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Jean Luc Erero, Daniel Djauhari Pambudi and Bonga Bonga  
Lumengo

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# Land Use in the Democratic Republic of Congo (DRC)

Jean Luc Erero\*, Daniel Djauhari Pambudi<sup>†</sup> and Bonga Bonga Lumengo<sup>‡</sup>

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## Abstract

This paper examines the effects of land use in the DRC through the application of DRC formal-informal sector computable general equilibrium model, developed with the 2007 DRC Social Accounting Matrix. Two policy options are analysed. Firstly, the hypothetical policy change introduced in the short and long run application of this model is a land use subsidy where a 10% cut in the price of land both in the formal and informal sector is applied. In tracing the impact of this shock on the economy, as expected, gross domestic product and employment increase. Intuitively one would expect positive contribution on GDP (0.34% in the short run and 0.26% in the long run) and employment (0.25% in the short run). The significant increase in employment can be explained as any gains due to the land price decrease which influences the activity level. Secondly, land use productivity is achieved through the shock applied to the factor technical change which causes the producers to make use of the three primary inputs, namely labour, capital and land, as well as intermediate inputs in a more efficient way. The advantages of the productivity increase cause producers to gain considerable enhancement in competitiveness which leads to considerable higher growth in exports with export volumes increasing by 1.74% and 0.41% in the short and long run respectively.

JEL classification: C68, C88, D58, E26, O17, Q15, Q24

Key words: land use, informal sector, CGE model, Democratic Republic of Congo

## 1 Introduction

According to the World Map (2009), the total area of DRC is 2,344,860 square kilometers (905,063 square miles; approximately the size of the east of Mississippi, United States of America). The country area varies from tropical rainforests to mountainous terraces, highlands, savannahs, dense grasslands, and

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\*Specialist: Revenue Research at South African Revenue Service

<sup>†</sup>Consultant for Livestock Information, Sector Analysis and Policy Branch FAO and for Australian State

<sup>‡</sup>Head of Department of Economic and Financial Sciences, University of Johannesburg

mountains. The largest portion of the DRC's immense rainforest is mainly for forest products such as timber and wildlife (CBFP, 2006). The vast central rainforest space sloping toward the equator is the richest absorption of agricultural land in the globe. If the agricultural systems do not improve and remain unproductive over the years, most of unused lands including forests might not be transformed to agricultural lands. DRC has also the planet's second affluent river structure for fish (700 species) and mollusks (Usongo *et al.*, 2007). The Congo River occupies approximately 400,000 square miles with an exit to the Atlantic Ocean. A fertile portion of agricultural land is situated at the north side of the Congo River.

DRC is well distinguished for its immense reserve of unused land that could be transformed into agricultural uses. Land clearing for agriculture usually causes enormous issues. According to Babcock (2009), the portion of land clearing can be easily evaluated nowadays. It is done through the satellite monitoring technique even though its sources are not easy to evaluate. He argues that "the argument concerning biofuels are crucial as their use triggers considerable transformation on ordinary lands to both crop and livestock output across the universe". This argument is of economic significance, as regulations concerning biofuels depend essentially on the indirect land use conversions stimulated by the growth of agricultural products which generate energy.

It may be of interest to point out that the land use in DRC is not necessarily a legal or political issue but more precisely part of a broader agricultural crisis with financial, social and economic facets (Huggins, 2010). The agricultural crisis curtails from an amalgamation of organisational constraints on the income systems, the immense quantity of unused land and the widespread crisis in terms of trade for agricultural produce that is being experienced across Africa associated with the diverse practices of globalisation. This agricultural crisis is aggravated, of course, by the lack of access to finance, inaccessibility to agricultural equipment and armed conflict in the country.

Although the law made it relatively simple for individuals and corporations to purchase land, it is however problematic for the majority of Congolese to buy and register their land rights, as the process is very complicated and generally requires travel to major cities of the provinces and other expenses such as bribes. According to Huggins (2010:14), the cost of registering a small plot of land is approximately US\$500 in Masisi (very small district in the province of Kivu), but can exceed US\$1,000 in some areas of North Kivu. This is an exorbitant amount of money for the average Congolese citizen, placing registration out of access for most.

Even with the legislation in place, the government is faced with challenges in land clearing for agricultural uses. The main reason for the problem of unused land can be traced to a bureaucratic hassles and exorbitant prices of land which prevent the majority of the population to possess the land. Despite the considerable reserve of unused land, its exploitation is a big challenge for the DRC government because of the poor regulatory quality, absence of law enforcement and corruption. A considerable number of land use development programmes and projects have been initiated without implementation (World

Bank, 2007). Indeed, one possible solution to the land use should be that the government provides subsidy on land use that should unleash the potential for more agricultural production and addressing an assortment of economic, social, environmental and political issues. In this paper, an attempt to evaluate the impact of land use subsidy and improvement in land productivity is done in view to advise the DRC government about the importance of the land use in the economy.

The studies of Ferreira Filho and Horridge (2011), Nassar *et al.* (2010), as well as that of Ferez (2010) are counted among researches that attempted to evaluate the indirect land use conversions related to the growth of the derived agricultural products. However, their methodological techniques are different when compared to ours. They used a specific model database composed mainly of formal sectors of the economy of Brazil. Therefore, in contrast to existing research, our investigation on the land use is based on the application of a CGE model based on a database that accounts for the formal and informal sectors in the DRC. Thus, this study applies a new method of measuring the land use in both the formal and informal sectors in the DRC. It adds to the debate by making use of a policy simulation, namely the land use subsidy, as there is a vast stock of unused land in the DRC. Taking into account the particularity of the formal and informal land use developed in the CGE model, Section 2 introduces the current state of the land use in the DRC. Section 3 presents the land use legislation. The methodology and model description are examined in Sections 4 and 5. The simulation results are given in Section 6. Critical policy evaluation is performed in Section 7 and the last section concludes this paper.

## 2 Land use in DRC

Table 1 below provides the statistics on the land use by agriculture in the DRC. The "Unused" land is described as the overall zone in the country less the used zones such as forests and grasslands, as taken from the Agricultural Survey (2000). It involves also the entire zones predominately composed of natural forests, rivers and roads which are not yet used for agriculture purposes. The fraction of 78.3% of unused land is immense. This immense reserve of land could be transformed to agricultural uses. In this respect, the transformation of these zones to the land for agricultural uses is the main challenge for the government. We will consider the transformation of the unused land as a substitution to the agricultural uses.

These statistics demonstrate that DRC has considerable reserve of unused land. This implies that agricultural land can expand from the immense reserve of unused land although there is no need to transform the forests to the agricultural uses. Currently for the entire country, around 928 million hectares (Mha) of unused land are available for additional agricultural land use according to the DRC Agricultural Survey of 2000. The 257.1 Mha of total agricultural land represents only 27.69% of unused land.

Figure 1 below shows that there is no necessity for land substitution espe-

cially for agriculture growth because of the immense reserves of unused land. Babcock (2009) studied the indirect land use process and found that there is a need for land substitution and imputation for some specific crop zone or grasslands growth in Brazil. This is acceptable because the land clearing for agriculture is a multifaceted and complicated phenomenon that creates serious matters in Brazil. Contrary to Babcock (2009), in the DRC there is no need for land substitution because of the immense reserves of unused land.

Recently, the DRC Department of Agriculture (2010) pointed out that cassava, which is the main consumption product in the DRC decreased considerably between 1995 and 2010. The lowest decrease occurred in 2010 with 9 billion kilograms produced compared to 26 billion kilograms in 1995. The decrease emanated essentially from the Bandundu province, which produces 75% of the total cassava production in the country because of its rich natural soil<sup>1</sup>.

Although International Monetary Fund provides technical and financial supports based on operational land use strategy, the DRC contraction of agricultural production impacted negatively on food guarantee and food distribution, attributable to the inability to use the agricultural land. This phenomenon has caused the latest scrambles in food prices due mainly to the decrease in the cassava production, the main agricultural product used by households. In this respect, a considerable decrease was observed in per capita output of all agricultural products and land use during the same period (IMF, 2010).

