



# Combined use of three whole farm simulation tools for designing innovative production strategies with crop-livestock farmers in Burkina-Faso

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D:\Mes donnees\SEMPORÉ\Thèse\GAMS\koubia_VA_2\Agriculteur_koubia_Modif_elev.gms
Agriculteur_koubia_Modif_elev.lis | Agriculture_koubia_Modif_elev.gms

Context
*Analyse des pratiques des producteurs à travers l'utilisation de la
programmation linéaire
*Rappelons que les lignes étoilées sont des commentaires qui ne seront pas lu
par GAMS
*Tout élément doit être déclaré avant d'être utilisé. La fin de la déclaration
est signalée par un point virgule
*Pour écrire chaque équation on doit donc déclarer les ensembles avant tout, suiv
de tous les éléments qui vont entrer dans l'équation
* Le modèle fonctionne à un pas de temps saisonnier
* Saison hivernale (t1=100 jours, t1b=60)
* Saison sèche froide (t2= 60 jours)
* Saison sèche chaude (t3=120 jours)

$offtext
option limrow = 0;
***** Déclaration des ensembles*****
set
  j cultures possibles /coc, mai, sor, riz, nie, ara/
  c(i) ensemble des céréales /mai, sor, riz/
  l types d'élevage /bov, bdt, bemb/
  n type d'insecticides /premar2, deukisem2, troisesem2 /
  m type d'herbicides /herbi1, herbiles, herbi2a1 /
  k type d'engrais /spk, ure /
  ti ensemble des périodes /t1a, t1b/
  a ensemble des types d'années climatiques /ath, ah, am, as, ats/
  sc ensemble des scénarios climatiques / sc1, sc2, sc3, sc4, sc5,sc6/

