop mix it may require revision.[9] The assumption of 90 percent value added in all the agricultural sectors would give a total input figure of 20 669 mill. Tsh. in sectors 1-11; also much larger than the figure we arrive at by using the input-output coefficients from 1976. Thus, by applying three alternative ways of estimating input use in the agricultural sectors we turn out with three alternative figures.

As our estimates of sectoral, agricultural gross production are based on the Marketing Development Bureau-studies, we choose to use the input figures from the same sources, with a few adjustments; we have adjusted downwards the marketing board input figures where these seem unreasonably high. For 1-Cotton, 2-Coffee, 4-Tobacco, 5-Cashew and 7-Maize, the marketing board input use figures were larger than gross output of these crops. Our adjustments of inputs are such that we end up with a positive value added in these sectors. We made the following adjustments of the Marketing Development Bureau-figures:

First, we have ignored the figures for tools as input since they account for less than 3 percent of the total estimated input use.

Second, the figure for input of bags are adjusted downwards to become roughly equal to the availability of bags in the economy, as it appears in the FTS commodity import table and production figures from the industrial survey. We classify bags as part of commodity 15-Textiles. Subtracting the exports of sisal ropes and adding the imports of jute bags gives a maximum availability of bags of about 3 000 mill. Tsh., yet the use of bags in agriculture was according to the marketing board estimates 7 839 mill. Tsh. We have adjusted the bag input fi-

Table 9. Input use, agriculture. Mill. Tsh.

	Fertil.	Transp.	Bags	Seeds	Total	Gross production	GDP
1. Cotton	3 557	632	420	687	5 296	7 114	1 818
2. Coffee	2 918	175	32	90	3 214	5 873	2 659
3. Tea	11	7		185	203	1 232	1 029
4. Tobacco	497	90	90	140	817	995	178
5. Cashew	690	20	390		1 100	1 380	280
6. Cassava			120		120	9 396	9 276
7. Maize	1 794	2 271	1 170	2 600	7 835	26 895	19 060
8. Rice		166	450	612	1 228	9 239	7 911
9. Sorghum		54	180	334	568	4 118	3 550
10. Beans	120	158	90	1 425	1 793	10 579	8 786
11. Other	1 000	1 000	90	2 059	4 149	129 970	125 821
Total	10 587	4 573	3 032	8 132	26 324	206 691	180 367

9 Tanzania Economic Trends: A Quarterly Review of the Economy, vol.4, no.1, p.76 (Economic Research Bureau, 1991).

gures downwards so that they sum to 3 000 mill. Tsh.

Our third adjustment is to lower the figure for input of seeds (intra sectoral input) to 7-Maize from 8 007 mill. Tsh. to 2 600 mill. Tsh. For most of the other crops, roughly 10 percent of gross production seems to go as input to own sector, the same assumption for maize gives seed inputs of 2 600 mill. Tsh.

Fourth, the transport input of more than 50 percent of output in 4-Tobacco is set more in line with transport use in other sectors; 10 percent of gross production.

Fifth, 1-Cotton, 4-Tobacco and 5-Cashew have estimated fertiliser and agro-chemical inputs of 74, 71 and 80 percent of their gross output respectively. These input figures seem rather high when compared to the use of fertilisers and agro-chemicals in the fertiliser-intensive coffee production. We assume that use of fertilizers and agro-chemicals in the production of tobacco, cotton and cashew are roughly the same as for coffee and set these inputs to 50 percent of gross output in each of the three sectors.

In addition to the adjustments made of the Marketing Development Bureau-figures, we have made use of the input figures arrived at by using the 1976 input-output coefficients in the sectors where marketing board surveys are missing. We end up with input use in the agricultural sectors as displayed in table 9[10].

The remaining task is to make sure that for each non-agricultural sector, the use of inputs estimated on the basis of the 1976 input-output table, must equal our estimate of total input use which follows from the difference between estimated gross output and GDP at market prices. It comes as no surprise that for many sectors there is a somewhat large discrepancy between the two values. We take the difference between gross production and gross product to be the "correct" estimate of total intermediate input in each sector, and leave the necessary adjustments of inter-sectoral deliveries until we have made our estimates of the components of final deliveries.

The estimated total input figures for each sector enables us to fill in the missing elements of the supply side of the SAM. Applying the agricultural input figures and the gross production estimates displayed in Table 4, paragraph 4.1.3, we get GDP in the agricultural sectors 1-11. Total value added for sectors 1-11 is 180 367 mill. Tsh. From Table 1 we have that GDP in the primary sectors 1-13 is 233 804 mill Tsh. As we by now have GDP in sectors 1- 11 and 13-Forestry, Fishing and Hunting we are able to calculate value added of sector 12-Livestock as a residual. We get GDP in sector 12-Livestock of 38 304 mill. Tsh. and with our assumption of 90 percent value added this gives us gross production in sector 12-Livestock of 42 560 mill. Tsh.

Table 10. Production for the domestic market and taxes

	Production for the domestic market, mill. Tsh.	Sales tax revenue, mill. Tsh.	Sales tax rate, percent
14. Food and Beverages	77 216	14 106	18
15. Textiles	57 043	7 524	13
16. Manufacturing	218 652	37 766	17

Our estimates so far, of GDP at factor costs and market prices, gross production, imports and exports in domestic prices are summarized in Table 1 in Appendix 2. Gross production (X_j) less exports (A_j) equals the term "Production for the domestic market" (XD_j) in the model. XD_j plus imports add to total supply of each of the composite goods (XC_j) in the model.

To finish our discussion of the supply side of the SAM, we are now able to calculate the sales tax rates (TS_j) which enters our model as an element of the domestic market price (PD_j). The sales taxes were introduced in paragraph 4.1.2 where we calculated GDP at market prices. The gross production at market price values for the sectors 14-Food and Beverages, 15-Textiles and 16-Manufacturing (which we assumed where the only commodities subject to sales tax), less exports yield production for the domsetic market (XD_j). Applying the corresponding tax revenues estimated in paragraph 4.1.2, we get the tax rates displayed in Table 10.

4.3 Final deliveries

4.3.1 Change in stocks

From the National Account, total change in stocks is 18 022 mill. Tsh. We make no attempt to allocate this figure to different sectors. We leave change in stocks to be determined as a residual so that the

10 Note that the sectors 6,8 and 9 there are no inputs of fertilisers according to our sources. We do however want the option of applying fertilisers in all agricultural sectors, and have included this input in all agricultural production functions. The use of fertilisers in the model, in the sectors that does not in fact use any in the model base year, is set to be greater than zero but not large enough to disturb the elements in our forthcoming input-output table.

size of change in stock in each sector is set in order to make total use of each composite equal to total availability.

4.3.2 Government consumption

Government consumption is given in the NA as 52 637 mill. Tsh. GDP in the NA sector "Public Administration and other Services" is 35 134 mill. Tsh. We assume that the difference is consumption of intermediates. Inputs of each model composite is found from the coefficients in the 1976 input-output table, assuming gross production in the public sector to be 52 637 mill. Tsh., and distributing imported inputs proportionally to domestically produced inputs.

4.3.3 Investment

We classify two composites only as investment goods; 16-Manufacturing and 17-Constructions. Table 13 of the National Accounts divides total investment of 217 404 mill. Tsh. by type of capital good. Initially, we assumed that all "Buildings" and "Other works" (Land improvements, Roads and Bridges, and Water supply) consisted of the construction-commodity. According to this procedure however, the deliveries for investment purposes exceeded the domestic supply of this good. Instead we take our estimates of demand for constructions as intermediates and government consumption for given, calculate private consumption by applying the budget share for "Rents" from the national Consumer Price Index[11], and let the rest of domestic supply of the construction-commodity be deliveries for investment purposes in the production sectors. Investment demand for the commodity 16-Manufacturing follows as the residual of the NA value for total investments.

