Impact of biofuels on the poverty and food in Senegal : A Dynamic CGE Model of

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Presentation

1.Objectives

2. Methods : some aspects of the CGE dynamic model

3. Data

4 . Scenarios and initial results

5. Next steps

1. Objectives

GO: Evaluate the impact of the biofuel on poverty and food security.

SO1 : Build a SAM with biofuel sectors

SO2: Build a CGE dynamic model

SO3 : Identify the canal of the impact and simulations of biofuel policies

2. Methods: A Recursive Dynamic CGE Model of Senegal

- The **core** of the model is **Exter_DS Model**. The dynamic model of Annabi, Cockburn and caluwé (2004), which is a recursive dynamic model. Some specificities have been added.

- The model has been used to assess agricultural sector issues (the impact of increasing public budget in agricultural sector, agricultural growth objective and the achievement of the MDG's).

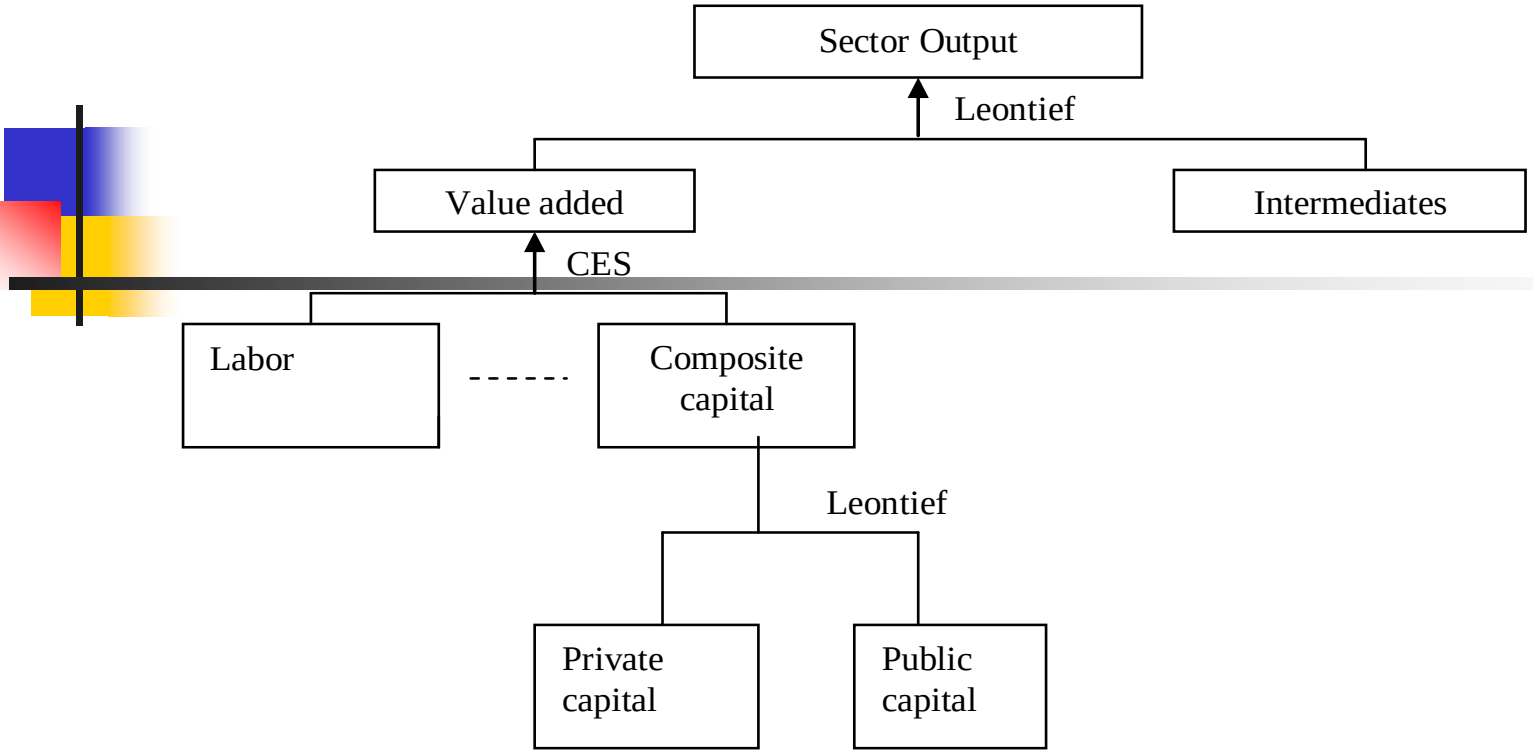
- Additionally, it has been designed to assess the impact of biofuels on the poor in Senegal.