### 3 DRC land use legislation

DRC, like other countries in the developing world, has a number of different systems which hold decision-making powers over land. Unruh (2005) identifies three types of systems: (i) customary; (ii) informal; and (iii) statutory systems. The first, *customary* systems are normally administered by local traditional leaders who regulate the land use according to clan ownership. They tend to favour the men while women and children are frequently deprived of their land rights. The second, *informal* land use systems derive from the circumstances in which the government and traditional leaders are unable to regulate the land use. A prominent example of informal systems comprises “squatter” townships which accommodate despondent and displaced people. The last, *statutory* systems rely on national laws and regulations, in which land is owned and title deed is obtained. They provide an adequate basis for the registration of urban land such as national parks, game ranches, commercial farms, production forests, wildlife reserves and other strict nature reserves. Nonetheless, in the DRC, statutory systems may not be administered nationwide because of poor capacity or political will.

Prior to the DRC’s independence in 1960, the Belgian colonial authorities applied indirect rule in the land use (Huggins, 2010). They worked in collaboration

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<sup>1</sup>The largest part of growth of cassava planted zone occurred in Bandundu and Bas Congo provinces, which accounts for 60% of total agricultural production. Bandundu’s planted zone decreased from 4.9 Mha in 1995 to 2.7 Mha in 2010.

with the traditional leaders in view to establish a form of “ethnic” governance. The central government applied the Belgian civil code to administer access to land as most Congolese were accessing the land in the traditional custom. In this respect, payment was made to the government in return for title deeds to the potential buyers. The decree issued by King Leopold II (1885) stipulated that all “vacant land” was the property of the government and was therefore no longer under the regulation of the traditional leaders (Hochschild, 1998). The implementation of this legislation affected negatively on the customary rights of ownership and land use practiced across the country. For instance 27 million hectares from customarily reserved land for periodic grazing, hunting and future habitation were transformed to the vast agricultural plantations in certain provinces of the country such as Ituri territory in Orientale Province, and the Kivu Provinces (Leisz, 1998).

The customary and statutory systems of land access were practised after the independence of DRC in 1960. Nonetheless, they were allegedly abolished by the decree of the General Property Law in 1973 (amended 1980)<sup>2</sup>. This 1973 land law included an important amendment from the colonial system. It offered an opportunity to purchase land by abolishing the customary system and preventing the local traditional leaders to receive the usual payment (Mugangu, 2006). In reality, the land law brought all land in the country under government control. It was enforced by president Mobutu who ruled the country from 1965 to 1997. His administration took control over land away from customary authorities, who were acting as government administrators, rather than decision makers. All rights were reduced to rights to use, not ownership anymore as all land became government’s land. The main reason for the abolishment of the customary system was to establish the president’s political power so that all citizens could depend on his political loyalty. As contended by researchers such as Chabal and Daloz (1999), the change of law in Zairean (Congolese) public life was to some extent a strategic political and economic diplomacy of the ruling party. The land law has never been modified since the time of President Mobutu due to political instability in the country.

## 4 Methodology

In this paper we use a CGE model of the DRC based on ORANI model of the Australian economy. The generic version of the model, ORANI-G<sup>3</sup>, intended for expository purposes was developed by Horridge (1998). The model has a theoretical composition which is typical of a static AGE model. It consists of equations describing factors such as producers’ demands for produced inputs and primary factors; producers’ supplies of commodities; demands for inputs to capital formation; household demands; export demands; government demands;

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<sup>2</sup>République de Zaire, *Loi du 20 juillet 1973 portant régime général des biens, Régime foncier et immobilier et régime des sûretés*, Kinshasa, 1973.

<sup>3</sup>Horridge, M. 1998. *ORANI-G: A generic single-country computable general equilibrium model* Paper prepared for the practical GE Modelling Course, February 7-11.

the relationship of basic values to production costs and to purchasers' prices; market-clearing conditions for commodities and primary factors; and numerous macroeconomic variables and price indices. We use GEMPACK (General Equilibrium Model Package) techniques to develop the DRC Formal-Informal Model (DRCFIM) as a research tool to assess the impact of land use in the DRC economy.

As described by Erero *et al.* (2013), one particularity of the DRCFIM is that it is a multi-sectoral CGE model that considers the structure of the DRC's formal and informal sectors as well as a range of linkages between various economic agents such as government, investors, traders and enterprises. This model is a system of equations that depicts the behaviour of the DRC economy, comprising all major industry groups, markets and institutions. Moreover, it is a comparative-static model by all accounts. Besides using its own core database, the DRCFIM is based on the 2007-DRC Social Accounting Matrix (SAM), which reconciles a wide range of data sources, including national accounts, household income and expenditure surveys, as well as labour force surveys. The primary data sources used in constructing the 2007-SAM are the 2007-DRC bureau of statistics (INS) supply-and-use tables, 2008-DRC Reserve Bank (BCC) macro-economic data and the 2007-Household Survey (HS).

The supply-and-use tables were utilised to establish the sector links and relationships, while the HS data provided information regarding employment levels and average wages across different labour groups and sectors. For lack of better information, the 1996-Income and Expenditure Survey data generated by INS was used to model household factor income distribution and consumption behaviour. The 2007-SAM consisted of comprehensive information on demand and supply for 30 activities and commodities in the formal and informal sectors. The labour component was divided into formal and informal sector. Four labour groups were specifically identified in each of the formal and informal sector, namely: (1) subsistence factor, (2) child labour, (3) female adult labour and (4) male adult labour. The household sector of 2007-SAM was disaggregated according to income into rural and urban areas with four groups in each of the formal and informal sector: i.e. (1) rural poor households, (2) rural non-poor households, (3) urban poor households and (4) urban non-poor households. The land component was also divided into the formal and informal sector.

It is important to note that there are endogenous and exogenous accounts in the disaggregated 2007-SAM. The endogenous accounts are composed of activities, commodities, labour, capital, land, enterprises and households, while the exogenous accounts consist of government, capital account, rest of the world and residual. Thus the 2007-SAM is an economy-wide database that accounts for all monetary flows in the DRC economy during 2007. It was used as database for the construction of the DRCFIM and the parameters of the model equations were calibrated to observed data from the 2007-SAM. Producers in the formal and informal sectors employ labour and capital under the assumption of constant returns to scale and profit maximisation. In this respect, we use a nested production system, with a constant elasticity of substitution (CES) function determining factor demand, and a Leontief function combining value-added and

intermediates.

## 5 Modelling Land Use

Land use is modelled through increasing the production of the agricultural sector, which might expand due to technical improvement, or by using more inputs, such as capital, labor and land. We assume that agricultural land is not in limited supply because of the massive reserves of unused land. In order to generate considerable agricultural crops, there is no necessity to transform land from new crops because it will increase food prices, nor transform unused land to agricultural — at the detriment of the natural zone. Besides, agricultural land could be expanded, without influencing land accessibility for new crops. In order to assess these assertions, the CGE model requires a specific modelling of the land use as depicted in this paper. Our expectation is that the land use subsidy will stimulate production and employment in the agricultural sector.

Agricultural and land use are modelled distinctly with a specific agricultural combination; and, we assume that land is not mobile. Data shows a number of distinctions in soil, climate and factors (rain and fertile soils) that motivate the usage of specific land for specific purposes.

