Cereal supplies in rural families of the Senegalese Groundnut Basin. Who is responsible for meeting family food needs?

Maam Suwadu SAKHO-JIMBIRA* and Michel BENOIT-CATTIN**

* CIRAD/ INRA/UMR MOISA (Montpellier), 2 place Pierre Viala. 34060 Montpellier Cedex 01, France. Tel: +334 99 61 23 28, Fax: +334 67 63 54 09, E-mail: souamintou@yahoo.fr (jimbira@supagro.inra.fr). ISRA-BAME (Senegal), route des Hydrocarbures, Bel-Air, BP 3120 Dakar, Senegal. Tel: +221 859 17 55

** CIRAD, TA 279/04, 34398 Montpellier cedex 05, France. Tel: +334 67 61 57 82, Fax: +334 67 61 56 57, E-mail: michel.benoit-cattin@cirad.fr

Paper prepared for presentation at the 106th seminar of the EAAE

Pro-poor development in low income countries: Food, agriculture, trade, and environment

25-27 October 2007 – Montpellier, France

Abstract

In the traditional operation of production-consumption groups in rural areas of Senegal, the group chief, or *Borom njël*, has a social duty to make sure family food needs are met. His ability to do this is supported by certain social rules governing these groups, and by a favourable environment. However, various changes have now adversely affected the environment. These changes prompted us to assess the *Borom njël's* current ability to go on playing his social rule as a food provider.

From data collected in two villages of the Senegalese Groundnut Basin, using multivariate analysis, we identified three production-consumption group profiles according to how the *Borom njël* ensured main cereal supplies: (i°) market purchase with migrants' remittances; (ii°) home production and (iii°) market purchase with own resources. The ability of the *Borom njël* to ensure cereal supplies differed according to the profile.

We used a multivariate logit model to study the determinants affecting the *Borom njël*'s ability to ensure cereal supplies for the production-consumption group. We found that physical assets and wage labour employment increased this ability. We also found that agricultural income, including livestock, was positively correlated to the likelihood of the *Borom njël* successfully ensuring cereal supplies, particularly those depending heavily on own production. Additional income earned by the *Borom njël* from non-agricultural activity had the same positive effect, particularly when ensuring cereals provision through market purchase.

We end with some thoughts on the increasing reliance of *Borom njëls* on migrants' remittances to ensure that family cereal needs are met.

Keywords: Senegal, Groundnut Basin, Cereal supplies, consumption-production groups, multinomial logit

Introduction

In many rural areas of developing countries, agriculture remains the population's main activity because of its major role in income generation and food supply. During the 60s in Senegal, agricultural activity enjoyed a favourable context, characterized by land and family labour availability, together with strong state regulation. Rural households belonging to the same lineage were organized in consumption-production groups under the responsibility of the *Borom njël*, who, in addition to his social obligation to ensure food provision, was expected to manage agricultural production activities at the collective level.

However, various changes have profoundly affected this favourable context. These include less state intervention, a fall in land productivity and increased population pressure. At the level of the whole country, these conditions have caused a negative commercial balance for agriculture, and an imbalance between national agricultural production and increasing consumption needs. Several reasons have been put forward to explain this situation, among which are decreased soil fertility, low price incentives and the abandoning of public agricultural policy support (Dieng, 1998; République du Sénégal, 1984, 2001; Gaye et Kelly, 1996).
At the household level, these conditions have jeopardized the *Borom njël's* ability to fulfil his basic social obligation to ensure cereal supplies for the production-consumption group.

We undertook to analyse how the *Borom njël* managed to ensure cereal supplies at the family level in this unfavourable context. To this end, we studied the determinants that account for the relative abilities of Borom *njëls* to meet family food needs.

To address this issue, we used data collected in a detailed survey conducted in 2006 in two villages of the Senegalese Groundnut Basin. Here we first review the evolution of the environment at different levels: political, economic, demographic and physical. We then describe the operation of consumption-production groups and the major role of their chiefs, the *Borom njëls*. Thirdly, we describe the survey methodology and the data collected. We go on to present the estimation method and the empirical results obtained from the multinomial logit model, and end with a discussion and concluding remarks.

1- Senegalese background

Agriculture has occupied a central place for the Senegalese rural population, particularly those in the Groundnut Basin, through its role in income generation and food self-sufficiency. The Groundnut Basin remains one of the most important agro-ecological zones of Senegal: it covers a vast area of rainfed groundnut and millet production, accounting for 33 percent of Senegal's land area, 65 percent of its rural population, 80 percent of its exportable groundnut production, and 70 percent of its cereal production in the early 80s (Kelly et al., 1996).