2. Methods: A Recursive Dynamic CGE Model of Senegal

The model identifies 19 productive sectors.

Factors of production : private capital, public capital and labor.

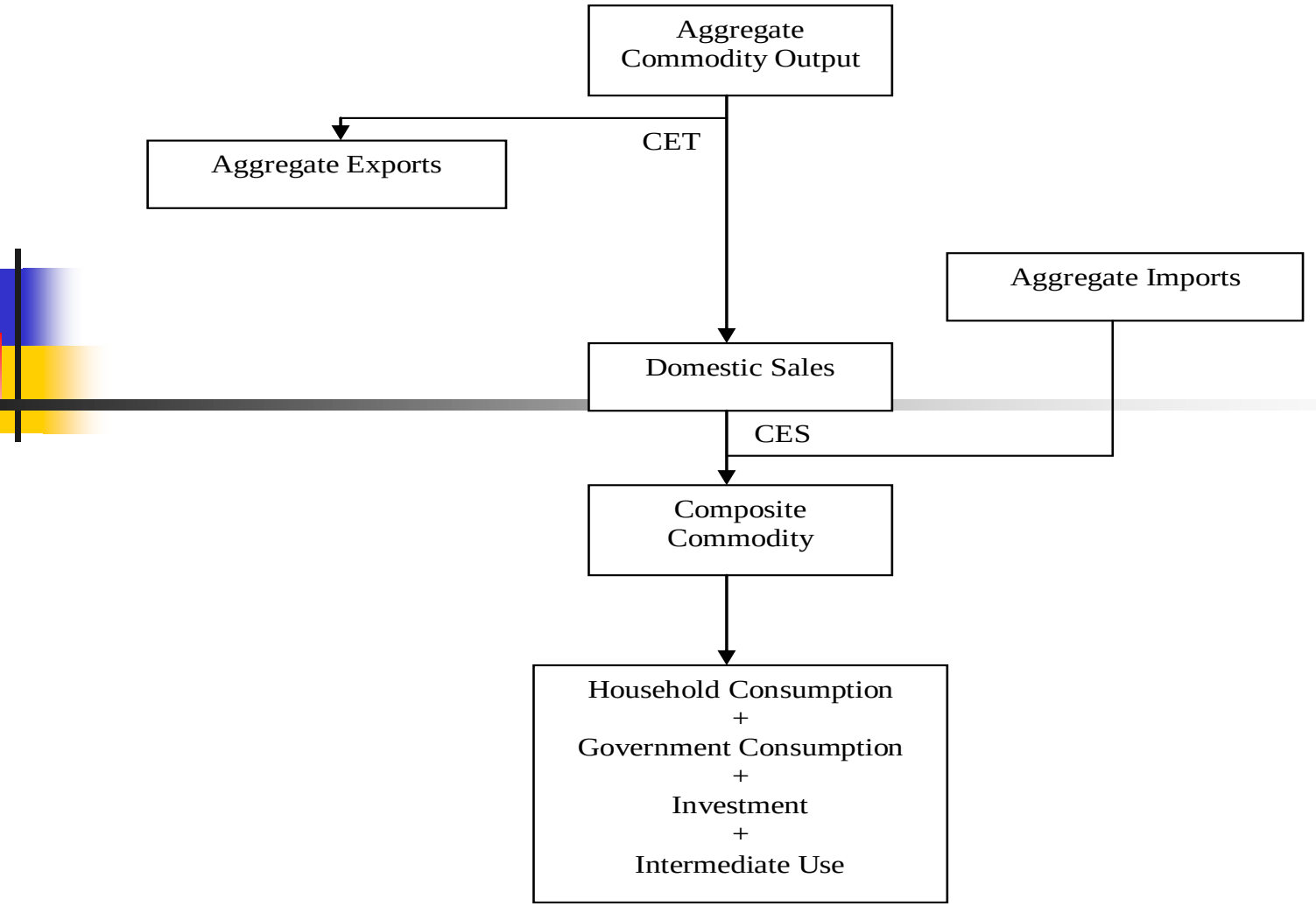
Figure 2.1: Production Technology[1]



1 'CES' is a constant elasticity of substitution aggregation function. 'Leontief' is fixed shares.