4.3.4 Private consumption

The figure of total private consumption, 394 530 mill. Tsh., is found in the NA; Table 5. If we leave out the change in stocks, our estimates of intermediate input demand, investments and government consumption, private consumption of each composite should in principal be given as the residual of the total supply. Our aggregate residual private consumption is however greater than the NA figure. Furthermore, the allocation between goods is quite different from the one given by the weights of the various consumption items in the national Consumer Price Index (CPI), which we will use as a guide in our further attempts to derive at private consumption figures. The CPI weights are shown in Table 11.

Table 11. CPI weights and SAM-budget shares. Percent

Consumption category	CPI weights	Corresponding model goods	Budget shares in the SAM
Food	64.2	1-14	
Drinks and Tobacco	2.5	1-14	64.3
Rents	4.9	17	4.9
Fuel, Light		18	0.2
and Water	7.6	16	(7.4)
Clothing,		15	8.0
Footwear	9.9	16	(1.9)
Furniture, Utensils	1.4	16	(1.4)
Household Operations	3.4	16	(3.4)
Personal care and Health	1.3	20	
Recreation, Entertainment	0.7	20	2.0
Transport	4.1	19	2.5
Total	100		
Model commodity 16			18.0
Total			100

The last column of the table shows the budget shares first applied to derive the consumption figures in the SAM. The figures in parenthesis refers to "residual" budget shares which added up should give our budget share for commodity 16-Manufacturing.

Private consumption of commodities 1-13 is calculated residually. Given our earlier estimates of intermediate and final deliveries from these sectors, consumption of each good is the amount which makes the corresponding lines in the SAM sum to sectoral gross production. Then consumption of commodity 14-Food and Beverages is calculated so that the budget share of commodities 1-14 added up is close to the CPI weight for Food, Drinks and Tobacco. The budget share of commodities 1-14 in the SAM is now 64.3 while the weight in the CPI is 66.7.

Somewhat arbitrary, we assume that of the CPI weight of 9.9 percent for Clothing and Footwear, 8 percent is commodity 15-Textiles and the remaining 1.9 percent enters commodity 16-Manufacturing. Consumption of commodity 17-Constructions was already calculated by applying the CPI weigh of 4.9. Private consumption of 18-Electricity is calculated residually, giving a budget share of 0.2,

11 Economic Bulletin, Vol. 21, no 1, p.9 (Bank of Tanzania, 1991).

which is low compared to the CPI weight of Fuel, Light and Water of 7.6. Applying the CPI weight for transport to calculate consumption of commodity 19-Transport and Communication yield consumption greater than domestic supply. We calculate consumption of this good residually so that total domestic supply equals total demand. For commodity 20-Other private services, consumption is calculated by applying the CPI weights of Personal care and Health, Recreation and Entertainment (2.0). Finally, our estimates so far leaves consumption of commodity 16-Manufacturing to be determined as residual private consumption. This gives a budget share of 18, which is somewhat too high if one adds the so far unused CPI weights of Furniture and Utensils (1.4), Households operations (3.4) Footwear (assumed to be 1.9) and the remaining Fuel light and water weight (7.6 -0.2), which sum to 14.1. The reason why our budget share for commodity 16-Manufacturing is high is our low budget shares of 18-Electricity and 19-Transport and Communication.

4.3.5 Status of the SAM

The status of the SAM is by now the following: For most sectors we have that total use equals total supply, as we for several sectors calculated private consumption residually to secure equality. Thus these lines will not be adjusted. Our problem setors/commodities are 14-Food and Beverages, 15-Textiles, 16-Manufacturing and 20-Other private services. In sector 14-Food and Beverages, total domestic availability is less than our estimate of total demand. In the sectors 15-Textiles, 16-Manufacturing and 20-Other private services the problem is that total availability is much larger than our estimates of use of each commodity.

First, we take our estimated final deliveries as given. Before we turn to adjusting the figures for intermediate inputs we have to check weather the use of material inputs in each non-agricultural sector, as calculated on the basis of the 1976 input-output table, corresponds to our estimate on the basis of GDP and gross production. For the agricultural sectors there is no discrepancy as GDP is calculated as gross production less material input-figures, both based on the Marketing Development Bureau-data. For the remaining sectors our estimates of input use from the 1976 input-output table does not equal the input figures which follow from the difference between our estimated gross production and GDP at market prices.

For sectors 12-Livestock, 13-Forestry, Fishing and Hunting and 18-Electricity the differences between the two estimates are small and we adjust the input figures proportionally until the sum to the difference between gross production and GDP at market prices. In sectors 14-Food and Beverages, 15-Textiles, 16-Manufacturing, 17-Constructions, 19-Transport and Communication and 20-Other private services, the input estimates from the 1976-input coefficients are lower than the input use figures which follow from the difference between our estimated gross production and GDP at market prices. Thus, in order to make columns sum up right we have to increase input use. The only intermediate deliveries we can increase without disturbing the balance of the lines of the SAM, are inputs from sectors 15-Textiles, 16-Manufacturing and 20-Other private services, as these are the only commodities where domestic supply exceeds domestic demand. Accordingly, we increase inputs of these goods proportionally to the previous input estimates, until we end up with total input use in all sectors equal to the difference between our estimated gross production and GDP at market prices.

The resulting input-output table is displayed in Table 2 in Appendix 2. The input-output coefficients (a_{ij}) needed for the model follows directly by dividing each element by the corresponding gross production values (X_j) from Table 1. The input-output coefficients are displayed in Table 3 in Appendix 2. Note that the coefficient measuring inputs of commodity 16-Manufacturing in the agricultural sectors does not enter the model as such. We have defined this commodity as fertilisers, which is applied by the agricultural sectors on the basis of profit maximisation.

The SAM we end up with after adjusting intermediate inputs still reveal discrepancies between the use and availability of output for commodities 14-Food and Beverages, 15-Textiles, 16-Manufacturing and 20-Other private services. The estimated supply of 15-Textiles, 16-Manufacturing and 20-Other private services is larger than estimated demand. Supply of commodity 14-Food and Beverages is still unadjusted and thus to low. If we assume that some of the private consumption of food and beverages takes place at hotels and restaurants, private consumption of commodity 20-Other private services may be increased on the behalf of consumption of commodity 14-Food and Beverages. We allow the budget share of commodity 20-Other private services to double from 2.0 to 4.0 to account for this, and adjusts consumption of commodity 14-Food and Beverages downwards correspondingly.

The remaining discrepancies of the commodities 14-Food and Beverages, 15-Textiles, 16-Manufacturing and 20-Other private services, enters the SAM as changes in stock. Relative to total domestic supply (XC_j), the change in stock of commodity 14-Food and Beverages is 21 percent, commodity 15-Textiles is 42 percent, 16-Manufacturing is 7 per cent and 20-Other private services is 4 per cent. The change in stock of 15-Textiles is thus quite high,

while that of the other commodities are more acceptable. The large value for change in stocks of 15-Textiles may of course reflect serious errors in out estimation methods, but may on the other hand reflect *actual* change in stocks, due to the substantial uncertainties facing the producers during economic reforms. As the industrial surveys do not report data on changes in stocks and the NA only displays aggregate change in stocks, it is impossible to check the realism of our figures. Our aggregate change in stocks, of 40 492 mill Tsh. is however not too far from the NA figure of 18 022 mill Tsh., and corresponds to less than four percent of total domestic supply. One reason why our discrepancy between demand and supply is larger than in the NA is that while the components of total final demand (private and public consumption plus investments) corresponds to the NA values, the components of domestic supply are largely estimated. For instance is our figure for total exports adjusted downwards compared to the NA value. Cet. par., this increases domestic supply. On the other hand, we made no adjustments to account for bank service charges, which cet. par. decreases domestic demand.

The demand side of the SAM is displayed in Table 4 in Appendix 2. The table shows the use of each composite good for intermediate inputs (denoted $\Sigma_i a_{ij} X_i$ in the model), Private consumption (C_j), Government consumption ($a_{Gj} C_G$) and Gross investments (DK_j). The last column displays total domestic demand, which equals total domestic supply of each composite good.

