

# Designing flexible cropping patterns in zones with high constraints: examples from Burkina Faso

Andrieu Nadine<sup>ad</sup>, Eduardo Chia<sup>b</sup>, Eric Vall<sup>cd</sup>

<sup>a</sup>CIRAD, UMR Innovation, Bobo Dioulasso/Montpellier, France; <sup>b</sup>INRA, UMR Innovation, Montpellier, France; <sup>c</sup>CIRAD, UPR18, Bobo Dioulasso, Burkina Faso/Montpellier, France; <sup>d</sup>CIRDES, Bobo Dioulasso, Burkina Faso - [nadine.andrieu@cirad.fr](mailto:nadine.andrieu@cirad.fr)

**Abstract:** The cotton zone of Burkina Faso is characterised by high constraints, thus farmers develop flexible cropping patterns allowing them to face economic and climatic risks. These strategies are a combination of different sources of flexibility (relational, structural, operational, and external). The characterization of these strategies is the first step to design innovative cropping patterns able to cope with the specificity of the environment.

**Keywords:** mixed farming systems, flexibility, climatic risks, economic risks, Burkina Faso

## Introduction

The cotton zone of West Africa production systems are characterized by mixed-farming more or less integrated with livestock. They are constrained by the high spatio-temporal variability of rainfall that makes unstable farmers' incomes, food and fodder supply. This unstable environment is also characterized by an increase in the prices of inputs for agriculture and livestock, the fall in the world price of cotton fibre, the risks on prices of food crops and animal products, the weakness of investment capacities of households and the absence of regulatory mechanisms (guaranteed price, insurance...).

In a zone where environmental and economic constraints are high, weighting more and more on farming systems, the objective of this research, founded by the Ministry of Foreign and European Affairs, is to draw up how the management of the cropping pattern by farmers leads to various levels and types of flexibility to face these risks and how to support the design of cropping patterns allowing to cope with on-going change. This research began in 2006. After a presentation of the methodology, this communication presents the analysis framework used to characterize the flexibility of farmers' management strategies and the first results of the field investigations.

## Material and methods

The research was carried out in Koumbia and Kourouma villages located in the middle of the cotton zone of Burkina Faso. The 40 farmers interviewed belongs to three types corresponding to three modes of integration of agriculture to livestock from producers privileging agricultural production to those supporting livestock. For the first stage of the research we made a comparison of their practices during 2006 and 2007 growing seasons. 2007 was characterized by a decrease of 17 % of the price of the cotton fiber, an increase of the prices of inputs and unfavourable weather conditions (delay in the inception of rainfall, flood...).

## Results

### The Analysis framework of flexibility

The concept of flexibility means the capacity of farmers to face the fluctuations of the environment (economic and physical) and to plan possible evolutions of this environment.

We designed from a literature review an analysis framework of flexibility specific to the risks met in these zones. Figure 1 shows the different source of flexibility characterised in this work (Chia, 2008; Chia and Marchesney, 2008; Volberda, 1996). To face climatic and economic uncertainty, and

according to the objectives and means of production of the households, farmers can potentially mobilize different sources of flexibility. The flexibility of the cropping pattern is the focus of our study. It can be *structural*, based on a modification of the equipments or the crops or *operational* through adjustments of the dates of technical operations, the quantity of inputs and the surfaces allocated to the various crops. The source of flexibility can also be *external*, corresponding to an adaptation of the management of livestock systems or farmer's involvement in non agricultural activities. A specific kind of external flexibility can also be distinguished : the relational flexibility that depends on the farmers' social networks.