Commodity Flows

Figure2: Commodity Flows[1]

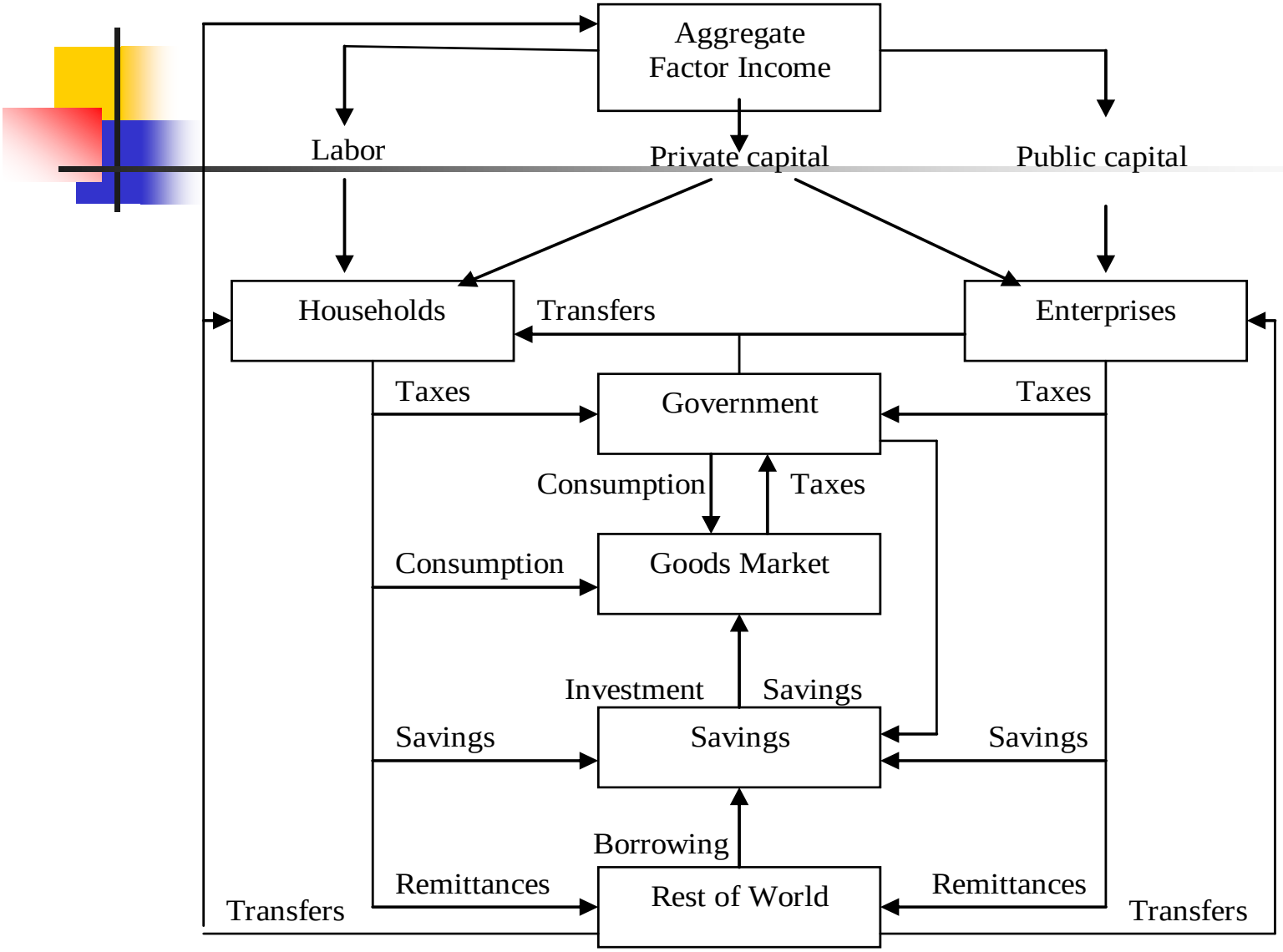


1 'CES' is a constant elasticity of substitution aggregation function. 'CET' is constant elasticity of transformation function.