4.4 Additional data

Some additional data are needed as input in the CGE model outlined in chapter 3, in order to determine the distribution of income, investments, the LES, foreign trade and government consumption. The data discussed below are included in order to give base year values to the model's exogenous variables and default values to the parameters.

4.4.1 Distribution of income

For each sector of production and for the public sector, value added at factor cost (GDP) has to be divided between wages, returns to capital and profits in the agricultural sectors in which the use of capital is fixed, and depreciation; in order to find the cost share parametes of the production function, the rate of depreciation of capital-parameter, and the stock of capital.

Table 5 of the National Accounts displays aggregate values of GDP at factor cost. Of the total GDP value of 410 930 mill. Tsh. (the discrepancy between this figure and our is GDP in the public sector and imputed bank service charges), 57 071 mill. Tsh. is wages, 339 506 mill. Tsh. is operating surplus (returns to capital) and 14 364 mill. Tsh. is depreciation. We have not been able to find any estimates of the rate of depreciation or the rate of return to capital in Tanzania. Neither do we know the stock of real capital, either at a sectoral level or as an aggregate. The NA figures does however imply either an extremely high nominal rate of return to capital, or an extremely low depreciation rate; if the NA figures are correct, the nominal rate of return has to be almost 24 times as high as the rate of depreciation. A very high rate of inflation could explain a high nominal rate of return. However, according to the Tanzanian Economic Trends, Table 3 (Economic Research Bureau, 1993), the increase in the Retail Price Index from 1989 to 1990 was less than 20 percent. Furthermore, the rate of return is dependent on the interest rate; in a perfect market economy the two should be the same (when the interest rate is adjusted for expectations of devaluation). The interest rates in 1990 ranged between 9 and 31 percent (Table 8b, Tanzanian Economic Trends). If the rate of return was equal to an interest rate of 24 percent, the NA figures of depreciation and profits imply a rate of depreciation of only 1 percent. This is highly unlikely, and in contrast to the values in the industrial survey. According to the value added figures for the industries, the depreciation rate is almost three times as high as the rate of return. The discrepancy between the NA and industrial survey figures could be due to very high profits in the non-industrial sectors, but the magnitude of the differences is too large for this to be a reasonable explanation. As our only sources of information on these matters are rather inconsistent, we simply assume the that the rate of returns to capital in 1990 was 25 percent, which is between the interest rate on long term savings of 26 percent and the interest rates on Treasury Bills of 23 percent (Tanzanian Economic Trends, Table 8b). Together with additional assumptions outlined below, this enables us to come up with figures for sectoral depreciation rates and real capital stocks,which we take to be at the beginning of the year.

The basis of information about the distribution of income in the agricultural sectors are the annual reviews of the different crops by the Marketing Developing Bureau. The use of real capital is very low in most of the agricultural sectors. In the sectors 1, 6, 8, 9, 10 and 11, real capital costs accounts for less than 5 percent of factor costs. In these sectors we assume there is no capital, thus GDP at factor costs is all due to returns to labour. In the other sectors, distribution of value added between labour and capital is found in the reviews. We first make the assumption that the use of capital is optimal and that the zero-profit condition holds. We do however not know the distribution between depreciation and returns to capital, or the stock of capital. Thus we have to make additional assumptions either about the stock of capital or about the rate of deprecia-

tion. Quite arbitrary, we assume the latter to be 10 percent. Together with our assumption on the overall rate of return to capital, we are able to split the part of value added that is due to real capital into returns to capital and depreciation, and to estimate the stock of capital.

Labour costs, the value of depreciation and value added in the sectors 14-Food and Beverages, 15-Textiles, 16-Manufacturing and 18-Electricity are found in the industrial survey. The cost shares of labour and depreciation in 1988 are used to find the distribution of income in these sectors in 1990. According to the industrial survey, depreciation in the textile industry was larger than value added in 1988. We have used the average ratio of depreciation to value added for "Total Industry" from the industrial survey to calculate the depreciation in the sectors 14-Food and Beverages, 15-Textiles and 16-Manufacturing. Thus we ignore the negative net value added in the textile industry. The returns to capital follows as a residual, and this enables us to estimate the stock of real capital, given that the rate of return is 25 percent. Our estimate for the stock of capital enables us to calculate the rate of depreciation.

In the sectors 12-Livestock and 13-Forestry, Fishing and Hunting, it seem reasonable to assume that labour is the most important factor of production and that the stock of real capital is low. We assume that wages are 95 percent of GDP, the rate of return to capital is 25 percent and the rate of depreciation is 10 percent. For the remaining sectors; 17-Constructions, 19-Transport and Communication and 20-Other private services, we use the 1976 input-output table to find rough shares of labour, depreciation and returns to capital in GDP.

We have already assumed all production to take place in private sectors, and that the public sector uses labour and materials only. The NA figure for value added in the public sector (35 134 mill Tsh.) is thus assumed to be returns to labour.

Table 5 in Appendix 2 summarises our estimates. Compared to total gross investments, which according to the NA (and applied in our SAM) is 217 404 mill. Tsh., our estimated stock of capital is quite low at 230 354 mill Tsh. As total depreciation is 29 553 mill Tsh, net investments is 187 849 mill. Tsh., implying that the stock of real capital almost dubles during this one year. Most likely, either our stock of capital estimate is too low or the investment figure from the NA is too high. Our stock of capital estimate is dependent on the assumptions regarding returns to labour versus returns to capital and depreciation. High shares of returns to labour reduces the estimate of the stock of capital, given the rate of return and depreciation-assumptions. Given the share of returns to labour in value added, high rates of depreciation and returns to capital-assumptions also reduces the resulting estimate for the stock of capital. Accordingly, either our figure for returns to labour, the rate of return, or the rate of depreciation, or all these factors, may be to high. Leaving out real capital in the public sector also contributes to a low stock of capital-estimate. On the other hand, the NA figure for investments may include goods like tools and plants, that in our tradition of work is defined as materials and not as real capital. As we have based our figures on official statistics, apart from for the sectors 12-Livestock and 13-Forestry, Fishing and Hunting (which in any case is unlikely to contribute a lot when in comes to the stock of capital), we leave our estimates as they are.

Our shares of returns to labour, returns to capital and depreciation in GDP is 80, 13 and 7 percent respectively. The corresponding figures according to the NA is 14, 83 and 3 percent. Thus, the largest difference between the NA figures and ours is when it comes to the distribution of income between returns to capital and labour. Our estimate of private income, which is returns to labour and capital, is 409 173 mill Tsh. and the NA figure for National Income at factor cost is 355 585 mill. Tsh. As we have allocated all incomes from real capital to the private sectors, the two income terms should be equal. The discrepancy occurs because the NA figure subtracts net factor incomes from abroad and imputed bank service charges.

In the non-agricultural sectors 12-20, the cost share of labour-parameters (α_j) required for the model's production functions, are found as the ratio between returns to labour and value added. In the agricultural sectors 1-11, the costs share of labour-parameters are calculated as the ratio between returns to labour, and GDP plus inputs of fertilisers. In these sectors, the cost share of capital (β_j) are calculated as the ratio between returns to capital and GDP plus inputs of fertilisers. In the sectors 6,8 and 9, there is no inputs of fertilisers according to our sources of data on input use in the agricultural sectors. We do however want our model to be able to handle future inputs of fertilisers in these sectors as well, and have included this input in the production function; we want the parameter that measures the cost share of fertilisers ($1 - \alpha_j$ ($- \beta_j$ when included)) to be greater than zero. Accordingly, we have adjusted our estimates of the cost shares of labour (and capital when included) somewhat downwards in order for the $1 - \alpha_j$ ($- \beta_j$)-parameter to be greater than zero, and at the same time not large enough to obscure the lines and columns of our base year input-output matrix. Table 6 in Appendix 2 displays our cost share parameters.