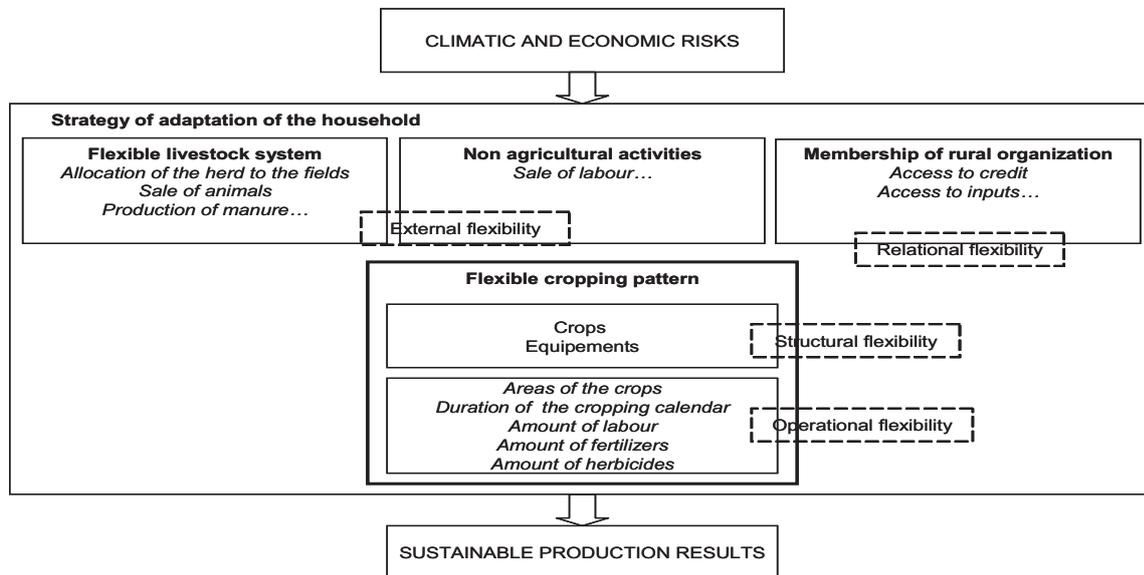


Figure 1. Analysis framework of the sources of flexibility used by farmers to face environmental risks

### The 2007 flexibility of the farmers' management strategies

Despite unfavourable weather conditions in 2007, farmers were more sensitive to economic risks. The response of farmers to these risks was a decrease of the areas of cotton and an increase of the areas of cereals, the increase being higher for sorghum that do not require inputs and is more tolerant to drought (table 1). Farmers also decreased the amount of chemical fertilizers used that led to a better integration of livestock to cropping systems by a higher valorization of manure. Farmers decreased the amount of credit contracted in order to be more autonomous, purchasing directly their inputs on the market. Modifications relating to structural flexibility were not carried out in 2007.

Table 1 : Example of modifications carried out by farmers in 2007 to face environmental risks (Koumbia village)

Relational flexibility		Operational flexibility			External flexibility	
Amount of credit contracted	Nb of producers purchasing inputs on the market	Area of cotton	Area of maize	Area of sorghum	Amount of chemical fertilizers	Amount of manure used
- 37 %	+ 45 %	- 33 %	+ 19 %	+ 69 %	- 36 %	+ 50 %

### Discussion and Conclusion

Our analysis framework helped us to renew the characterization of the way farmers face on going changes. In areas with high constraints, farmers combine the different sources of flexibility characterized. The ability for farmers to activate (in case of good forecasts) or not (bad forecasts) their relational networks in order to have access to inputs improves their capacity to adjust to climatic and economic fluctuations. Diversified cropping patterns allow operational flexibility substituting one product by another. External factors such as livestock systems improve the autonomy of the cropping pattern management by a decrease of the dependance on industrial inputs and credit. The design of

adaptable strategies should thus promote the diversification of the cropping systems (reducing the part of cotton area but intensifying its production) and their integration with the livestock systems (animal manure and energy for autonomous and intensified systems).

## References

Chia, E., 2008. La flexibilité relationnelle : rôle des réseaux, groupements et associations d'éleveurs, in Dedieu, B., Chia, E., Leclerc, B., Moulin, C.H., Tichit, M. (Eds), *L'élevage en mouvement. Flexibilité et adaptation des exploitations d'herbivores*, in press

Chia, E., Marchesnay, M., 2008. Un regard des sciences de gestion sur la flexibilité : enjeux et perspectives, in Dedieu, B., Chia, E., Leclerc, B., Moulin, C.H., Tichit, M. (Eds), *L'élevage en mouvement. Flexibilité et adaptation des exploitations d'herbivores*, in press

Volberda, H.W., 1996. Toward the Flexible Forms: How to Remain Vital in Hypercompetitive Environments, *Organization Sciences*, 7, 4, 359- 374