Agricultural activity took place in a moderately favorable political context, characterized by broad state intervention in rural areas, providing easier access to inputs through government subsidies and credits. We can summarize the major agricultural policies as follows:
First of all, with the adoption of the "Programme Agricole" the government aimed to facilitate access to groundnut seeds, fertilizer and equipment for draught animals with subsidized prices and credits. The "Office National de Coopération et d'Assistance pour le Développement" (ONCAD) was created in 1966 to ensure input supplies, collect and market groundnut production through cooperatives. However, the ONCAD was withdrawn in 1980 (Benoit-Cattin in Delgado, 1991) and its functions were assigned to new bodies, the "Société National d'Approvisionnement Rural" (SONAR) for agricultural supplies, the "Société de Développement et Vulgarisation Agricole" (SODEVA) for technical assistance in the Groundnut Basin and the "Société Nationale de Commercialisation des Oléagineux du Sénégal" (SONACOS) for groundnut oil production.

Later in the 80s, structural adjustment policies ended these earlier programs and withdrew state intervention, at a time when the government was heavily involved in supplying inputs and marketing in rural areas. According to Kelly et al. (1996), the principals underlying this structural adjustment were:

i) To curtail direct government intervention in the agricultural sector and encourage private sector players (both cooperative and commercial) to fill the gap
ii) To eliminate government subsidies and taxation to the greatest extent possible.

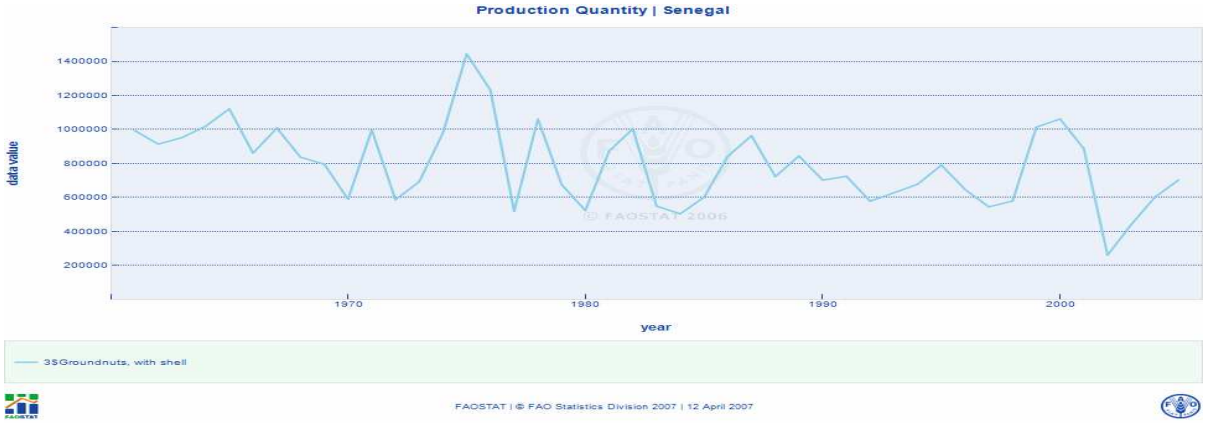
This structural adjustment in the agricultural sector was embodied in the New Agricultural Policy (NPA) launched in 1984 by the Senegalese government. The objectives of the NPA were (i°) to increase cereal self-sufficiency from fifty to eighty percent by the year 2000 and (ii°) to transfer certain economic activities (input and product marketing) from the state to the private sector (Martin and Crawford, 1991). This New Agricultural Policy thus led to the privatization of input distribution and output marketing functions and to the cessation of direct subsidies for agricultural inputs, particularly fertilizer (Kelly et al., 1996).

Other changes affected both the economic and demographic context. According to Ly (2000), the preferential rates enjoyed by Senegalese groundnuts were discontinued under the terms of an agreement made between European Union members. Diagne (1998) showed that this situation depressed groundnut production and caused only a small increase in gross domestic product (1%), while the rate of demographic growth was 2.5%. For the rural population, from 1976 to 1988 the annual population growth was 2.1% (USAID, 1991 quoted by Kelly, 1996). Thus from 3 million in 1970 rural population reached 6 million in 2005 (République du Sénégal, 2005).