4.4.2 Sectoral investments

In the SAM we have so far only made assumptions about deliveries of investment goods. In the previous paragraph we calculated sectoral capital stocks at the beginning of 1990 and replacement investments at the end of 1990 (depreciation). For the model, we also need to know in which sectors investments are taking place, and how these sectoral investments are distributed between the two investment goods in the model.

Table 16 of the National Accounts provides information about gross fixed capital formation by sector. According to these figures the primary sectors 1-13 accounted for 54 percent of investments in 1990, while the corresponding figure for 1988 was less than 3 percent. During the 1980's the investments in the primary sectors have been around 10 percent of total investments, with declining shares since 1986. We have not been able to find any comments on the large increase in agricultural investments from 1988 to 1990. Furthermore, the growth does not correspond to capital stock figures from the annual crop-reviews. Until we have more information about the subject, we are sceptical to the enormous increase in agricultural investments. As a result, we distribute investments between the sectors of destination and origin on the basis of a few more reasonable assumptions.

Total gross investments, which are all private, are allocated between the sectors in accordance with the share of real capital found in the previous section. Table 7 in Appendix 2 displays the results.

Future demand for investment goods in the non-agricultural sectors will be determined by the first order condition for profit maximisation by the model. A constant share of net investments will however be allocated to each agricultural sector (m_j in the model). We apply the same shares as we just used to allocate gross investments between sectors. According to our estimates, agricultural capital added up was less than two percent of total capital in 1990. The agricultural investment shares are displayed in Table 7, Appendix 2.

Only the industrial survey provides any information on the allocation of investment demand. To distribute gross investments between our two sectors of origin, we first make the assumption that investments in the agricultural sectors are all of the commodity 16-Manufacturing. Second, the industrial survey distributes gross investments between different types of investment goods for the sectors 14-Food and Beverages, 15-Textiles, 16-Manufacturing and 18-Electricity. We apply the share of "buildings" in each sector's gross investments to calculate these sector's demand for commodity 17-Constructions. Furthermore, we assume that demand for constructions amounts to 5 percent of gross investments in the sectors 17-Constructions and 19-Transport and Communication. What is left of the supply of constructions is allocated to sector 20-Other private services. The sectoral demand for commodity 16-Manufacturing follow as residuals. Table 8 in Appendix 2 summarises our findings. The investment by destination-investment by origin- coefficients (b_{ij}) are now given as the ratio between demand for each good in each sector and total gross investment in that sector. The coefficients are displayed in the last two columns of Table 8, Appendix 2.

4.4.3 Aggregate income and savings

To assign numbers to the marginal propensity to consume parameter and the income tax rate, and to check that savings in fact equals net investment, we have to make estimates of the various components of income and savings. Applying our estimates of returns to labour and real capital, subtracting the Economic Survey 1991 value of 41 765 mill. Tsh., which is "Income taxes and other taxes" (indirect taxes not include, Table 18 in the survey), which we assume to be income taxes only, we get private disposable income (Y in the model) of 367 408 mill. Tsh. The implicit income tax rate is 10 percent. With private consumption being 394 530 mill. Tsh., the marginal propensity to consume (c) is 1.07. The savings rate (1-c) is -0.07, and private savings is thus negative and equal to - 27 122 mill. Tsh. in the base year. In the model (as in accordance with the NA), excess private consumption over private income is covered by foreign transfers.

In our model framework, where we have assumed all sectors of production to be private, government income is due to tax revenues only. In paragraph 4.1.2, we distributed the NA value of indirect taxes of 94 280 mill. Tsh. between sales taxes and cus-

Table 12. Aggregate income and its application. Mill. Tsh.

Private income	409 173
-Income tax	41 765
=Private disposable income	367 408
-Private consumption	394 530
=Private saving	-27 122
Government revenue	136 045
Sales tax	59 396
Export tax	7 326
Import tax	27 558
Income tax	41 765
-Government consumption	52 637
=Government savings	83 408
Foreign transfers	172 055
Total saving	187 849
Net Investments	187 849

toms duties, and the revenue from customs duties between import and export taxes (paragraph 4.1.6). Adding the revenue from income taxes of 41 765 mill. Tsh., we get total government income of 136 045 mill. Tsh. With government consumption being 52 637 mill. Tsh., government savings is 83 408 mill. Tsh.

Foreign transfers equals the trade defecit net of customs duties, which is 172 055 mill. Tsh. in the model base year. Adding foreign transfers (often refered to as foreign savings), and private and public savings and subtracting changes in stocks of 40 492 mill. Tsh. yields total savings of 187 849 mill. Tsh., which eauals the net investment figure calculated in the preceeding paragraph. To summarise, we have the values displayed in Table 12.

4.4.4 The Linear Expenditure System

To our knowledge, up to date information on private consumption in Tanzania is largely restricted to unpublished expenditure data on 423 households from december 1991. This material is part of the Household Budget Survey 1991/1992 conducted by the Bureau of Statistics, Dar es Salaam. The full survey is however not yet available. The december survey supplies information on the household size and geographical location (Dar es Salaam, other towns, urban municipalities or rural areas), as well as one months consumption of more than 30 commodities.

Intentionally, private consumption was to be allocated between the model goods on the basis of the consumption pattern that follows from the Household Budget Survey (HBS). That is, 1990 average budget shares where assumed to equal the budget shares calculated for the sample. However, when applying the sample budget shares on the value of total private consumption from the 1990 National Accounts (394 530 mill. Tsh), consumption of several goods turned out to be higher than output. Furthermore, the derived budget shares did not correspond very well with the weights in the Consumer Price Index. As discussed in section 4.3.4, a different approach was applied to calculate private consumption. The two first columns of Table 9 in Appendix 2 displays private consumption as calculated for the SAM and the corresponding budget shares.

We make no further attempts to utilize the 1991/92 HBS. Instead, we base our estimates of the parameters of the LES on information found in a study by Sarris and van der Brink (1993) on household welfare in Tanzania. This work is largely based on the 1976/77 HBS.

One result in Sarris and van der Brink is that per capita subsistence expenditure in rural households amounts to 52 per cent of total expenditure. The corresponding figure in urban households is around 9 per cent. In 1991, 82 per cent of the population lived in rural areas[12]. Applying these shares, we assume that 45 per cent of total consumption in 1990, or 177 539 mill. Tsh, may be classified as subsistence expenditure.

According to Sarris and van der Brink (Table 33), subsistence expenditure in low income, rural households amounts to approximately 97 percent of their total expenditure. This finding gives some support to our next and somewhat basic assumption. We assume that the average Tanzanian household allocates their *minimum expenditure* between goods in the same way as the poor rural households allocates *total expenditure*. Accordingly, the estimated total minimum expenditure of 177 539 mill. Tsh. is allocated between the model commodities on the basis of budget shares in the low income rural households in the study by Sarris and van der Brink (Table 33).

Sarris and van der Brink applies the same classification of goods as the one used in the CPI, displayed in Table 11, paragraph 4.3.4. As the study reports one budget share for total food consumption, additional information and assumptions are needed in order to distribute subsistence expenditure on food between our model commodities 1-14. Table 41 in Sarris and van der Brink shows daily calorie intake of various foods in rural households, divided between subsistence and monetary quantities. This enables us to calculate the share of total calorie intake derived from subsistence consumption for each food item. These shares are then assumed to equal the share of subsistence consumption to total consumption of a similar model food item. We may then calculate the value of the subsistence consumption of each food, and derive the subsistence budget shares. Finally, these subsistence budget shares are scaled down proportionally to add to 0.85, which is the approximate share of foods in total subsistence expenditure in the low income rural households. The resulting subsistence budget shares correspond to the γ_j-parameter of the LES.

Our estimates of subsistence quantities, together with our figures for total consumption of each good determines the non-subsistence consumption of each good, and by that also the non-subsistence budget shares κ_j.