Institutional Incomes and Domestic Demand

- The model distinguishes between various institutions including firms, the government, the rest of the world and 8 types of households.
- The household categories are disaggregated across areas (2 urban households for Dakar and the other cities and 6 rural households following the 6 agro-ecological areas).

Figure 2.3: Institutional Income and Domestic Demand



Specificities of the model : Additions to the Exter_DS Model

Total Productivity Factor

The total factor productivity (TFP) is a function of human capital $\left(KH_{tr}^{t}\right)$, research-development $\left(RD_{tr}^{t}\right)$, infrastructures $\left(IP_{tr}^{t}\right)$, the ratio between the total public capital and the sectorial private capital $\left(\frac{\text{KDpubG}^{t}}{\text{KDpriv}_{\text{tr}}^{t}}\right)$ and the sensitivity of the TFP top all those factors given by elasticities.

The total public capital stock (KDpubG^{t}) creates a positive externality that affects the total productivity of the sector.

The TFP will then be affected by the distribution of public investment between human capital, research-development and infrastructures. It will also be affected by the level of externality that benefits to the sector and the elasticity of TFP to all factors:

$$A_{tr}^{t} = \overline{A_{tr}^{t}}\left[\left(KH_{tr}^{t}\right)^{\varepsilon_k} * \left(RD_{tr}^{t}\right)^{\varepsilon_r} * \left(IP_{tr}^{t}\right)^{\varepsilon_i} * \left(\frac{\text{KDpubG}^{t}}{\text{KDpriv}_{\text{tr}}^{t}}\right)^{\varepsilon_k}\right]$$