DRC land area statistics released by the DRC Bureau of Statistics distinguish three categories of agricultural land use: crop, pasture, and forestry (INS, 1995). We assume that both formal and informal sectors may use agricultural land. The demands for primary factors are chosen to minimize production cost and they are structured as follows:

$$xFac(f, i) = xFac\_f(i) + aFac(f, i) - CESPRIM(i) * [pFac(f, i) + aFac(f, i) - pFac\_f(i)] \quad (1)$$

$$[VFAC(i) * wFac\_f(i) = \mathbf{sum}\{f, FAC, SAM(f, i) * [pFac(f, i) + xFac(f, i)]\}] \quad (2)$$

$$wFac\_f(i) = pFac\_f(i) + xFac\_f(i) \quad (3)$$

$$pFac(fi) = fFac(fi) + fFac\_i(f) + pTotHou \quad (4)$$

Where the parameters and variables in the demands for primary factors are described as follows:

$AFac(f, i)$  represents the factor usage technical change

$XFAC(f, i)$  represents the firm  $i$  demand for factor  $f$

$PFAC(f, i)$  represents the factor prices for firm  $i$

$CESPRIM(i)$  represents the constant elasticity of substitution between primary factors

$VFAC(i)$  represents the factor cost for the firm  $i$

$WFAC\_f(i)$  represents the expenditure on factors by firms

$fFac(f, i)$  represents the real price shift for the firm  $i$

$fFac\_i(f)$  represents the total industry real price shift

$pTotHou$  represents the consumer price index

- Equation (1) determines the firm demand for factor  $f$ . Ignoring factor technical change terms, demand of different factors ( $f$ ) by different firms ( $i$ ),  $XFAC(f, i)$ , is proportional to overall primary factor demands and to a price term powered by the elasticity of substitution between primary factors. The price term is the ratio of the price of factor,  $PFAC(f, i)$ , to the price of composite factors,  $CESPRIM(i)$ . Factor price changes induce substitution in favour of cheapening factors. Changes in  $AFAC(f, i)$ , a technical variable, will affect factor demanded per unit of value added. The price of factor composite is determined by equation 2.
- Equation (2) determines the value of the composite primary factors equals the sum of all factor costs.
- Equation (3) explains that expenditure on factors by firms equals the sum of all value-added composite cost.
- Equation (4) determines the demand for land

It should be noted that the equations are in percentage change form. In our first scenario, we only allowed the amount of land use to decrease both in the formal and informal sector by shocking the variable factor price “pfac” in the model. In the second scenario however, the variable technical change “afac” is shocked in view to assess the effect of the land use productivity in the DRC economy.

## 5.1 Closure and shock

The number of the variables and equations in the CGE model is important from the theoretical description of the CGE model. Usually, the researcher must choose which variables will be determined endogenously within the model, and which variables will be determined exogenously. The number of exogenous variables must be chosen so that the economic environment in which the policy shock is tested, best reflects the true economic environment in which the policy shock is applied. Within modelling methodology, the assumptions about exogenous and endogenous variables are known as ‘model closure’. A suitable closure needs to be established in view to test the impact of the land use subsidy on the DRC economy. Many closures can be used for different purposes. There is no unique natural or correct closure. Nonetheless, the hypothesis of testing the impact of land use subsidy and improvement of land use productivity in the DRC economy is performed within a short and long run setting. The main reason for using a short run closure is that the literature on the land use demonstrates that the land use subsidy holds positive advantage for the country’s economy irrespective of the effects of institutions and policies (Ferreira Filho and Horridge, 2010).

### 5.1.1 Short run closure

Figure 2 below shows the main assumptions underpinning the interactions between endogenous (oval) and exogenous (rectangular) macroeconomic variables in the model's short run closure. With the closure specified in Figure 2, it is assumed that there are more variables than equations. Thus, to close the model, we choose which variables are to be exogenous and which endogenous. We set the exogenous variables while the endogenous variables are explained by the model. The number of endogenous variables must equal the number of equations.

On the expenditure side of GDP as indicated in Figure 2, the sum of real household consumption, real aggregate investment, real government consumption and trade balance produces the GDP. In this respect, real household consumption, real aggregate investment and real government consumption are assumed to be constant.

On the income side, GDP is obtained from the labour, primary-factor efficiency, capital stocks and land. The primary-factor efficiency and capital stocks are assumed to be constant. Only employment is free to adjust in the short run. Constant real wages in the short run closure determine employment. The model also allocates fixed investment following endogenously determined rates of return (ROR). Land is free to adjust as mentioned earlier that DRC is well known for its vast stock of land which could be transformed to agricultural use.

The best way of evaluating the effect of the land use subsidy is through shocking the appropriate variable in the model. In our case the variable that allows a shock to be applied as a percentage change is "pfac". In ordinary simulations this variable is endogenous and cannot therefore be shocked when the specific hypothesis that needs to be tested within a simulation is not appropriately specified in the closure. We solve the problem by finding another appropriate exogenous variable to swap with "pfac". Therefore, the investigation is done in the case of simulating the effects of a 10% price reduction in land use, and the variable "pfac" is swapped with the exogenous variable "ffac" (all industry real factor price shift). The exogenous variable "ffac" represents all industry real factor price shift in the model where labour is mobile with wages indexed to consumer price index<sup>4</sup>.

Figure 3 below demonstrates the interaction between demand and supply in the short run closure. This implies that the equilibrium is reached from the right side of the land supply which has lower price and higher quantity than initially. The interaction has less elastic supply curve. The original equilibrium is at point E. The shock shifts the supply curve downward from S to S'. Subsequently, the equilibrium shifts from point E to E', has lower price and higher quantity than originally specified. Therefore, because of input-output linkages, employment, wages and household income all increase. In this respect, the demand curve will move upward from D to D'. It forms a new equilibrium at point E'', which

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<sup>4</sup>It must be noted that GEMPACK technique recommends the swapping of endogenous variable with exogenous variable before its shock while GAMS' technique allows that the endogenous variable be held fixed and shocked.

has larger quantity and higher price than point E'. We simulate the model by shifting the land supply schedule for agricultural and livestock sectors uniformly by 10% to the right side (see Figure 3). Normally there are no specified formulas for determining the level of the shock and interpreting macroeconomics results, though one explanation can be offered to justify the choice of the shock (10%). It is simply important to set the boundary within the scenario context and to identify the kind of variables, especially those which are affected by the shock in view to provide realistic results from the simulation. Thus, the government can provide a land use subsidy by reducing the price of the land by 10%. The model is shocked by setting “ $\text{ffac}(\text{land}, \text{ind}) = \text{uniform } -10$ ” (see Equation 4). As indicated earlier, the ‘ $\text{ffac}$ ’ represents price-shift variable for the informal and formal factor of land, “ $\text{land}$ ”, used by industry, “ $\text{ind}$ ”. The “-10” means that we shift the land supply function to the right side by 10%. This shock will affect agricultural and livestock land in the DRC.

### 5.1.2 Long run closure

In the long run closure, labour is completely mobile between sectors. A wage differential is needed to induce labour movement between formal and informal sectors. In percentage change form, the variable “ $\text{xlab}_i$ ” is used as follows:

$$\text{xlab}_i = \alpha * \text{averealwage} + \lambda$$

Where  $\text{xlab}_i$  is the total employment in the formal and informal sectors,  $\lambda$  is a slack variable determined by fixed national employment and  $\alpha$  the DRC migration factor. We did not find any empirical study of DRC migration factor which offered suitable estimation of  $\alpha$ . In this respect, we tested with  $\alpha$  values, and selected 1 for the simulations reported in this paper. Wage relativities are constant within both formal and informal sectors. We further assume that the national labour supply and population are fixed. ROR is exogenous and capital is not fixed. Foreign currency prices of imports are exogenous. Additional exogenous variables comprise price and quantity shift variables, rates of production tax and technological coefficients.

## 6 Results

Short run (SR) and long run (LR) simulations are carried out to evaluate the effect of the land use subsidy and improvement in the land productivity in the DRC economy. We performed four different simulations. The first two simulations relate to a 10% reduction in the price of land in both the formal and informal sectors. The last two simulations relate to the land use productivity. By increasing the overall productivity of land use, a 10% reduction in all input augmenting technical change is achieved. The effects of such a gain have economy-wide impacts, as a result of lower prices while the productivity is allowed to adjust. The main purpose is not about investigating or postulating exactly how this productivity increase would be achieved in practice but in

assuming that all the human resources and financial supports are offered for improving the productivity of land use in the DRC economy. This increase of 10% in the model is achieved by shocking all input augmenting technical change (**aFac**) from the model production function specifically for the land use in the formal and informal sectors. The land use policy simulations affect various macro and micro economic variables. The rationale behind this empirical examination is not to point out how each one of these variables has changed, but to assess and illustrate changes in some macroeconomic and sector specific variables that could benefit both DRC official government and economic agents who are involved in socio-economic policies. For instance the macroeconomic aggregate variables consist of gross domestic product, employment, consumption, exports and prices of specific inputs.