Table 9 in Appendix 2 displays consumption figures, budget shares and LES-parameters. The last column of the table displays the elasticities of income

12 The Economic Survey 1991, p.92, (the Planning Commission, 1991).

that derive from our calculated parameters and figures. According to these estimates, all food crops are normal goods with elasticities between 0 and 1. Livestock, (which delivers meat and milk for consumption), Forestry, fishing and hunting (fish for consumption), all manufactured foods and other goods, and services are all luxury goods with elasticities greater than 1. Construction (housing) has the highest elasticity of income (1.8), Transport and Communication and Other private services has the second largest (1.7). All in all, our elasticities seem quite reasonable.

4.4.5 Trade

Next, we have to make assumptions regarding the elasticities between imports (I_j) and domestically produced goods (XD_j), and between export (A_j) and deliveries for the domestic market (XD_j). Commonly, commodities that are considered the most tradable are given higher elasticities than the ones that are considered less tradable. The middle column of Table 10 in Appendix 2 displays our base case assumptions regarding substitution between imports and domestic goods, and the middle column of Table 11 displays the assumptions regarding the substitution between export and domestic goods. Whenever a commodity is both imported and exported the elasticities are assumed to be equal. All crops are given high elasticities (0.9), services and transport and communications are given low elasticities (0.3) and the elasticities for industrial products are given elasticities between the high and low ones (0.6). The elasticities may be altered in sensitivity analysis, and the ones displayed here are merely our default values.

Given the assumptions regarding the elasticities of trade, the share parameter in the export supply and import demand equations are calculated. The share parameters and the elasticities then determine the values of the shift variables in the CES and CET equations. Note that all parameters are calibrated with base year domestic market prices set to unity. Share parameters and shift variables are also shown in Tables 10 and 11 in Appendix 2, together with the base year values of total production (X_j), deliveries for the domestic market (XD_j), export (A_j), imports (I_j) and the value of the composite good (XC_j).

4.4.6 Government intermediate consumption

Finally, we have to calculate the parameters measuring the government's demand for labour (g) and intermediate inputs of each composite (a_{Gj}). The demand for labour parameter is the ratio between public labour costs (or returns to labour) of 35 134 mill. Tsh., and total government consumption of 52 637 mill. Tsh. This gives a value of the cost share of labour of 0.67.

The government demand for intermediate input-parameters are simply the share of total government consumption, directed at each good. Accordingly, the values are found as the ratio between government consumption of each good, and total government intermediate consumption, found in Table 4, Appendix 2. Table 12 in the appendix displays the coefficients.

5. Conclusions

In this report, we document a Computable General Equilibrium model for the economy of Tanzania, the Social Accounting Matrix underlying the model, and the calibration of model parameters. The model is developed to account for effects of land degradation processes; this report does, however, only deal with the pure economic part of the model, treating land degradation as an exogenous variable in the agricultural production functions. The model presented here is quite standard; producers maximises profits subject to Cobb Douglas production functions, households maximise utility and distribute expenditure according to a linear expenditure system. The model exhibits two way trade assuming imperfect substitution between domestically produced and imported varieties of each good, and between production for the domestic market and export. Prices are endogenous and adjust to obtain market equilibria. Economic growth occurs through growth in the stock of capital, which is determined by savings (which again are largely exogenous, as a major part consists of foreign transfers), exogenous technological progress, and declines in the land degradation processes (which are treated as exogenous in this report, but are endogenous and dependent on the application of fertilisers in the complete model).

The SAM underlying the model is mostly based on official Tanzanian statistics. The Tanzanian Bureau of Statistics provides a number of publications on economic data. Tanzania is however still in the process of developing National Accounting procedures, and the data available are often somewhat inconsistent as different sources often give different figures for what should be the same issue. Much of the official data are based on outdated information from the 1976 input-output table. Furthermore, apart from the agricultural sectors, we have found no gross production figures. To develop the SAM presented above, several somewhat arbitrary and rough assumptions were made. Other assumptions would of course give a different SAM, which may be just as reasonable as the one presented here. Accordingly, it is important to adjust the SAM and the model parameters as new information becomes available.

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Appendix 1. Model equations, list of sectors and variables

Model equations. The figure in parenthesis refers to the equation numbers in chapter 3. The last column shows the number of equations.

1 (1)	Agricultural production	$X_j=B_j \cdot S_j \cdot L_j^{\alpha_j} \cdot K_j^{\beta_j} \cdot F_j^{1-\alpha_j-\beta_j}$	j ∈ AG1	5
2 (6)	Agricultural production	$X_j=B_j \cdot S_j \cdot L_j^{\alpha_j} \cdot F_j^{1-\alpha_j}$	j ∈ AG2	6
3 (7)	Industrial production	$X_j=B_j \cdot L_j^{\alpha_j} \cdot K_j^{1-\alpha_j}$	j ∈ IND	9
4 (2,8)	Intermediate inputs	$M_j=X_j \cdot \Sigma_i a_{ij}$	j ∈ J i ∈ J	20
5 (4,9)	Demand for labour	$W_j \cdot L_j=X_j \cdot \alpha_j \cdot (P_j-\Sigma_i a_{ij} \cdot PC_i)$	j ∈ J i ∈ J	20
6 (5)	Demand for fertilisers	$PC_{16} \cdot (1+TF_j) \cdot F_j=X_j \cdot (1-\alpha_j-\beta_j) \cdot (P_j-\Sigma_i a_{ij} \cdot PC_i)$	j ∈ AG1+AG2 i ∈ J	11
7 (10)	Demand for capital	$PK_j \cdot (R+\delta_j) \cdot K_j=X_j \cdot (1-\alpha_j) \cdot (P_j-\Sigma_i a_{ij} \cdot PC_i)$	j ∈ IND i ∈ J	9
8 (3)	Price on· capital	$PK_j=\Sigma_i PC_i \cdot b_{ij}$	j ∈ AG1+IND i ∈ 16,17	14
9 (11)	Import price	$PI_j=PW_j \cdot ER \cdot (1+TI_j)$	j ∈ J	20
10 (14)	Composite price	$PC_j \cdot XC_j=PD_j \cdot XD_j+PI_j \cdot I_j$	j ∈ J	20
11 (13)	Composite aggregation	$XC_j=Q_j \cdot [q_j \cdot I_j^{-\tau_j}+(1-q_j) \cdot XD^{-\tau_j}]^{-\frac{1}{\tau_j}}$	j ∈ J	20
12 (15)	Demand for imports	$\frac{I_j}{XD_j}=[\frac{PD_j}{PI_j} \cdot \frac{q_j}{(1-q_j)}]^{\sigma_j}$	j ∈ J	20
13 (12)	Export price	$PA_j \cdot (1+TA_j)=PW_j \cdot ER$	j ∈ J	20
14 (17)	Value of sale	$P_j \cdot X_j=PD_j \cdot (1-TS_j) \cdot XD_j+PA_j \cdot A_j$	j ∈ J	20