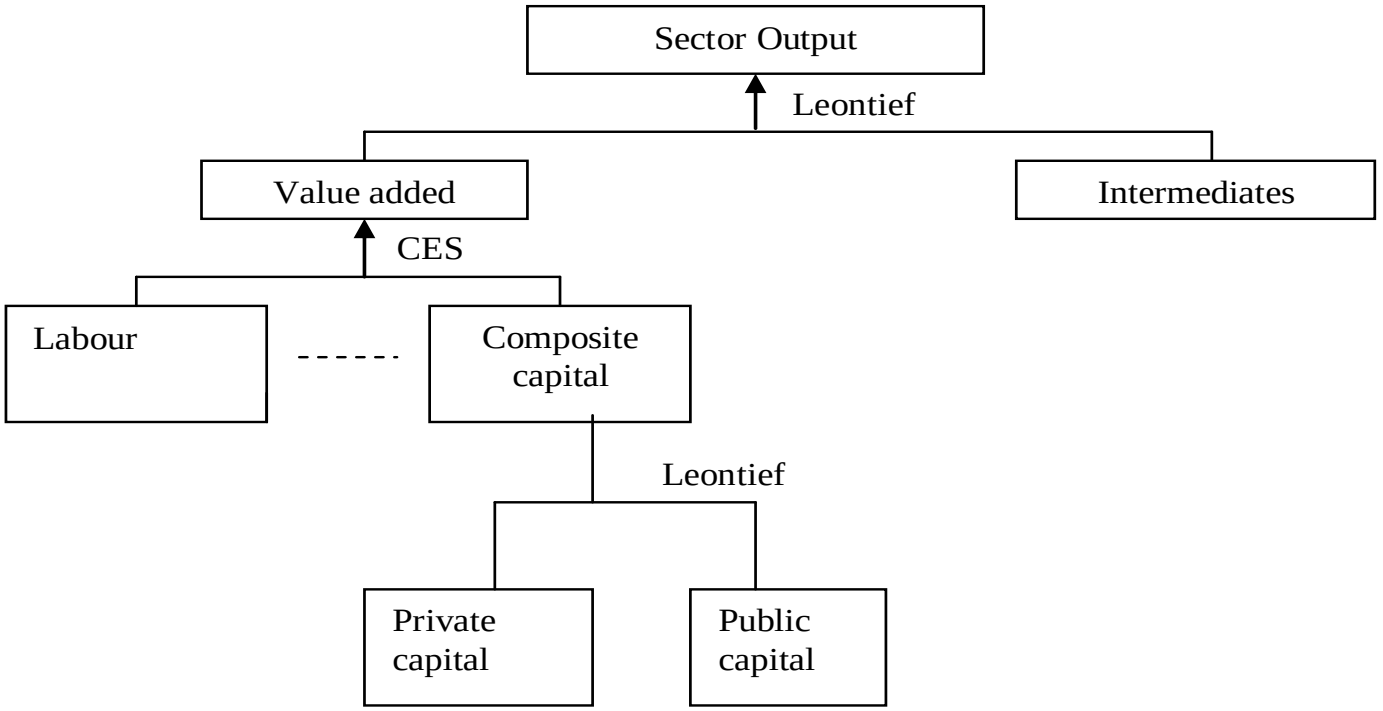
Additions to the Exter_DS Model

Production Technology

- **A Leontief function** is used to combine **public and private capital** reflects the fact that we assume that those two are complementary factors in the case of a developing country like Senegal.
- A certain amount of public capital (road, other infrastructures) is necessary to expect flows of private capital.

Production Technology

Figure .1: Production Technology[1]



1 'CES' is a constant elasticity of substitution aggregation function. 'Leontief' is fixed shares.

Export demand function

In order to take into account the Senegalese exporter's constraints on the foreign market, we introduce an export demand function in the model (EXD). This one relies on a finite elasticity and is based on the ratio between the world price (PWE) and the fob price (PEfob). Then, to increase their market share, local producers have to reduce their export price.

The export demand of a product (EXD) is based on the free on board (PFOB) price, their initial market share on the global market ($\overline{EXDO}$), the global market price ($\overline{PWE}$), and the elasticity of export demand ε^{ex} of the product:

$$EXD^{t}_{tr} = \overline{EXDO}_{tr} \frac{\overline{PWE}_{tr}^{\,t}}{PFOB^{t}_{tr}}$$

Budget block

The total budget is equal to the Government income minus the transfers from Government to the rest of the world:

$$BG^{t} = YD^{t}_{Gov} - RTF^{GOV}_{ROW}$$

We distinguish three groups of sectors: agricultural (AG), non-agricultural (NAG) and non-tradable (NTR) sectors. So, the budget of each group of sectors is a share of the total budget.

$$B^{t}_{AG} = \theta^{t}_{AG} * BG_{t}$$
$$B^{t}_{NAG} = \theta^{t}_{NAG} * BG_{t}$$
$$B^{t}_{NTR} = \theta^{t}_{NTR} * BG_{t}$$

Budget block

The public investment allocated to a group of sectors is a share (δ_i) of the budget of this group of sectors. Public consumption also represents a share (δ_c) of the budget allocated to the group of sectors.

$$ING^{t}_{AG} = \delta\_iag^{t}_{AG} * BG^{t}_{AG}$$

$$CG^{t}_{AG} = \delta\_cag^{t}_{AG} * BG^{t}_{AG}$$

$$ING^{t}_{NAG} = \delta\_inag^{t}_{NAG} * BG^{t}_{NAG}$$

$$CG^{t}_{NAG} = \delta\_cnag^{t}_{NAG} * BG^{t}_{NAG}$$

$$ING^{t}_{NTR} = \delta\_intr^{t}_{NTR} * BG^{t}_{NTR}$$

$$CG^{t}_{NTR} = \delta\_cntr^{t}_{NTR} * BG^{t}_{NTR}$$

Budget block

In each sector, the public investment has three components: human capital (KH^t_i), research-development (RD^t_i) and physical investments expenditures (IP^t_i):

$$KH^t_i = \tau\_k_i * ING^t_i$$

$$RD^t_i = \tau\_i_i * ING^t_i$$

$$IP^t_i = \tau\_p_i * ING^t_i$$

Poverty module

- A poverty module is link to the model.

- The FGT (1984) poverty index is used to evaluate the impact of the biofuel in the household.

$$P(\alpha, z) = \frac{1}{N\sum_{h=1}^{H} w_h} \sum_{h=1}^{H} w_h \left(\frac{z - y_h}{z} \right)^{\alpha}$$

- After every shock of policy, the model generate for each group of household and for every year the changes in the expenditures vector ehold and the poverty line.