## 6.1 Land use subsidy shock

### 6.1.1 Macroeconomic results

Table 2 below reports the simulation results for both short and long run effects of land use subsidy and improvement in the land use productivity in the DRC economy for a series of macroeconomic variables. The prior expectations are confirmed by the policy simulations results. As expected, gross domestic product, exports and employment increase. In tracing the impact of the land use subsidy shock, output rises indicating considerable efficiency which raises output in most sectors, stimulating the real GDP to rise by 0.34% and 0.26% in the SR and LR, respectively from the baseline economy (see Table 2). The increased output and consequent drop in domestic prices (-0.68% in SR and -0.1% in LR) reflect significant efficiency and lower costs per unit output, resulting in increased real GDP. As a direct result of the growth in productivity, the consumer price index (CPI) declines by 0.79% and 0.11% in the SR and LR respectively. The considerable level of real GDP allows consumers to enjoy a considerable level of consumption as the CPI declines. In this respect, higher factor earnings and higher consumption due to low-price of commodity raise household welfare specifically for low-income households. Besides, a reduction of land price causes a reduction of cost of production which induces a reduction of export price (0.37% in SR and 0.08% in LR), while export volume increases by 1.87% and 0.41% in the SR and LR respectively. This stimulates the formal sector to export more as the export volume increases. Although import price is fixed in the SR and LR, a fall on export price causes term of trade to decline. We observe that balance of trade increases by 0.26% and 0.04% in the SR and LR respectively, due especially to the considerable increase in exports.

As there is substitutability among factors which favour the cheapening resources, a reduction on land price induces the aggregate land to increase by 5.77% and 5.83% in the SR and LR respectively because the land is used as intermediate input for some sectors. Economy-wide productivity improved considerably as confirmed by the significant increase in domestic output.

The simulation results show that output has a positive impact on employ-

ment. The increase in employment represents an increase in labour in the production process, which naturally leads to a rise in productivity. This economy-wide improvement in productivity in turn has a significant impact on employment with increased output stimulating more job creation. Employment increases by 0.25% in the SR, while it remained constant in the LR as declared in the closure. The main reason for this increase is that the economy-wide output combined with increasing export demand raises the demand for factors of productions. Because the capital is fixed in the SR, an increase in the demand for labour and land, leads to the decrease in the output price index (-0.68% in SR and -0.1% in LR). Figure 4 below reports employment by skills category with unskilled labour benefiting more than skilled labour in the SR. Skilled labour in the formal and informal sectors is composed of male labour (MALELAB\_F and MALELAB\_I) while unskilled labour includes female subsistence (FSUB\_F and FSUB\_I), child labour (LCHILD\_F and LCHILD\_I) and female labour (FEMLAB\_F and FEMLAB\_I). The largest rise of unskilled employment occurs in LCHILD\_F (1.07%) followed by FSUB\_F (0.83%) and FEMLAB\_F (0.74%) because agriculture and livestock sectors which increased in output are highly labour-intensive and absorb more unskilled labour. Considering the rise of output, the land use subsidy shock stimulates more demand of unskilled labour than that of skilled labour. As indicated earlier, there is substitutability among factors which favour the cheapening resources; a reduction on land price induces nominal wages to fall. Given the fact that real wages are fixed in the SR, the decrease in CPI by 0.79% indicates that the nominal wages have also decreased, which explain the increase in employment by 0.25%. The increase in land use has led to the increase in unskilled labours in the formal and informal sectors. The results support observations that the wage improvement reduces the cost of workers for firms and thus raises demand for labour (Davies and Thurlow, 2010:453). Besides, the aggregate land use in the formal and informal sectors increased in employment by 6.07% (LAND\_F) and 5.24% (LAND\_I) respectively (see Figure 4).

### 6.1.2 Sectoral results

Table 3 below reports on the percentage change in sectoral results caused by land use subsidy and land productivity policy simulations. Although all sectors increased in output in the LR, overall, the land use subsidy had a positive economic impact on some sectors in both the formal and informal sectors in the SR. For instance, the formal sectors benefit the most from the land use subsidy in terms of output. These sectors include livestock (LIVES\_F at 0.89% in SR and 0.72% in LR), agriculture (AGRI\_F at 0.72% in SR and 0.71% in LR), and processed food (FOOD\_F at 0.09% in SR and 0.44% in LR) as is proven by the results in column 1 in Table 3. Most of these sectors are labour-intensive sectors that absorb the majority of lower-skilled workers. Hence, the increase in output in these sectors is driven especially by the land use subsidy allocation. The main reason for this improvement in output is that the land use subsidy cuts the cost of production in the formal sector. Furthermore, the

formal sector production and employment also increases to a certain extent due to the enhanced production efficiency and improved export opportunities.

It is not surprising that the sectors that are closely linked to the land use are winners or perform well, while those sectors that are not linked to the land use are the losers or perform poorly. The policy simulation results show that the livestock, agriculture and food sectors are the biggest winners under the proposed land use subsidy. These are the sectors that rely heavily on the land use as an input in the production process. The outputs of these sectors increased considerably and this increase is a result of an increase in the export demands for these products. Moreover, the increase in the output of the related sectors implies an increase in employment of unskilled and informal sector labour in these sectors.

The outcome of the land use subsidy shows that the cost of production is reduced both in the formal and informal sectors. In this respect both the price of formal and informal goods decreases. Therefore, in the SR it stimulates purchasers to demand more goods as the output increases for the sectors such as livestock formal sector (0.89%), agriculture formal sector (0.72%), livestock informal sector (0.64%), agriculture informal sector (0.32%), utilities informal sector (0.26%), trade formal sector (0.23%) and private service formal sector (0.20%). Nonetheless, among the sectors which performed poorly are manufacturing formal sector (-0.46%) followed by clothing sector both formal (-0.37%) and informal (-0.08%) sectors and real estate both formal (-0.12%) and informal (-0.04%) sectors (see column 3 in Table 3). The main reason for poor performance could be that the demand for labour is derived from the increase in output and sectors related to land attracted labour from other sectors.

The direct impact of land use subsidy in some sectors is the rise of employment in these sectors, although marginally proportional to their output gain as land demand rises. Increased output stimulates sectors to improve their production process by rising employment demand in various skill categories. The rise in employment in labour intensive sectors is stimulated by improved efficiency which allows profit-maximising producers to grow by employing more resources, specifically labour, due to its increased marginal productivity. The simulation results show a positive employment increase in most labour intensive sectors. For instance in the SR, employment rises significantly in sectors such as agriculture both formal (0.34%) and informal (0.36%) sectors, livestock both formal (0.8%) and informal (0.19%) sectors and food both formal (0.13%) and informal (0.02%) sectors (see column 3 in Table 3). Even though employment increases in most sectors, a substantial increase occurred in the trade sector especially. Employment increased in the trade formal and informal sectors by 2.68 and 0.66% respectively due to the land subsidy allocation that influences the activity level of the sector. Falling output prices and increased trade with the formal sector does, however, benefit informal traders. Increased formal sector production also benefits workers who are informally employed in the formal sector, despite the substantial overall shift in labour demand toward formally employed workers. This is consistent with the findings of previous studies (see, for instance, Davies and Thurlow 2010). Overall this policy shock related to

land use subsidy shows that national employment increased by 0.25%.

### **6.1.3 The terms of trade**

The terms of trade presume important meaningful results for DRC's exports and competitiveness. However, the positive impact of the terms of trade depends on the adjustment in export prices which decreased by 0.37% and 0.08% in the SR and LR respectively (see Table 2). Our simulation result appears more intuitive for a land use subsidy policy simulation because the considerable decrease in export prices was expected with a positive impact on DRC's competitiveness.