15 (16)	Allocation of goods	$X_j=H_j\cdot[h_j\cdot A_j^{\rho_j}+(1-h_j)\cdot XD_j^{\rho_j}]^{\frac{1}{\rho_j}}$	j ∈ J	20
16 (18)	Supply of export	$\frac{A_j}{XD_j}=[\frac{PA_j}{PD_j(1-TS_j)}\cdot\frac{(1-h_j)}{h_j}]^{\alpha_j}$	j ∈ J	20
17 (19)	Private income	$Y=(1-TY)\cdot[\Sigma_m W_m L_m+W_G\cdot L_G+\Sigma_i PK_i\cdot R\cdot K_i$ $+\Sigma_k(X_k\cdot(P_k-\Sigma_j a_{jk}\cdot PC_j)-PC_{16}\cdot F_k-\delta_k\cdot K_k)]$	m ∈ AG2+ IND i ∈ IND k ∈ AG2 j ∈ J	1
18 (20)	Private expenditure	$E=cY$		1
19 (21)	Private consumption	$PC_j\cdot C_j=PC_j\cdot\gamma_j+\kappa_j\cdot(E-\Sigma_i PC_i\cdot\gamma_i)$	j ∈ J i ∈ J	20
20 (22)	Public revenue	$GR=\Sigma_j(TS_j\cdot PD_j XD_j+TA_j\cdot PA_j A_j+TI_j\cdot PW_j I_j\cdot ER)$ $+TY[\Sigma_m W_m\cdot L_m+W_G\cdot L_G+\Sigma_i PK_i\cdot R\cdot K_i+\Sigma_k(X_k\cdot(P_k-\Sigma_j a_{jk}\cdot PC_j)$ $-PC_{16}\cdot F_k-\delta_k\cdot K_k)]+\Sigma_i TF_i\cdot PC_{16}\cdot F_i$	j ∈ J m ∈ AG2+IND i ∈ IND k ∈ AG2 s ∈ AG1+AG2	1
21 (23)	Public revenue application	$GR=C_G+S_G$		1
22 (24)	Public demand for labour	$g\cdot C_G=W_G\cdot L_G$		1
23 (25)	Public demand for intermediates	$PC_j\cdot M_{Gj}=a_{Gj}\cdot(1-g)\cdot C_G$	j ∈ J	20
24 (26)	Total net investments	$J=(1-c)\cdot Y+S_G+Z\cdot ER-\Sigma_j CS_j$	j ∈ J	1
25 (27)	Agricultural net investments	$m_j\cdot J=(DK_j-\delta_j\cdot K_{j,t})\cdot PK_j$	j ∈ AG1	5
26 (28)	Agricultural capital	$K_{j,t+1}=DK_j+(1-\delta_j)\cdot K_{j,t}$	j ∈ AG1	5
27 (29)	Non-agricultural investments	$DK_j=K_{j,t+1}-(1-\delta_j)\cdot K_{j,t}$	j ∈ IND	9
28 (30)	Equilibrium savings-net investments	$J\cdot(1-\Sigma_i m_i)=\Sigma_j[(DK_j-\delta_j\cdot K_{j,t})\cdot PK_j]$	j ∈ IND i ∈ AG1	1
29 (31)	Equilibrium, composite 16	$XC_{16}=\Sigma_j a_{16j}\cdot X_j+\Sigma_k F_k+M_{G16}+C_{16}+\Sigma_i b_{16i}\cdot DK_i+CS_{16}$	j ∈ J k ∈ AG1+AG2 i ∈ AG1+IND	1
30 (32)	Equilibrium, composite 17	$XC_{17}=\Sigma_j a_{17j}\cdot X_j+M_{G17}+C_{17}+\Sigma_i b_{17i}DK_i+CS_{17}$	j ∈ J i ∈ AG1+IND	1
31 (33)	Equilibrium, other composites	$XC_j=\Sigma_i a_{ji}\cdot X_i+M_{Gj}+C_j+CS_j$	j ∈ J-16-17 i ∈ J	18

=340 eq.

Commodity/Sector list (J)	AG1	AG2	IND
1. Cotton		*	
2. Coffee	*		
3. Tea	*		
4. Tobacco	*		
5. Cashew	*		
6. Cassava		*	
7. Maize	*		
8. Rice		*	
9. Sorghum		*	
10. Beans		*	
11. Other crops and cereals		*	
12. Livestock			*
13. Forestry, Fishing and Hunting			*
14. Food and Beverages industries			*
15. Textiles			*
16. Other manufacturing sectors, Mining and Quarrying			*
17. Construction			*
18. Electricity			*
19. Transport and Communication			*

List of variables

Endogenous:

A_j	Export	(20)
C_j	Private consumption	(20)
DK_j	Demand for real investments, j=2-5,7,12-20	(14)
GR	Government revenue	(1)
E	Total private expenditure	(1)
F_j	Use of fertilisers, j=1-11	(11)
I_j	Imports	(20)
J	Total nominal investments	(1)
$K_{j,t+1}$	Demand for real capital, j=2-5,7,12-20	(14)
L_G	Government demand for labour	(1)
L_j	Demand for labour	(20)
M_j	Demand for intermediate inputs	(20)
M_{Gj}	Government demand for intermediate inputs	(20)
P_j	Composite gross production price	(20)
PA_j	Producers export price	(20)
PC_j	Composite price of domestic and imported commodities	(20)
PD_j	Domestic market price	(20)
PI_j	Import price	(20)
PK_j	Price of real capital, j=2-5,7,12-20	(14)
R	Rate of return to real capital	(1)
S_G	Government savings	(1)
X_j	Gross production	(20)
XC_j	Composite good	(20)
XD_j	Gross production sold at the domestic market	(20)
Y	Private disposable income	(1)
		=340

Exogenous:		**Base year value:**
B_j	Factor neutral technological change	1 ∀ j
C_G	Nominal government consumption	52362
CS_j	Change in stocks	Table 4
ER	Exchange rate	1
H_j	Shift variable in the export transformation function	Table 11
$K_{j,t}$	Stock of capital, beginning of the year, , j=2-5,7,12-20	Table 7
PW_j	World market price	1 ∀ j
Q_j	Shift variable in the import substitution function	Table 10
S_j	Land degradation variable, j=1-11	1 ∀ j
Z	Foreign transfers	172055
TA_j	Export tax rate	0.87 for j =1-5, 0.00 for j ≠ 1-5.
TF_j	Fertiliser tax rate, j=1-11	0.00 ∀ j
TI_j	Import tax rate	0.11 for j=11,14,15,16,20, 0.00 for j ≠11,14,15,16,20.
TS_j	Sales tax rate	TS_{14}=0.18, TS_{15}=0.13, TS_{16}=0.17, TS_j=0.00 for j ≠ 14, 15, 16.
TY	Income tax rate	0.10
W_j	Wage rate	1 ∀ j
W_G	Wage rate public sector	1

Parameters:		**Base year value:**
a_{Gj}	Government intermediate consumption coefficient	Table 12
a_{ij}	Input-output coefficient	Table 3
b_{ij}	Investment by origin-investment by destination coefficient, i=16,17, j=2-5,7,12-20	Table 8
c	Marginal propensity to consume	1.07
g	Cost share of labour in government consumption	0.67
h_j	Export share	Table 11
m_j	Agricultural sector j's share of investments, j=2-5,7	Table 7
q_j	Import share	Table 10
α_j	Cost share of labour	Table 6
β_j	Cost share of real capital, j=2-5,7	Table 6
κ_j	Budget shares, non-subsistence private consumption	Table 9
γ_j	Subsistence quantities, private consumption	Table 9
δ_j	Depreciation rate of real capital, j=2-5,7,12-20	Table 5
τ_j	Constant elasticity of substitution parameter	Table 10
ε_j	Elasticity of import substitution	Table 10
ρ_j	Constant elasticity of transformation parameter	Table 11
Ω_j	Elasticity of export transformation	Table 11

Appendix 2. Tables

Table 1. Components of domestic supply

	Gross product at factor costs	Sales tax	Gross product at market prices	Gross production at market prices (X_j)	Imports (I_j)	Export (A_j)	Total domestic supply (XC_j)
1 Cotton	1818		1818	7114		1250	5864
2 Coffee	2659		2659	5873		5783	90
3 Tea	1029		1029	1232		341	891
4 Tobacco	178		178	995	41	664	372
5 Cashew	280		280	1380		336	1044
6 Cassava	9276		9276	9396			9396
7 Maize	19060		19060	26895			26895
8 Rice	7911		7911	9139	551		9690
9 Sorghum	3550		3550	4118			4118
10 Beans	8786		8786	10579			10579
11 Other Crops	125821		125821	129970	5728	18675	117023
12 Livestock	38304		38304	42560	1121	855	42826
13 Forestry, fishing, hunting	15133		15133	16814	372	3416	13770
14 Food and Beverages	5490	14106	19596	78384	3756	1168	80972
15 Textiles	2928	7524	10452	61482	7141	4439	64184
16 Other Manufacturing	14698	37766	52464	228104	243834	9452	462486
17 Construction	23053		23053	57118			57118
18 Electricity	4760		4760	7677			7677
19 Transport and Communication	36242		36242	48323		14000	34323
20 Other private Services	82616		82616	188580	18296	13522	193354
Sum	403592	59396	462988	935734	280840	73901	1142673