- We calculate the new vector of expenditures and poverty line for each group.

- The new poverty index are the derived.

- For every year, the variation of poverty index is calculated comparing to the reference scenario.

3. DATA

A SAM is build from the 2005 input out put and the National 2005 household Survey.

Parameters of CES and CET functions are not estimated

Integrate biofuel in the model

To build the SAM with biofuel sector we use the same approch than Channing for the Mozambique Biofuel model.

The production of jatropha and ethanol are very low in the year 2005 of the SAM.

The petrol is a substitute of the biofuel. The model have also the sectors of brut fuel and raffined fuel. nous distinguons le pétrole brut du pétrole raffiné.

The brut petrole is fully imported and not local production. It is a input to the raffined petrole.

From the 2007 date, we assume that in the 2005 SAM : Jatrofa production is estimed **10%** of the 2007 year, *Ethanoll :* **5%** of the 2007 production.

4. Scenarios

MULATIONS	CLOSURES
aseline scenario	The current account is assumed as endogenous The share parameter between sectorial budget and the total budget is fixed Land for jatrofa and ethanol and are fixed to the SAM year
mulation1 : 170,2% yearly Increase of ne land of Jatropha	The current account is assumed as endogenous The share parameter between sectorial budget and the total budget is fixed
mulation 2 : 45,4% yearly Increase of ne land of Ethanol	The current account is assumed as endogenous The share parameter between sectorial budget and the total budget is fixed
mulation 3 : 10% increase of the nported price of the bio carburant	The ratio current account /GDP is fixed The share parameter between sectorial budget and the total budget is fixed

Simulation1 : 170,2% yearly Increase of the land of Jatropha

Tableau 4.7 : Change involume and price

Années	Agricole Capital	Non agricol capital	wage	Value added price	Value added	Labor	Agrcole capital	Non agricol capital	Public capital
2005	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2006	**2.79**	**-25.58**	**-8.11**	**-8.97**	**8.37**	**1.13**	**9.75**	**31.78**	**12.11**
2007	-0.21	-38.72	-14.42	-15.66	15.92	2.71	19.21	57.51	22.11
2008	-5.00	-46.98	-19.60	-21.04	22.98	4.54	27.99	79.70	30.74
2009	-9.92	-52.71	-23.97	-25.54	29.70	6.52	36.00	99.38	38.35
2010	-14.19	-56.90	-27.54	-29.24	36.14	8.51	43.31	117.13	45.18
2011	-16.51	-59.80	-29.35	-31.34	42.15	9.59	50.03	133.33	51.40
2012	**-22.08**	**-62.85**	**-34.04**	**-35.84**	**48.76**	**13.30**	**56.60**	**148.45**	**57.26**

Tableau 4.9:`Change in production (Comparing to Reference scenario)

Mais	Riz	Légumes	Fruits	Coton	Arachide	Autreprim	Jatrofa	Canetha	Elevage	Pêche	Huile	Autalim	Autind	Pétrole raffine	SM	SNM	Total
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000
0.00	0.00	0.00	0.00	0.00	0.00	0.00	37.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000
0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.02	0.00	0.00	0.000
0.00	0.00	0.00	0.00	0.00	0.00	0.00	230.00	0.00	0.00	-0.01	-0.01	0.00	0.00	-0.07	0.00	0.00	0.000
0.00	-0.02	0.00	0.00	0.00	0.00	0.00	525.19	-0.36	-0.01	-0.03	-0.04	0.00	-0.02	-0.33	-0.01	0.00	-0.004
-0.01	-0.14	-0.01	-0.03	-0.08	0.00	-0.04	14872.41	-1.10	-0.04	-0.21	-0.20	-0.03	-0.11	-2.04	-0.08	0.00	-0.032
-0.12	-0.86	-0.11	-0.21	-0.42	-0.01	-0.27	103519.23	-6.45	-0.30	-1.27	-1.28	-0.22	-0.69	-12.46	-0.53	-0.02	-0.235
0.05	-0.22	0.06	0.04	0.04	0.00	0.07	19991.30	-3.34	0.04	-0.10	-0.08	0.05	0.08	-2.50	0.02	0.00	**0.072**

ations des auteurs

Change in reference to Base line scenario

Années	Global Trade balcnce	Agricol trade balance
2005	-	-
2006	-0.005	-0.02
2007	-0.02	-0.07
2008	-0.07	-0.23
2009	-0.29	-0.91
2010	-1.69	-4.94
2011	-9.90	-27.57
2012	-1.42	-3.19