The prior expectation is confirmed by the policy simulation results. Evaluation of the adjustment in the terms of trade shows that the reduction in export prices justifies the two significant elements. Firstly, the land use subsidy is not completely generated on the export goods, but on the intermediate use of the land. Even though the intermediate land use subsidy could increase the export price, its inflationary impact on export prices is not as severe than it would be if the land use subsidy was completely imposed on exports. Secondly, the considerable reduction in the price of the fixed factors of production did offset the inflationary impact of land use subsidy. It shows that DRC's prevalent exports goods are demanding in the utilisation of unskilled labour and land. Thus, these industries denote mainly the primary sector of DRC's production and comprise both formal and informal sectors such as agriculture, livestock, food and mining informal sector. The reduction in the price of land therefore decreases the export prices of these products. Besides, the service sector usually requires intensive utilisation of capital and skilled-labour in the course of production. Therefore, the price reduction of these fixed factors of production leads to a reduction in the export prices of these products. Despite the fact that the formal sector stimulates certain demand for informal inputs from the informal sector, the informal sector experiences reduction in production and faces considerable import competition without any enhanced strategy to penetrate foreign exports markets. The main reason is that it is the formal sector that is involved in foreign exports and not informal sector. The formal sector produces and generates products that profit considerably from the reduction in export prices

### **6.1.4 The effect on the demand for land use**

The effect of land use subsidy on the demand for land use appears to be substantial. The domestic demand for land use increases by 5.77% and 5.83% in the SR and LR respectively. The rise of the land use demand is mostly the result of an increase in output of the sectors that make significant use of land in the production process (the agriculture formal sector, the livestock formal-informal sector and the food formal sector). Due to the fact that the structure of the DRC economy provide enough reserves of land, the final user benefits the most from the land use subsidy. The price reduction for the consumers results in a rise in the demand for these products and subsequently in a rise in the domestic

demand for land use. Nevertheless, because the elasticity of demand for these products is relatively low, the rise in the demand for land intensive products is not limited and the positive dividend, that arises from the subsidy, is also substantial.

Furthermore, due to the lack of alternative sources of land, there is no substitution effect and the considerable level of subsidy results in a relatively high increase in land use. While the land use subsidy has a positive land use benefit, this indicates a further motivation for availing considerable resources for systematic investment in land research, development and technological innovation to maximise land use in the DRC economy.

## **6.2 Land use productivity shock**

### **6.2.1 Macroeconomic results**

Improvement in the land use productivity is simulated by shocking the overall factor technical change (“aFac” from the model) for the land in both formal and informal sectors. The overall economic impact of the improvement in the land use productivity has positive results on most macro-economic variables. The simulation results show that GDP increases by 0.31% and 0.26% in the SR and LR respectively (see the last two columns in Table 2 in Section 6.1.1). This means that the shock applied to the factor technical change causes the producers to make use of the three primary inputs namely labour, capital and land, as well as intermediate inputs in a more efficient way. The productivity gains for the land use sector translate into lower output prices in effect causing consumer inflation to decline by 0.74% and 0.11% in the SR and LR respectively. The advantages of the productivity increase cause producers to gain considerable enhancement in competitiveness which leads to considerably higher growth in exports with export volumes increasing by 1.74% and 0.41% in the SR and LR respectively. This increase in export volumes is expected since the land use sector plays a major role in the intermediate inputs for some sectors such as the agricultural and livestock sector.

Results of economy-wide land use productivity increase show output having a positive impact on employment. The expansionary economy combined with increasing export demand increases the demand for factors of production. The increase in employment by 0.23% in the SR represents an increase of labour in the production process. Usually, where producers conserve their labour force through labour saving technical change improvements, the improvement in labour productivity can be achieved through better management and a focus on the training and development of staff. Without any reduction in the growth rate of the average real wage in the LR (0.6%), the unit cost of labour is actually reduced through productivity improvements. This ensures significant improvements in competitiveness and a shift from production for the local market to exports, which consequently result in positive GDP effects. In this respect, to attract labour from both formal and informal sectors, wages had to rise by 0.6% even though the aggregate employment is constant in the LR.

### 6.2.2 Sectoral output

Table 3 in Section 6.1.2 reports on the changes in sectoral results caused by the improvement in the land use productivity. All sectors experience increase in output in the LR. This shows that the improvement in the land use productivity has positive effects on the DRC economy over the LR. The largest increase in output occurred to both formal and informal sectors that are heavily dependent on land in the production process. Nonetheless in the SR, for instance, the formal sectors benefit the most from the improvement in the land use productivity use in terms of output. These sectors include livestock (LIVES\_F at 0.83%), agriculture (AGRI\_F at 0.67%), and food (FOOD\_F at 0.08%) as is proven by the results in column 1 in Table 3. Most of these sectors are labour-intensive sectors that absorb the majority of lower-skilled workers. The main reason for this increase in output is that the improvement in the land use productivity cuts the cost of production in the formal sector.

We noticed on the one hand that non-traded sectors such as formal administration (ADMIN\_F at 0.12%), formal private sector (PRIVS\_F at 0.18%), and informal utility (UTIL\_I at 0.24%) increased in output in the SR. This increase is due to the improvement in the land use productivity. On the other hand, some trade-exposed sectors increased because users did not substitute products as a result of the dropping costs caused by the improvement in the factor technical change in the land use. In this simulation, then, the improvement in the land use productivity is used to support all sectors, not at the expense of one sector. Column 2 in Table 3 shows that in the SR most sectors report an increase in export reflecting the considerable mutual trade that takes place between the formal and informal sectors. The increase in export volumes is to be expected since it is the formal sector that deals with international trade and not the informal sector.

Sectoral employment shows increase in most sectors due to factor productivity increase in those selected sectors. Nonetheless, sectors with initial low output levels witness the worst of employment contraction in the SR. These sectors include clothing (CLOTH\_F at -0.09%), manufacturing (MANUF\_F at -0.07%) and utility (UTILI\_F at -0.07%) as is proven by the results in column 3 in Table 3. This is consistent with the findings of previous studies (see Punt et al, 2003) which indicate that productivity increases in sector such as agriculture reduces employment sectorally while increasing its output in an expanding economy. This outcome shows that efficiency gains in specific sectors have economy-wide positive employment effect when there is linkage between formal and informal sectors.

### 6.2.3 Terms of trade

The improvement in the land use productivity allows the price of export and the cost of production to fall. The price of exports decreases by 0.34% and 0.08% in the SR and LR respectively (see Table 2). It denotes the terms of trade and its decrease means positive effects for DRC's exports and international

competitiveness. Export volume increases by 1.74% and 0.41% in the SR and LR respectively; because the competitiveness of producers is stimulated by foreign markets. This can stimulate a slight depreciation of the real exchange rate required to boost exports. Thus, economic activity expands (real GDP increases by 0.31% and 0.26% in the SR and LR respectively) to stimulate a growth in employment. The increase in income stimulates the households to spend more. Although the volume of import contracted by 0.12% in the SR, we noticed that the rest of the world import volume increases by 0.09% in the LR because demand expands and imports gain market share. The rise in import is indeed the result of the expanded economic activity in the LR.

## **7 Policy implication and conclusion**

### **7.1 Policy implication**

In this paper, we attempted to assess the DRC's land use challenges through CGE technique by assessing two important policy shocks. The first relates to the land use subsidy and the second on the land use productivity shock. In the first shock, we performed the short and long run simulations in view to test the hypothesis that the land use subsidy could be used to address the problem of low economic growth, unemployment, and poverty which persist in the economy. Besides, there are also challenges in the incapacity to transform the unused land to the agricultural use. The considerable reserve of unused land demonstrates the extent of the need for government to provide subsidy on land use that should unleash the potential for more agricultural production. In the second shock, we performed another short and long run simulations in view to assess the impact of improving the land use productivity in the DRC economy.

We can conclude two important policy implications that derive from the four simulations performed in this paper.

Firstly, although the results showed that land use subsidy could achieve some welfare benefits, it became apparent that the price of land is a big concern in the DRC. The vast reserve of unused land is partly due to the lack of access to finance. The short and long run simulations in which the DRC government provides land use subsidy to both formal and informal sectors show that the government is capable to improve the deficiencies of the formal and informal households' incomes in a significant way. Moreover, the policy simulation results show that a subsidy through price decrease of land use would have a positive impact on DRC's competitiveness in the short and long run and the export would increase. This assumption is confirmed by our simulation result which shows that the export increased by 1.87% and 0.41% in the short and long run simulation respectively (see Table 2). Also because the price of fixed factors of production and price of DRC's aggregate exports decreased, the economic effects of land use subsidy could attract investment in DRC.

Secondly, land use productivity can be achieved through an improvement in factor technical change in the efficient land use in order for the economy to reap

a socio-economic benefit. Because the achievement of the land use productivity could hold considerable political impacts for the government, the improvement of the factor technical change in the land use was tested within a short and long run setting. Due to the lack of alternative expansion of land use, factor technical change that improve the efficiency of the land use in the production process across all DRC sectors was proposed. The results show that an improvement in the factor technical change in the land use causes efficiency gains in most sectors which have economy-wide positive employment effect because of the intersectoral linkages. DRC's policy makers should therefore consider an improvement in land use productivity policy that would stimulate economic growth, employment and welfare in the country.