*****agriculture-entree des donnees*****

parameter pri(j) prix du kg des produits agricoles vendus en fofa
/coc 200
/mai 110
/sor 115
/riz 100
/nie 200
```

# Supporting farmers' reflections in a constrained context

Increased demographic pressure

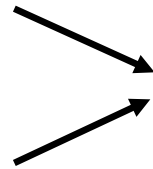


Land saturation



Lower soil fertility

Rainfall uncertainty



Unstable crop productivity



**Improving crop-livestock integration**



Diversifying incomes

Cotton, Maize,

Milk production, Animal fattening



Enhancing crop-livestock flows

(fodder and manure production)



**Which future for a given farm?**

➔ Supporting farmers' prospective reflections by using simulation tools

# Three tools used jointly in a one-to-one interaction

- 1 **OptimCikeda** : Linear programming tool optimizing cropping pattern for maximizing income under resource constraints

*Optimal compared to current farm pattern and farmer's project*

*Redesign of farmer's project*

- 2 **Cikeda** : Static simulation tool calculating resource balance (staple food, forage, manure) and income generated by a given farm configuration (yearly time step)

*Favoured future farm pattern*

- 3 **Simflex** : Multi-annual rule-based tool assessing the sensitivity of farm income to climatic and economic uncertainty

Farmer's evaluation at each step



# Three types of farms studied



<b>% of the farmers</b>	<b>78</b>	<b>12</b>	<b>10</b>
<b>Total cultivated area</b>	<b>&lt; 5 ha</b>	<b>&gt; 5 ha</b>	<b>&lt; 5 ha</b>