Besides these initial changes, there were further trends, for example concerning the physical environment. Kelly et al. (1996) report changes in the physical environment including

declining rainfall, shorter growing season, deteriorating soils and growing land and water constraints. In particular, for the Groundnut Basin, Akobundu (1998) notes that the environmental changes (erratic rainfall, decreasing soil fertility and inadequate supply of inputs) occurring in the Groundnut Basin have made millet and groundnut production more difficult for farmers.
All these changes have thus formed a new agricultural context in which production is characterized by a strong variability and some downward trends, for both millet and groundnuts (see Graphs 1 and 2).

Graph 1 Groundnut production in Senegal from 1961 to 2005



Graph 2 Millet production in Senegal from 1961 to 2005

2- Social rules for production-consumption groups

Rural populations involved in agriculture are complex. Many researchers have tried to elucidate their operation in African countries (Kleene, 1976, Gastellu, 1980 and Benoit-cattin and Faye, 1982), where rural populations, whose main activity is agriculture, come together in different production-consumption groups, based on mutual rights and obligations among members. These groups, which correspond to extended families, can include one or several households that work together on family farms and share the same residence unit.

The operation of these groups was studied by Benoit-Cattin and Faye (1982) in Sahelian-Sudanian Africa. They found a correspondence between the management of the production group - through farm labour organization and land allocation - and that of the consumption group. In the Wolof tradition predominant in the Groundnut Basin, these two groups are under the responsibility of the *Borom njël* who has a social duty to make sure family food needs are met. The social rules traditionally governing these groups, the *njël*, are as follows.

On the production side, decisions are made by the *Borom njël*, who typically heads the production group. He is responsible for the management of the total family land, which he allocates between a common field and individual fields. These last are for adult dependants and wives who grow cash crops, particularly groundnuts, which represent their main individual income sources. In return, these family members have to participate in agricultural work in the common millet field, which is under the *Borom njël's* responsibility. Thus, millet is grown as a subsistence crop, and groundnut as a cash crop, the sale of which gives the *Borom njël* disposable agricultural income. He owns the agricultural equipment available at the family level, although other members may use it on their own individual plots. In addition to family labour, the *Borom njël* can hire labour to meet seasonal needs.

On the consumption side, the *Borom njël* ensures family food needs through the production of the common field (millet) and the purchase of other goods not produced on the family farm. He is the person essentially responsible for ensuring that family food needs are met, and the agricultural production roughly enables him to assume this responsibility.

In view of the different changes that have occurred in the Senegalese rural environment, we wondered whether these social rules were still effective, particularly on the consumption side. We therefore sought to determine whether the *Borom njël* was still able to meet his social obligations on the consumption side, particularly to ensure cereal supplies for different family members.

We used data collected in two villages of the Groundnut Basin to draw up different family profiles according to cereal supplies and the *Borom njël's* ability to satisfy family food needs. Rural surveys mostly take the household as the unit of analysis. However, considering our research topic and the social context described above, we chose the production-consumption group (*njël*), which can be identified as a family, as our unit of analysis. In other words, we considered that the chief of such a group (the *Borom njël)* was better able to give us the information needed than the heads of single households.

3- Differences in group profiles for cereal supplies

Our empirical analysis is based on data collected in the South and North of the Senegalese Groundnut Basin. These areas were chosen because of their contrasting agro-ecological features (rainfall amount, rainy season length, soil quality, etc.) and economic differences (access to markets, infrastructure level, etc.). We took one village from each of these zones, in which data were collected for all the rural families engaged in farming or holding land in the year 2005. In all, 89 rural families comprising 229 households were surveyed.

The North has a typically Sahelian climate, with rainfall 300 to 500 mm during a season lasting three to four months. The climate in the centre, southwest and southeast can be loosely classified as Sudanian, with rainfall 500 to 900 mm/ year and a rainy season of five to six months.
Access to markets and levels of infrastructure are relatively favourable in the North, with good road proximity and the influence of the religious *megalopolis* of Touba (one part of the Groundnut Basin where commerce and an informal sector are developed). By contrast, even though agricultural conditions are more favourable in the South, this zone is hampered by its low infrastructure level and its lower accessibility due to bad road conditions.

Surveys enabled us to collect data on individual and general family characteristics, including production means, consumption needs and *Borom njël* activities.
In particular, we emphasized consumption needs for each family, and we inquired how the *Borom njël* provided his dependants with cereals (millet, maize and rice), through home production, market purchase or gifts. We studied the costs of purchased cereals, the family members who made the payment and what activity provided the income.