## 7.2 Conclusion

The main interest of this paper was to assess the effects of a land use subsidy and improvement in land use productivity in the DRC economy. The paper presents literature and adopts a broader view of land use in the formal and informal sectors. We therefore adopted an economywide perspective and accounted for formal–informal interactions in both factor and product markets. We developed a multi-sectoral CGE model that is empirically based on the structure and behavior of DRC formal and informal economies. We used the model to examine two policies designed to expand the land use production and employment.

Results for the first policy shock indicate that a cut in price by 10% for the land use in the formal and informal sector essentially reduces the cost of production. With decreased prices of domestic output, the demand for domestically produced goods spur domestic production hence real GDP increases by 0.34% and 0.26% in the short and long run respectively from the baseline economy. Results of economy-wide productivity increase show output having a significant positive impact on employment. The labour increases by 0.25% in the short run can be explained by the increase occurred in output and the factors of production. The expansionary economy combined with increasing export demand increases the demand for factors of productions. As more people get employed, the rise in income stimulates the export volume to increase by 1.87% and 0.41% respectively in the short and long run which creates less demand for imported goods (-0.13%) in the short run. The rise in export is the result of the expanded economic activity. Formal sectors such as agriculture (AGRIC\_F at 8.11% in SR and 2.53% in LR) and live stocks (LIVES\_F at 6.68% in SR and 1.48% in LR) contributed significantly to the rise of export. Thus, the balance of trade is on the positive side with an increase of 0.26% and 0.04% in the short and long run respectively. In general, the land price decrease has a relatively large impact on GDP and employment.

Results for the second policy related to the land use productivity shock indicate that an improvement of factor technical change of 10% for the land use in the formal and informal sector essentially reduces the cost of production. GDP increases by 0.31% and 0.26% in the SR and LR respectively. This means that the shock applied to the factor technical change causes the producers to make

use of the three primary inputs namely labour, capital and land, as well as intermediate inputs in a more efficient way. The advantages of the productivity increase cause producers to gain considerable enhancement in competitiveness which leads to considerable higher growth in exports with export volumes increasing by 1.74% and 0.41% in the SR and LR respectively. This increase in export volumes was expected since the land use sector plays a major role in the intermediate inputs for some sectors such as the agricultural and livestock sector. This shed light on a critical topic for public policies, since the higher productivity gains in agricultural and livestock production can be regarded as critical instruments to reduce the immense reserves of unused land in the country. These findings highlight the linkages and effects of socioeconomic policies between formal and informal sectors. In general, these findings warn policy makers against implementing formal sector policies without taking into account informal sector effects. The future research consists of updating the DRCFIM economy wide database.

## References

- [1] Agriculture Survey. (2000). Survey organized by the DRC Department of Agriculture.
- [2] Babcock, B. (2009). Measuring Unmeasurable Land-use Changes from Biofuels. Iowa Ag Review. Center for Agricultural and Rural Development. Summer 2009, Vol.15, no. 3.
- [3] Banque Centrale du Congo (BCC). (2007). *Activité économique*. Quarterly publication.
- [4] Banque Centrale du Congo (BCC). (2008). *Activité économique*. Quarterly publication.
- [5] Banque Centrale du Congo (BCC). (2009). *Statistiques Economiques, Direction des Etudes*.
- [6] Chabal, P., and Dalloz, J.P. 1999. *Africa works: Disorder as a political instrument*. International African Institute, James Currey and Indiana University Press.
- [7] Congo Basin Forest Partnership (CBFP). (2006). *The forests of the Congo Basin –state of the forest report*.
- [8] Davies, R. and Thurlow, J. (2010). Formal-Informal Economy Linkages and Unemployment in South Africa. *South African Journal of Economics*. Vol. 78(4):437-459.
- [9] DRC Bureau of Statistics (INS). 1996. *Income and Expenditure Survey*
- [10] DRC Bureau of Statistics (INS). 2000. *Household Survey*

- [11] DRC Department of Agriculture. (2000). *Agriculture Survey*.
- [12] DRC Department of Agriculture. (2010). *Annual Report*, p.87
- [13] DRC Reserve Bank. 2007. Quarterly Bullitin
- [14] DRC Reserve Bank. 2008. Quarterly Bullitin
- [15] Erero, J. L., Pambudi, D. D. and Bonga Bonga, L. (2013). Wage Subsidy in the DRC: A CGE Analysis, ERSa working paper 373
- [16] Ferez, J. (2010). Produção de etanol e seus impactos sobre o uso da Terra no Brasil. 48°. Congresso da Sociedade Brasileira de Economia, Administração e Sociologia Rural. Campo Grande, MS. Anais (CD-ROM).
- [17] Ferreira Filho, J. and Horridge, M. (2011). Ethanol Expansion And Indirect Land Use Change in Brazil. COPS, General Paper No. G-218, Monash University.
- [18] Ferreira Filho, J. and Horridge, M. (2010). Climate Change Impacts on Agriculture and Internal Migrations in Brazil. In: Thirteenth Annual Conference on Global Economic Analysis, Penang, Malaysia. COPS, General Paper No. G-218, Monash University.
- [19] Hochschild, A. (1998). King Leopold's ghost: a story of greed, terror, and heroism in colonial Africa. New York, USA, Houghton Mifflin Company.
- [20] Horridge, M. (1998). *ORANI-G: A generic single-country computable general equilibrium model* Paper prepared for the practical GE Modelling Course, February 7-11.
- [21] Huggins, C. 2010. Land, Power and Identity Roots of violent conflict in Eastern DRC. International Alert, United Kingdom.
- [22] International Monetary Fund (IMF). 2010. *World Perspective*
- [23] Institut National de la Statistique (INS). 1995. Statistique Agricole
- [24] Institut National de la Statistique (INS). 1996. Enquête familiale
- [25] Institut National de la Statistique (INS). 2007. Activité économique. Evolution mensuelle des principales productions en 2007 et 2008.
- [26] King Leopold II. 1885. Decree issued by King Leopold II, 1<sup>st</sup> July 1885.
- [27] Leisz, S. 1998. 'Zaire country profile' in J. Bruce (Ed.). *Country profiles of land tenure: Africa, 1996*. Research Paper No. 130. Wisconsin: Land Tenure Centre, University of Wisconsin.
- [28] Mugangu, S. 2006. 'Preface' in C. Mastaki and C. Vake. *L'implication des communautés locales dans la production du droit et la résolution des conflits fonciers en milieu rural*. Goma: AAP/ILC.

- [29] Nassar, A.M., Antoniazzi, L.B., Moreira, M.R., Chiodi, L., Harfuch, L. (2010). Contribuição do Setor Sucroalcooleiro para a Matriz Energética e para a Mitigação de Gases do Efeito Estufa no Brasil. Available at <http://www.iconebrasil.org.br/pt/?actA=8&areaID=7&secaoID=20&artigoID=2109> (last accessed March, 2012).
- [30] Pambudi, D. J. 2006. Regional strategies to attract investment: using a computable general equilibrium model of Indonesia, PhD thesis in Economics, Centre of Policy Studies (CoPS), Monash University Melbourne.
- [31] Punt, C., Pauw, K., Van Schoor, M., Rantho, L., Gilimani, B., McDonald, S., Chant, L., and Valente, C. 2003. The welfare impacts of national and international agricultural efficiency gains—A South African Case Study, *PROVIDE Working Paper Series*,2004:3.
- [32] République de Zaire. (1973). *Loi du 20 juillet 1973 portant régime général des biens, Régime foncier et immobilier et régime des sûretés*, Kinshasa, 1973.
- [33] Unruh, J. 2005. ‘Land policy reform, customary rule of law and the peace process in Sierra Leone’, *African Journal of Legal Studies*, Vol. 2, No. 2. pp.94-117.
- [34] Usongo, L. & Nagakwedi, J. (2007). *Participatory Land-use planning for priority landscapes of the Congo Basin. Vancouver, Canada.*
- [35] World Bank. (2007). World Bank Development Indicators. World Bank.
- [36] World Map. (2009). High resolution digital map of the world, [www.mpsoworld.com](http://www.mpsoworld.com) date of access: 28 March 2013.
- [37] Wolvekamp, et al., (2008). Sustainable forestry in the DRC, the way out of poverty and conflict. World Bank.
- [38] World Wide Fund for Nature (WWF). 2002. *Strategic planning –Western Congo Basin Moist Forest Eco-region*. Eco-region Technical Report. Libreville, Gabon, WWF Central Africa Regional Programme Office (CARPO).