Table 2. Intermediate inputs and deliveries

Output: \ Input:	1	2	3	4	5	6	7	8	9	10	11
1 Cotton	687										
2 Coffee		90									
3 Tea			185								
4 Tobacco				140							
5 Cashew											
6 Cassava											
7 Maize							2600				
8 Rice								612			
9 Sorghum									334		
10 Beans										1425	
11 Other Crops											2059
12 Livestock											
13 Forestry, fishing, hunting											
14 Food and Beverages											
15 Textiles	420	32		90	390	120	1170	450	180	90	90
16 Other Manufacturing	3557	2917	11	497	690		1794		120	1000	
17 Construction											
18 Electricity											
19 Transport and Communication	632	175	7	90	20		2271	166	54	158	1000
20 Other private Services											
Sum Material inputs	5296	3214	203	817	1100	120	7835	1228	568	1793	4149
Gross Product at market prices	1818	2659	1029	178	280	9276	19060	7911	3550	8786	125821
Gross Production at market prices	7114	5873	1232	995	1380	9396	26895	9139	4118	10579	129970

	12	13	14	15	16	17	18	19	20	Sum Material input
1 Cotton				5177						5864
2 Coffee										90
3 Tea			706							891
4 Tobacco			232							372
5 Cashew			564							564
6 Cassava										0
7 Maize			2516							5116
8 Rice			2221							2833
9 Sorghum			356							690
10 Beans									380	1805
11 Other Crops			11091	7586	166				7313	28215
12 Livestock			516		1461				4585	6562
13 Forestry, fishing, hunting		125	108		1001	1174			7767	10175
14 Food and Beverages	1537		5372		826				22695	30430
15 Textiles	321	684	1464	4155	3033				451	13140
16 Other Manufacturing	751	393	7890	17122	83511	21270	1998	5314	18916	167750
17 Construction			68	23	1776	86	124	1287	5214	8578
18 Electricity			344	363	1774	40	60	111	1346	4038
19 Transport and Communication		96	1155	274	5689	1328	160	741	8383	22399
20 Other private Services	1647	383	24185	16330	76403	10168	575	4628	28913	163232
Sum Material inputs	4256	1681	58788	51030	175640	34065	2917	12081	105964	472745
Gross Product at market prices	38304	15133	19596	10452	52464	23053	4760	36242	82616	
Gross Production at market prices	42560	16814	78384	61482	228104	57118	7677	48323	188580	

Table 3. Input-Output coeficients (a_{ij})

Output: \ Input:	1	2	3	4	5	6	7	8	9	10
1 Cotton	0.0966									
2 Coffee		0.0153								
3 Tea			0.1502							
4 Tobacco				0.1407						
5 Cashew										
6 Cassava										
7 Maize							0.0967			
8 Rice								0.0670		
9 Sorghum									0.0811	
10 Beans										0.1347
11 Other Crops										
12 Livestock										
13 Forestry, fishing, hunting										
14 Food and Beverages										
15 Textiles	0.0590	0.0054		0.0905	0.2826	0.0128	0.0435	0.0492	0.0437	0.0085
16 Other Manufacturing -										
17 Construction										
18 Electricity										
19 Transport and Communication	0.0888	0.0298	0.0057	0.0905	0.0145		0.0844	0.0182	0.0131	0.0149
20 Other private Services										

	11	12	13	14	15	16	17	18	19	20
1 Cotton					0.0842					
2 Coffee										
3 Tea				0.0090						
4 Tobacco				0.0030						
5 Cashew				0.0072						
6 Cassava										
7 Maize				0.0321						
8 Rice				0.0283						
9 Sorghum				0.0045						
10 Beans										0.0020
11 Other Crops	0.0158			0.1415	0.1234	0.0007				0.0388
12 Livestock				0.0066		0.0064				0.0243
13 Forestry, fishing, hunting			0.0074	0.0014		0.0044	0.0205			0.0412
14 Food and Beverages		0.0361		0.0685		0.0036				0.1203
15 Textiles	0.0007	0.0075	0.0407	0.0187	0.0676	0.0133				0.0024
16 Other Manufacturing		0.0176	0.0234	0.1007	0.2785	0.3661	0.3724	0.2603	0.1100	0.1003
17 Construction				0.0009	0.0004	0.0078	0.0015	0.0162	0.0266	0.0276
18 Electricity				0.0044	0.0059	0.0078	0.0007	0.0078	0.0023	0.0071
19 Transport and Communication	0.0077		0.0057	0.0147	0.0045	0.0249	0.0233	0.0208	0.0153	0.0445
20 Other private Services		0.0387	0.0228	0.3085	0.2656	0.3349	0.1780	0.0749	0.0958	0.1533

Table 4. Intermediate input and final deliveries

	Material inputs ($\Sigma_i a_{ij} X_i$)	Private consumption (C_j)	Government consumption (C_{Gj})	Investments ($\Sigma_i b_{ij} DK_i$)	Change in stock (CS_j)	Total domestic demand (XC_j)
1 Cotton	5864					5864
2 Coffee	90					90
3 Tea	891					891
4 Tobacco	372					372
5 Cashew	564	480				1044
6 Cassava		9396				9396
7 Maize	5116	21779				26895
8 Rice	2833	6857				9690
9 Sorghum	690	3428				4118
10 Beans	1805	8774				10579
11 Other Crops	28215	88808				117023
12 Livestock	6562	35974	290			42826
13 Forestry, fishing, hunting	10175	2737	858			13770
14 Food and Beverages	30430	67711	214		-17383	80972
15 Textiles	13140	31562	295		19187	64184
16 Other Manufacturing	167750	71015	5004	188619	30098	462486
17 Construction	8578	19331	424	28785		57118
18 Electricity	4038	887	2752			7677
19 Transport and Communication	22399	10009	1915			34323
20 Other private Services	163232	15781	5751		8590	193354
Sum	472745	394530	17503	217404	40492	1142673

Table 5. Distribution of income

	Gross product at factor costs	Returns to labour ($W_j * L_j$)	Returns to capital ($R * K_j * PK_j$)	Depreciation ($\delta j * K_j * PK_j$)	Rate of depreciation (δ_j)	Stock of real capital (K_j)
1 Cotton	1818	1818				
2 Coffee	2659	2526	95	38	0,1 0	380
3 Tea	1029	864	118	47	0,10	470
4 Tobacco	178	164	10	4	0,10	41
5 Cashew	280	263	12	5	0,10	48
6 Cassava	9276	9276				
7 Maize	19060	18107	681	272	0,10	2723
8 Rice	7911	7911				
9 Sorghum	3550	3550				
10 Beans	8786	8786				
11 Other Crops	125821	125821				
12 Livestock	38304	36389	1368	547	0,10	5472
13 Forestry, fishing, hunting	15133	14376	540	216	0,10	2162
14 Food and Beverages	5490	1559	1022	2910	0,71	4086
15 Textiles	2928	831	545	1552	0,71	2179
16 Other Manufacturing	14698	4173	2735	7790	0,71	10939
17 Construction	23053	17733	4729	591	0,03	18915
18 Electricity	4760	512	1728	2521	0,36	6912
19 Transport and Communication	36242	7060	25416	3765	0,04	101666
20 Other private Services	82616	54731	18590	9295	0,13	74361
The Government	35134	35134				
Sum	438726	351584	57589	29553		230354

Table 6. Cost shares of labour, capital and fertilisers.