Revenues effects

Effets sur les revenus varaition par rapport reference

	Dakar	ACU	BA	Niay	Casa	ZSP	SO	Fleuv
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
4	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.02
5	0.04	0.03	**0.03**	**0.03**	**0.03**	**0.02**	**0.03**	**0.11**
6	0.24	0.19	**0.16**	**0.16**	**0.19**	**0.13**	**0.19**	**0.59**
7	1.50	1.19	**0.98**	**1.01**	**1.15**	**0.77**	**1.18**	**3.32**
8	0.15	0.12	**0.08**	**0.08**	**0.08**	**0.05**	**0.11**	**0.35**

Consumption price (comparing to RS)

	Dakar	ACU	BA	Niay	Casa	ZSP	SO	Fleuv
1.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4.00	0.000	0.011	0.000	0.011	0.011	0.000	0.011	0.011
5.00	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023
6.00	0.130	0.130	0.151	0.139	0.152	0.152	0.163	0.150
7.00	0.828	0.854	0.901	0.871	0.926	0.906	0.961	0.890
8.00	0.049	0.049	0.048	0.048	0.060	0.061	0.048	0.048

Consumption change (comparing to RS)

Consommations des ménages

TABLE 108								
CONSOMMATION TOTALES DES MENAGES%								
	Dakar	ACU	BA	Niay	Casa	ZSP	SO	Fleuv
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
4	0.01	0.01	0.01	0.01	0.01	0.01	0.09	0.03
5	0.04	0.03	0.03	0.04	0.03	0.05	0.60	0.11
6	0.28	0.21	0.19	0.25	0.21	0.28	7.61	0.64
7	1.77	1.33	1.14	1.54	1.31	1.74	615.38	3.58
8	0.18	0.13	0.10	0.12	0.09	0.11	-5.24	0.38

POVERTY IMPACT sim1

Year	National	Urban	Rural
2005	-38.35006	-38.28176	**-37.193**
2006	-37.10539	-38.98083	**-35.040**
2007	-36.26027	-36.63075	**-34.784**
2008	-37.83898	-35.98920	**-37.228**
2009	-38.00849	-35.33543	**-37.701**
2010	-39.13481	-35.46128	**-39.205**
2011	-39.04649	-35.13223	**-39.172**
2012	-40.86862	-36.90304	**-40.932**

	Niayes	sud	zso	fleuve	zsp	zba	dakr	other citues	all urban	rural	national
2005	16.49	68.95	86.59	44.70	69.14	61.22	32.46	38.81	35	62	50.76
2006	15.86	65.12	92.21	40.63	66.34	55.38	30.88	35.96	33	58	47.32
2007	15.26	63.24	91.14	37.77	62.47	51.83	28.04	32.07	30	55	44.12
2008	13.47	61.24	92.21	35.28	61.53	49.13	25.05	29.13	27	52	41.52
2009	6.89	57.40	93.43	32.36	57.13	46.48	23.42	26.90	24.89	50	39.08
2010	5.72	55.76	97.60	30.28	54.16	44.05	21.98	25.49	23.46	48	37.36
2011	5.05	53.51	98.45	28.48	49.43	41.39	20.09	24.19	21.82	45.62	35.26
2012	5.05	53.24	100.00	29.87	49.49	41.20	20.09	23.92	21.70	45.76	35.22

Sim 3 increase on import hydrcarbure

Year	National	Urban	Rural
2005	-0.00690	-0.02394	**0.000**
2006	0.25342	0.56650	**0.124**
2007	0.43273	0.14327	**0.548**
2008	0.44586	0.43340	**0.451**
2009	0.86306	0.57213	**0.972**
2010	0.91379	1.41619	**0.727**
2011	1.09030	1.76168	**0.842**
2012	-10.00118	1.90404	**-14.250**

Next steps

- Finalize scenario analysis
- Sensitive analysis to parameters values
- Impat of food security
- ....