**Table 1: Land Used by Agriculture in DRC, 2000 (Million Hectares)**

	Million hectares	Land type
Cassava	34.8	Crop
Rice	3.1	Crop
Sugar Cane	4.3	Crop
Corn	7.2	Crop
Soy	9.7	Crop
Wheat	0	Crop
Coffee	0.8	Crop
Fruit and Vegetable	2.3	Crop
Cotton	0.5	Crop
Tobacco	0.1	Crop
Dairy	2.4	Pasture
Beef Cattle	83.6	Pasture
Forestry	108.3	Plant forest
Total Agriculture	257.1	
Unused	928.3	
Total	1185.4	

Source: DRC Agriculture Survey of 2000

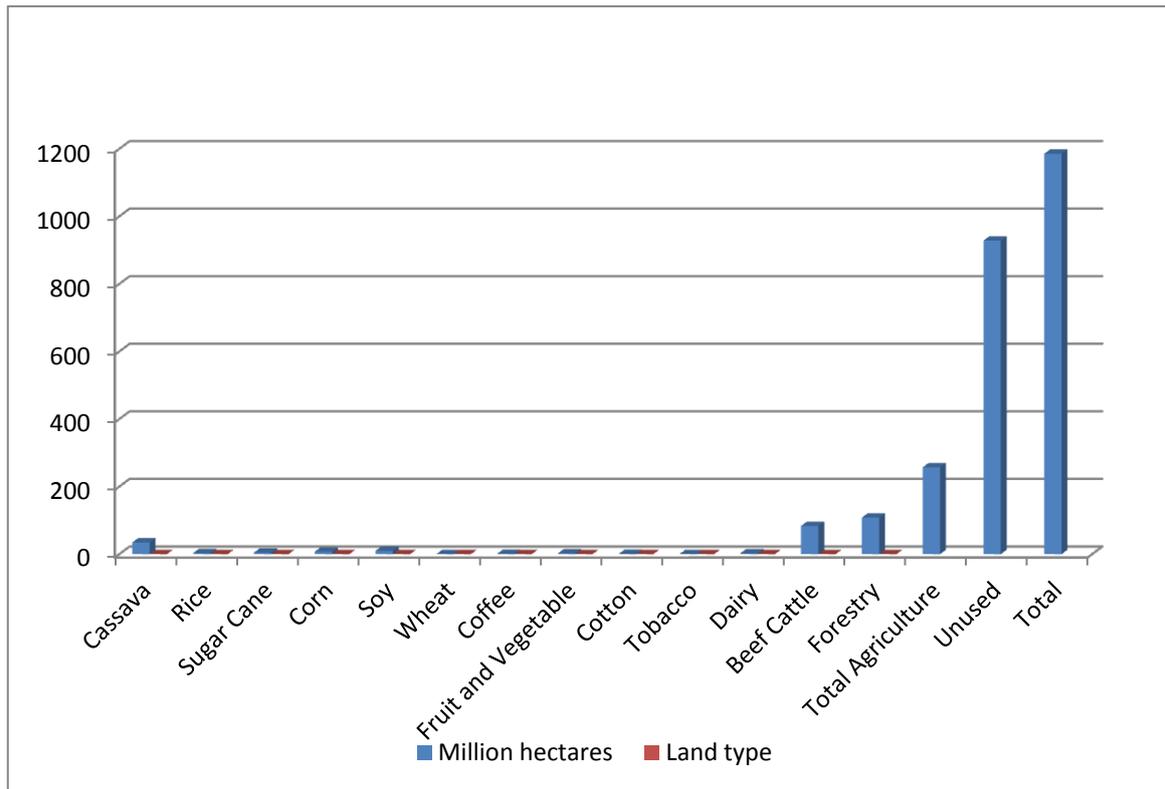
**Table 2: Macro Result (in percentage)**

Main Macro Variables	Description	Effect of 10% land subsidy		Effect of 10% land productivity	
		Short run	Long run	Short run	Long run
RealHou	Real Household Expenditure	0	0.26	0	0.26
RealInv	Real Investment Expenditure	0	0	0	0
RealGov	Real Government Expenditure	0	0	0	0
ExpVol	Export Volume	1.87	0.41	1.74	0.41
ImpVol	Import Volume	-0.13	0.09	-0.12	0.09
RealGDP	Real GDP	0.34	0.26	0.31	0.26
AggEmploy	Aggregate Employment	0.25	0	0.23	0
AveRealWage	Average Real Wage	0	0.60	0	0.60
AggCapStock	Aggregate Capital Stock	0	0.19	0	0.19
AggLand	Aggregate Land	5.77	5.83	-5.18	-4.76
GDPPI	GDP Price Index	-0.68	-0.10	-0.64	-0.10
CPI	Consumer Price Index	-0.79	-0.11	-0.74	-0.11
ExportPI	Export Price Index	-0.37	-0.08	-0.34	-0.08
ImportPI	Import Price	0	0	0	0
BOT_GDP	Change in bal. of trade as % of GDP	0.26	0.04	0.24	0.04

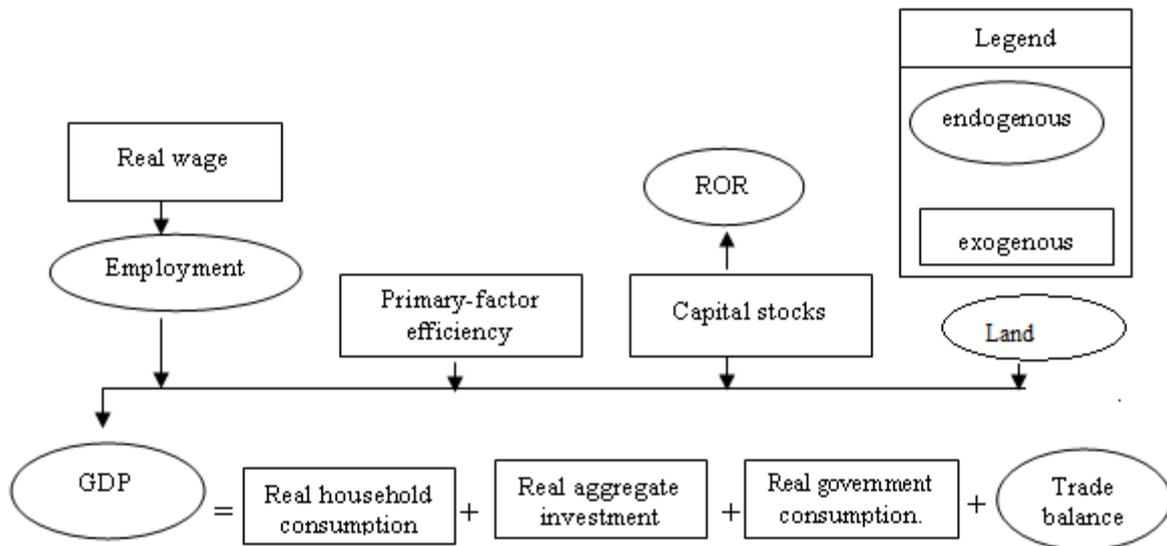
**Table 3: Sectoral results, effect of land use subsidy and land productivity shocks (percentage changes)**