	α_j	β_j	$1-\alpha_j-\beta_j$
1 Cotton	0.3382		0.6618
2 Coffee	0.4530	0.0238	0.5231
3 Tea	0.8311	0.1583	0.0106
4 Tobacco	0.2426	0.0211	0.7363
5 Cashew	0.2713	0.0173	0.7113
6 Cassava	0.9999		0.0001
7 Maize	0.8683	0.0457	0.0860
8 Rice	0.9999		0.0001
9 Sorghum	0.9999		0.0001
10 Beans	0.9864		0.0135
11 Other Crops	0.9921		0.0079
12 Livestock	0.9500		
13 Forestry, fishing, hunting	0.9500		
14 Food and Beverages	0.2839		
15 Textiles	0.2839		
16 Other Manufacturing	0.2839		
17 Construction	0.7692		
18 Electricity	0.1075		
19 Transport and Communication	0.1948		
20 Other private Services	0.6625		

Table 7. Investments

	Stock of real capital (K_j)	Gross investments (DK_j)	Agricultures's share of investments (m_j)
1 Cotton			
2 Coffee	380	359	0.0017
3 Tea	470	444	0.0021
4 Tobacco	41	38	0.0002
5 Cashew	48	45	0.0002
6 Cassava			
7 Maize	2723	2570	0.0122
8 Rice			
9 Sorghum			
10 Beans			
11 Other crops			
12 Livestock	5472	5164	
1 3 Forestry, fishing, hunting	2162	2040	
14 Foods and beverages	4086	3856	
15 Textiles	2179	2057	
16 Other manufacturing	10939	10324	
17 Construction	18915	17852	
18 Electricity	6912	6523	
19 Transport and communication	101666	95950	
20 Other private services	74361	70180	
Sum	230354	217404	0.0164

Table 8. Investments by destination- Invsetments by origin

	Gross investments (DK_j)	Manu-facturing (16)	Constructions (17)	Investments by destination b_{16j}	Investments by destiantion b_{17j}
1 Cotton					
2 Coffee	359	359		1.0000	
3 Tea	444	444		1.0000	
4 Tobacco	38	38		1.0000	
5 Cashew	45	45		1.0000	
6 Cassava					
7 Maize	2570	2570		1.0000	
8 Rice					
9 Sorghum					
10 Beans					
11 Other Crops					
12 Livestock	5164	5164		1.0000	
13 Forestry, fishing, hunting	2040	2040		1.0000	
14 Food and Beverages	3856	2708	1149	0.7022	0.2978
15 Textiles	2057	1642	415	0.7982	0.2018
16 Other Manufacturing	10324	8075	2250	0.7821	0.2179
17 Construction	17852	16959	893	0.9500	0.0500
18 Electricity	6523	2915	3608	0.4469	0.5531
19 Transport and Communication	95950	91153	4798	0.9500	0.0500
20 Other private Services	70180	54506	15674	0.7767	0.2233
Sum	217404	188619	28785	0.8676	0.1324

Table 9. Private consumption and the LES parameters

	Private consumption (C_j)	Budget shares, percent	Subsistance budget shares, percent	Subsistance quantities (γ_j)	Non-substiance budget shares (κ_j) percent	Non- subsistance consumption	Income elasticities
1 Cotton							
2 Coffee							
3 Tea							
4 Tobacco							
5 Cashew	480	0.12	0.15	267	0.10	213	0.81
6 Cassava	9396	2.38	4.80	8525	0.40	871	0.17
7 Maize	21779	5.52	10.22	18149	1.67	3630	0.30
8 Rice	6857	1.74	3.22	5715	0.53	1143	0.30
9 Sorghum	3428	0.87	1.60	2841	0.27	587	0.31
10 Beans	8774	2.22	4.25	7537	0.57	1237	0.26
11 Other Crops	88808	22.51	45.55	80862	3.66	7947	0.16
12 Livestock	35974	9.12	5.82	10339	11.81	25634	1.30
13 Forestry, fishing, hunting	2737	0.69	0.13	238	1.15	2499	1.66
14 Food and Beverages	67711	17.16	9.26	16439	23.63	51272	1.38
15 Textiles	31562	8.00	5.0	8877	10.45	22685	1.31
16 Other Manufacturing	71015	18.00	9.0	15978	25.36	55037	1.41
17 Construction	19331	4.90	0.1	178	8.83	19153	1.80
18 Electricity	887	0.22	0.1	178	0.33	709	1.45
19 Transport and Communication	10009	2.54	0.3	533	4.37	9476	1.72
20 Other private Services	15781	4.00	0.5	888	6.86	14894	1.72
Sum	394530	100.00	100.00	177542	100	216988	1.00

Table 10. Imports and the import equation parameters

	Composite good (XC_j)	Production for the domestic market (XD_j)	Imports (I_j)	Elasticity of substitution (ε_j)	CES parameter (τ_j)	Share parameter (q_j)	Shift parameter (Q_j)
1 Cotton	5864	5864					
2 Coffee	90	90					
3 Tea	891	891					
4 Tobacco	372	331	41	0.9	0.1111	0.0894	1.38
5 Cashew	1044	1044					
6 Cassava	9396	9396					
7 Maize	26895	26895					
8 Rice	9690	9139	551	0.9	0.1111	0.0423	1,22
9 Sorghum	4118	4118					
10 Beans	10579	10579					
11 Other Crops	117023	111295	5728	0.9	0.1111	0.0357	1.19
12 Livestock	42826	41705	1121	0.6	0.6667	0.0024	0.06
13 Forestry, fishing, hunting	13770	13398	372	0.6	0.6667	0.0025	1.07
14 Food and Beverages	80972	77216	3756	0.6	0.6667	0.0064	1.12
15 Textiles	64184	57043	7141	0.6	0.6667	0.0304	1.28
16 Other Manufacturing	462486	218652	243834	0.6	0.6667	0.5453	2.00
17 Construction	57118	57118					
18 Electricity	7677	7677					
19 Transport and Communication	34323	34323					
20 Other private Services	193354	175058	18296	0.3	2.3333	0.0006	1.15

Table 11. Export and the export equation parameters

	Gross production at market prices (X_j)	Export (A_j)	Production for the domestic market (XD_j)	Elasticity of transformation (Ω_j)	CET parameter (ρ_j)	Share parameter (h_j)	Shift parameter (H_j)
1 Cotton	7114	1250	5864	0.9	2.1111	0.8478	2.70
2 Coffee	5873	5783	90	0.9	2.1111	0.0097	9.06
3 Tea	1232	341	891	0.9	2.1111	0.7441	2.26
4 Tobacco	995	664	331	0.9	2.1111	0.3157	2.14
5 Cashew	1380	336	1044	0,9	2.1111	0.7790	2.37
6 Cassava	9396		9396				
7 Maize	26895		26895				
8 Rice	9139		9139				
9 Sorghum	4118		4118				
10 Beans	10579		10579				
11 Other Crops	129970	18675	111295	0.9	2.1111	0.8790	2.95
12 Livestock	42560	855	41705	0.6	2.6667	0.9985	11.51
13 Forestry, fishing, hunting	16814	3416	13398	0.6	2.6667	0.9070	2.81
14 Food and Beverages	78384	1168	77216	0.6	2.6667	0.9991	13.86
15 Textiles	61482	4439	57043	0.6	2.6667	0.9860	5.20
16 Other Manufacturing	228104	9452	218652	0.6	2.6667	0.9947	7.33
17 Construction	57118		57118				
18 Electricity	7677		7677				
19 Transport and Communication	48323	14000	34323	0.3	4.3333	0.9521	2.62
20 Other private Services	188580	13522	175058	0.3	4.3333	0.9998	7.51

Table 12. Government intermediate consumption coefficient

	a_{Gj}
1Cotton	
2 Coffee	
3 Tea	
4 Tobacco	
5 Cashew	
6 Cassava	
7 Maize	
8 Rice	
9 Sorghum	
10 Beans	
11 Other Crops	
12 Livestock	0.0166
13 Forestry, fishing, hunting	0.0490
14 Food and Beverages	0.0122
15 Textiles	0.0169
16 Other Manufacturing	0.2859
17 Construction	0.0242
18 Electricity	0.1572
19 Transport and Communication	0.1094
20 Other private Services	0.3286

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