<b>Family size</b>	<b>&lt; 15</b>	<b>&gt; 25</b>	<b>&lt; 10</b>
<b>Draught cattle</b>	<b>1-2 heads</b>	<b>&gt; 2 heads</b>	<b>&gt; 2 heads</b>
<b>Breeding cattle</b>	<b>0 heads</b>	<b>&gt; 10 heads</b>	<b>&gt; 20 heads</b>
<b>Main activities</b>	<ul style="list-style-type: none"> <li>- Cotton for sale</li> <li>- Cereals for sale and self-consumption</li> </ul>	<ul style="list-style-type: none"> <li>- Cotton for sale</li> <li>- Cereals for sale and self-consumption</li> <li>- Breeding cattle for prestige and sale</li> </ul>	<ul style="list-style-type: none"> <li>- Breeding cattle for prestige and sale</li> <li>- Cereals for self-consumption</li> </ul>

# Example of a crop-livestock farmer (1/3)

## Farm characteristics

Total area : 23,5 ha

Family workers: 6

Draught cattle: 6

Breeding cattle : 60

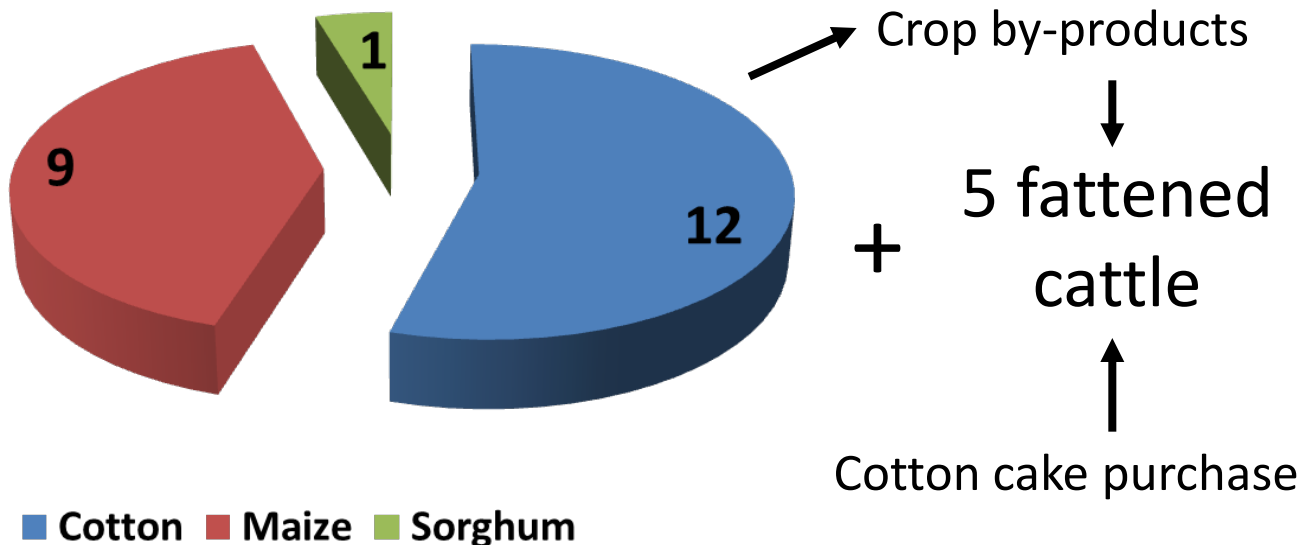
Manure (t): 18

## Farmer's initial Project (P0)

Increasing manure production for improving soil fertility

Implementing a cattle fattening activity for increasing and diversifying income (objective: 10 heads over 3 months)

## Stage 1. Identifying the optimal pattern with Optimcikεda



## Project (P1)

Cotton are: -1 ha

Maize area: +1 ha

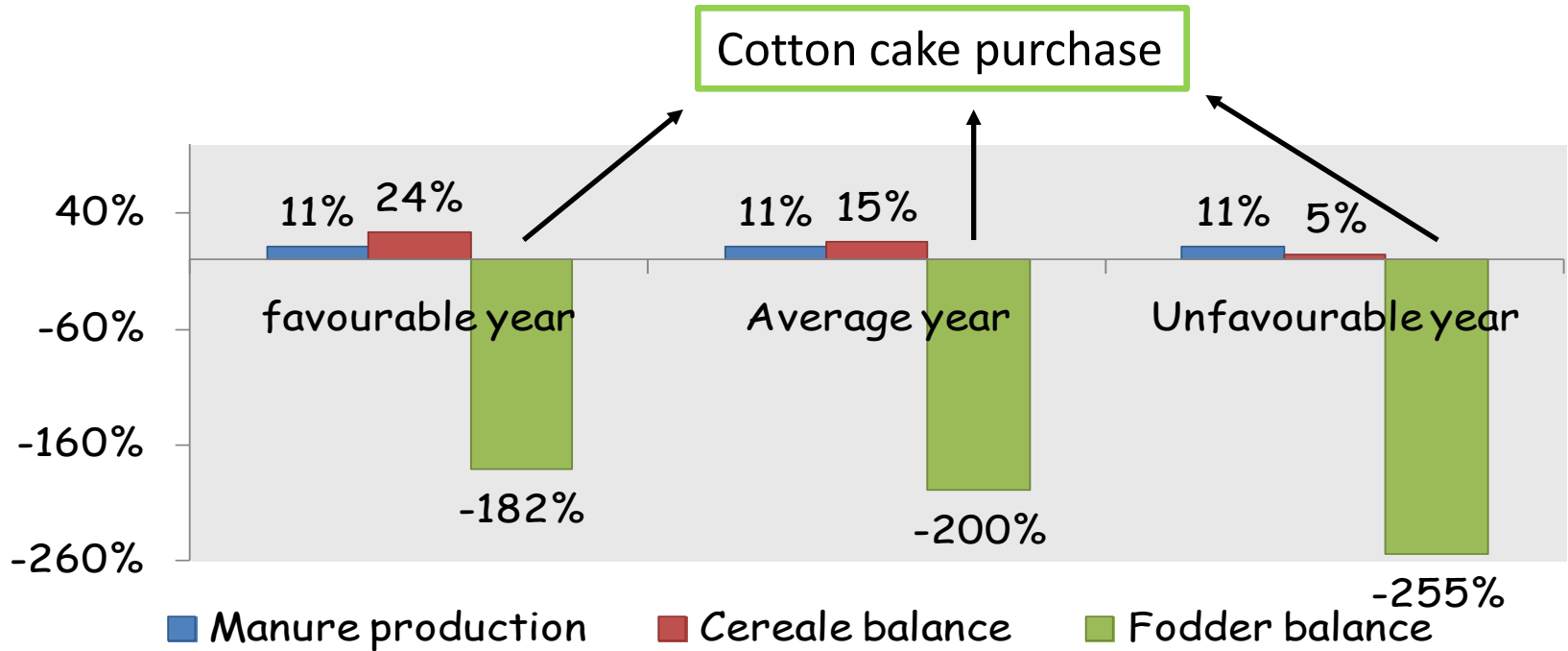
Sorghum area: -1 ha

Forage area: +1 ha

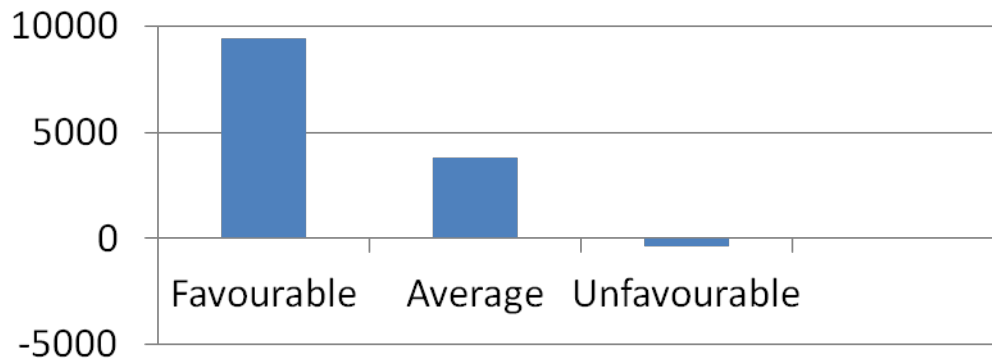
Fattened cattle: 10

# Example of a crop-livestock farmer (2/2)

## Stage 2. Simulating P1 with Cikedda



## Total annual income (\$)



# Example a crop-livestock farmer (3/3)

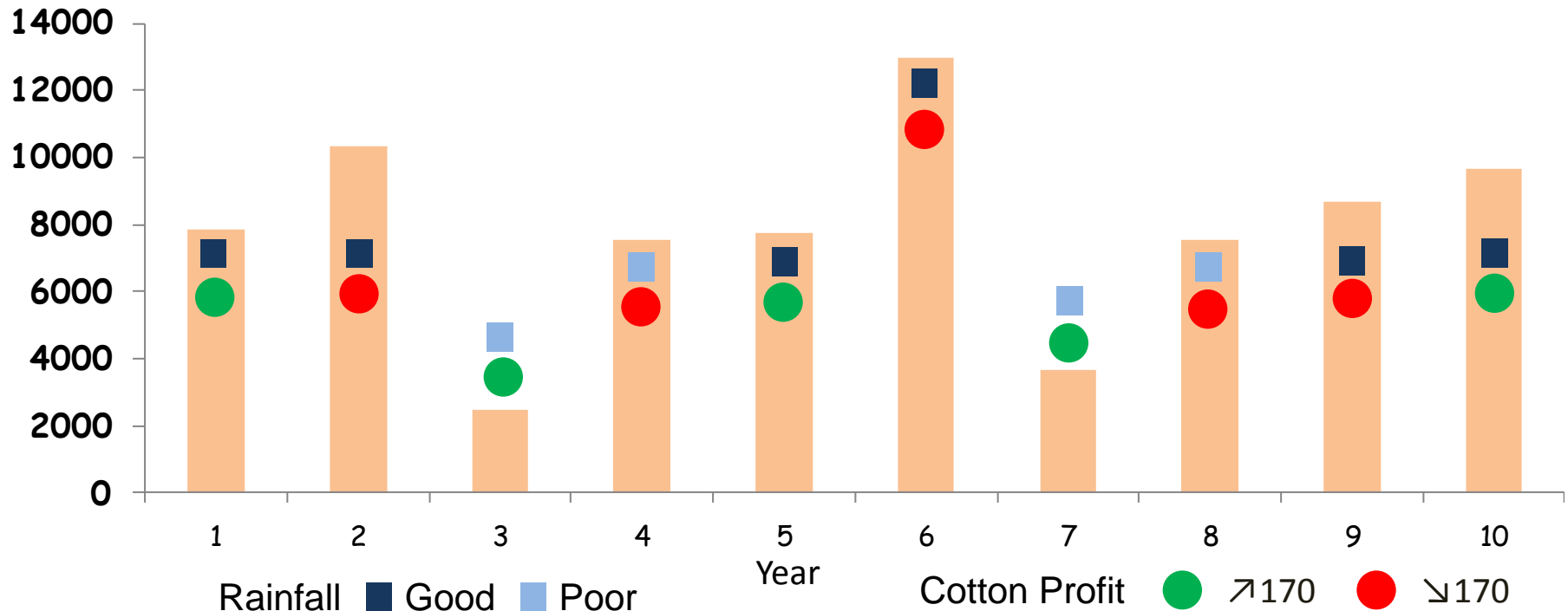
## Stage 3. Assessing the sensitivity of Cikeda scenarios with Simflex

### Decision rules

IF Cotton Profit < 170 US\$ THEN Cotton is removed

IF Price NPK > 40 US\$ / kg THEN No NPK

Income (\$)



➔ A production system which remains sensitive to rainfall and cotton profit variations

# Farmers' evaluation

## OptimCikeda

Assessing the gap between farmer's project and optimal allocation of resources on the farm

→ Farmers' projects are partly changed according to the gap between the optimal solution and their own objectives

## Cikeda

Comparing various farmer's project alternatives

→ Tool considered as useful and easy to understand thanks to its focus on technical/physical processes close to farmers' contexts of action

## Simflex

Assessing mid-term results of a project: an objective poorly understood by farmers

→ Farmers are interested by the yearly sensitivity of their project to climatic/economic variables but not by their sequence over 10 years

## Combination

OptimCikeda and Cikeda viewed as complementary for planning activities



# Conclusions

- ✓ Designing and simulating whole farm scenarios support farmers' reflections regarding their projects independantly from the kind of tool used
- ✓ Combining three different tools with the same farmer allows to providing him different views on his projects
- ✓ This approach is original but remains a research process which would be difficult to transfert to technicians



*Thanks for attention*