Sectors (Formal & Informal)	Column 1				Column 2				Column 3				Column 4				Column 5			
	Land use subsidy		Land productivity		Land use subsidy		Land productivity		Land use subsidy		Land productivity		Land use subsidy		Land productivity		Land use subsidy		Land productivity	
	xTot (Output)				xExp (Export)				xFac (Employment)				xHou (Household demands)				pTot (output prices)			
	SR	LR	SR	LR	SR	LR	SR	LR	SR	LR	SR	LR	SR	LR	SR	LR	SR	LR	SR	LR
AGRIC_F	0.72	0.71	0.67	0.71	8.11	2.53	6.11	2.53	0.34	0.00	0.92	0.00	0.84	0.65	0.45	0.65	-1.26	-0.50	-1.18	-0.50
AGRIC_I	0.32	0.18	0.29	0.18	3.13	0.12	3.21	0.12	0.36	0.00	0.32	0.00	-0.11	0.17	-0.11	0.17	-0.68	-0.02	-0.63	-0.02
LIVES_F	0.89	0.72	0.83	0.72	6.68	1.48	3.35	1.48	0.8	0.00	1.08	0.00	0.57	0.44	-0.08	0.44	-0.70	-0.29	-0.66	-0.29
LIVES_I	0.64	0.63	0.60	0.63	7.45	3.16	7.96	3.16	0.19	0.00	0.64	0.00	0.72	0.77	0.80	0.77	-1.63	-0.62	-1.52	-0.62
MININ_F	-0.24	0.02	-0.23	0.02	0.12	-0.04	-0.13	-0.04	0.06	0.00	0.00	0.00	-0.70	0.14	-0.76	0.14	0.03	0.01	0.03	0.01
MININ_I	-0.05	0.08	-0.05	0.08	0.18	-0.03	7.45	-0.03	-0.45	0.00	-0.01	0.00	-0.69	0.14	0.70	0.14	-1.53	0.01	-1.43	0.01
FOOD_F	0.09	0.44	0.08	0.44	5.54	1.13	3.43	1.13	0.13	0.00	0.07	0.00	0.35	0.37	-0.06	0.37	-0.72	-0.22	-0.67	-0.22
FOOD_I	0.03	0.15	0.02	0.15	3.08	-0.07	3.88	-0.07	0.02	0.00	0.01	0.00	-0.12	0.13	0.02	0.13	-0.81	0.01	-0.76	0.01
CLOTH_F	-0.37	0.09	-0.34	0.09	1.25	-0.29	1.28	-0.29	-0.18	0.00	-0.09	0.00	-0.48	0.09	-0.48	0.09	-0.27	0.06	-0.25	0.06
CLOTH_I	-0.08	0.09	-0.08	0.09	2.14	-0.43	3.36	-0.43	-0.06	0.00	-0.03	0.00	-0.30	0.06	-0.08	0.06	-0.71	0.09	-0.66	0.09
MANUF_F	-0.46	0.11	-0.43	0.11	0.26	-0.07	0.26	-0.07	-0.25	0.00	-0.07	0.00	-0.67	0.14	-0.68	0.14	-0.06	0.01	-0.05	0.01
MANUF_I	0.00	0.13	0.00	0.13	1.33	-0.11	3.40	-0.11	0.03	0.00	0.01	0.00	-0.46	0.13	-0.07	0.13	-0.71	0.02	-0.67	0.02
EQUIP_F	-0.05	0.02	-0.05	0.02	0.04	-0.01	-0.41	-0.01	0.35	0.00	0.03	0.00	-0.71	0.15	-0.82	0.15	0.09	0.00	0.08	0.00
EQUIP_I	-0.05	0.11	-0.05	0.11	0.65	-0.12	2.68	-0.12	0.04	0.00	0.00	0.00	-0.59	0.12	-0.21	0.12	-0.57	0.02	-0.53	0.02
UTILI_F	-0.31	0.15	-0.29	0.15	0.71	-0.29	3.03	-0.29	-0.35	0.00	-0.07	0.00	-0.58	0.09	-0.14	0.09	-0.64	0.06	-0.60	0.06
UTILI_I	0.26	0.34	0.24	0.34	0.00	0.00	0.00	0.00	0.59	0.00	0.36	0.00	-0.72	0.15	-0.74	0.15	0.00	0.00	0.00	0.00
CONST_F	-0.01	0.00	-0.01	0.00	1.59	-0.08	2.44	-0.08	0.09	0.00	0.06	0.00	-0.41	0.13	-0.26	0.13	-0.52	0.02	-0.48	0.02
CONST_I	-0.01	0.05	-0.01	0.05	1.71	-0.36	3.43	-0.36	0.01	0.00	0.01	0.00	-0.38	0.08	-0.06	0.08	-0.72	0.07	-0.67	0.07
TRADE_F	0.23	0.31	0.21	0.31	0.27	-0.12	-16.69	-0.12	2.68	0.00	0.09	0.00	-0.67	0.12	-4.29	0.12	4.00	0.02	3.72	0.02
TRADE_I	0.17	0.17	0.16	0.17	0.72	-0.27	-0.47	-0.27	0.66	0.00	0.08	0.00	-0.58	0.10	-0.83	0.10	0.10	0.05	0.10	0.05
HOTEL_F	0.08	0.04	0.08	0.04	1.66	0.10	2.05	0.10	0.27	0.00	0.06	0.00	-0.40	0.17	-0.33	0.17	-0.43	-0.02	-0.40	-0.02
HOTEL_I	-0.05	0.14	-0.05	0.14	1.90	-0.01	3.39	-0.01	-0.03	0.00	-0.01	0.00	-0.35	0.15	-0.07	0.15	-0.71	0.00	-0.66	0.00
TRANS_F	0.07	0.00	0.07	0.00	0.22	-0.01	0.09	-0.01	0.47	0.00	0.06	0.00	-0.68	0.15	-0.72	0.15	-0.02	0.00	-0.02	0.00
TRANS_I	0.11	0.07	0.11	0.07	0.80	-0.17	0.89	-0.17	0.45	0.00	0.05	0.00	-0.56	0.12	-0.56	0.12	-0.19	0.03	-0.18	0.03
ESTAT_F	-0.12	0.05	-0.11	0.05	2.69	-0.79	3.05	-0.79	-0.07	0.00	-0.06	0.00	-0.19	-0.01	-0.14	-0.01	-0.64	0.16	-0.60	0.16
ESTAT_I	-0.04	0.03	-0.04	0.03	2.48	-0.73	3.54	-0.73	-0.02	0.00	-0.02	0.00	-0.23	0.00	-0.04	0.00	-0.74	0.15	-0.69	0.15
ADMIN_F	0.13	0.01	0.12	0.01	2.70	-0.16	2.09	-0.16	0.25	0.00	0.22	0.00	-0.19	0.12	-0.32	0.12	-0.44	0.03	-0.41	0.03
ADMIN_I	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.4	0.00	0.00	0.00	-0.72	0.15	-0.74	0.15	0.00	0.00	0.00	0.00
PRIVS_F	0.20	0.00	0.18	0.00	0.58	-0.03	0.27	-0.03	0.57	0.00	0.17	0.00	-0.61	0.14	-0.68	0.14	-0.06	0.01	-0.05	0.01
PRIVS_I	-0.03	0.10	-0.02	0.10	1.26	-0.38	2.89	-0.38	0.05	0.00	0.01	0.00	-0.47	0.07	-0.17	0.07	-0.61	0.08	-0.57	0.08

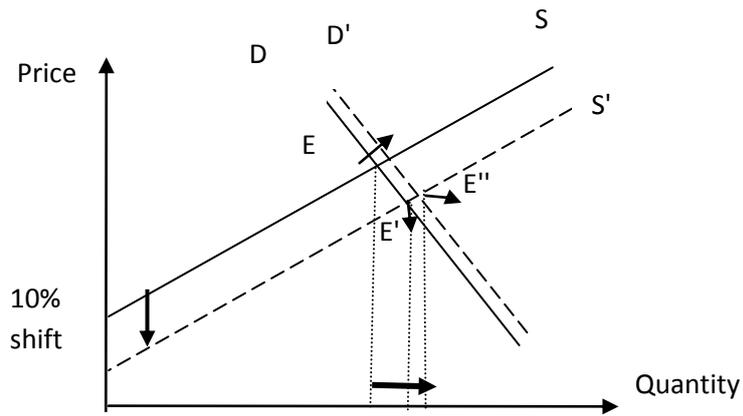
**Figure 1: Land Used by Agriculture in DRC, 2000 (Million Hectares)**



**Figure 2: Assumptions Underpinning Short-run Closure**



**Figure 3: Interaction between demand and supply for land use subsidy (short run)**



**Figure 4: Land use short run percentage change in employment by category of factor (formal and informal sectors)**