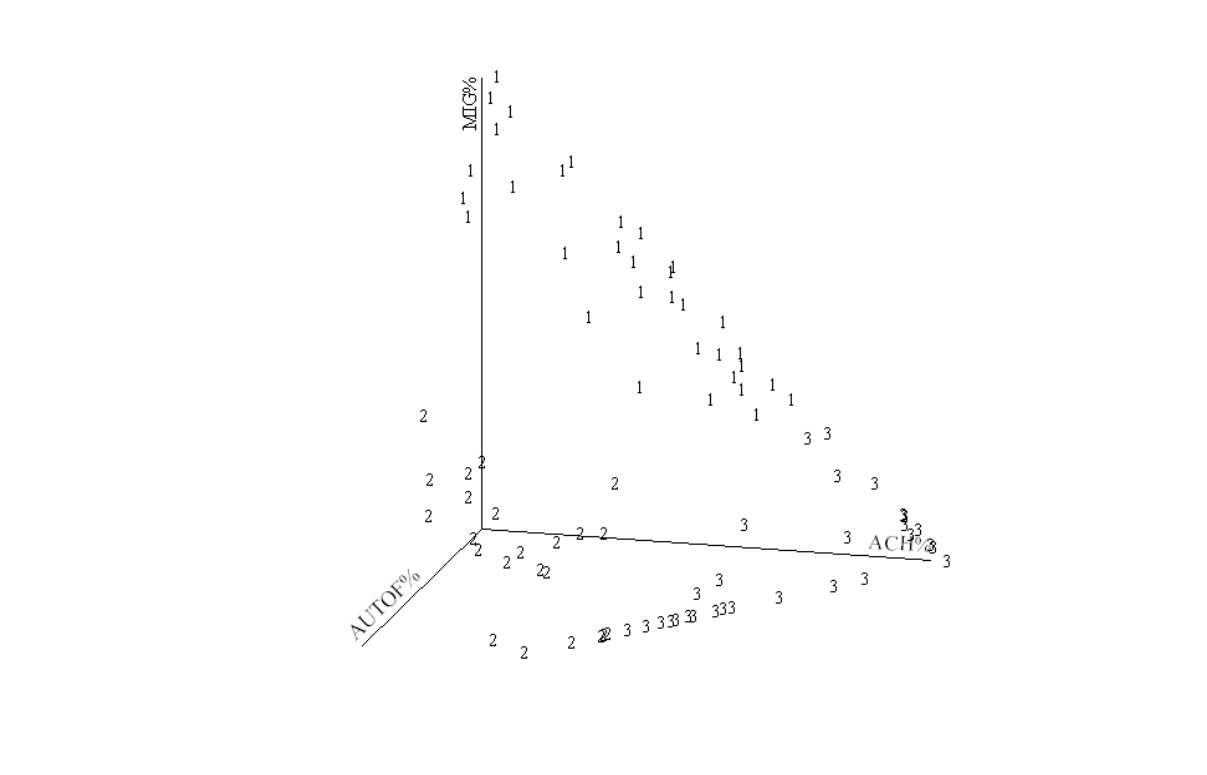
Using multivariate analysis, we found different family profiles according to three aggregated data sets (in percentages), namely the proportions of cereals purchased, from home production and from other family members, particularly migrants. A typology of three profiles emerged from an HAC (Hierarchical Ascendant Classification).

- In the first profile (41% of the production-consumption groups) families depended heavily on migrants for cereal supplies, with an average proportion of 65%. For these families, the *Borom njël* as a main person responsible for food supply was unable to meet family food needs by himself, and relied strongly on migrants' remittances to purchase cereals. However, we note that almost all these families were located in the North, a poor agricultural area with weaker endowments.

- In the second profile (26%), 82% of the cereal supplies were ensured by the *Borom njël*, with a higher amount from home production (55%) than from market purchase (27%). Thus the *Borom njël* was a capable provider, because he could ensure cereal supplies from his own resources. In this profile, by meeting family food needs mainly through home production, the *Borom njëls* come closer to the traditional ones described earlier. In addition, we note that almost all these families were located in the South, a rich agricultural area**.**

- In the third profile (33%), with an average proportion of 95% ensured by the *Borom njël*, cereal supplies were almost entirely provided under his responsibility. However, market purchases represented 74%. Unlike profiles 1 and 2, the third profile families were equally distributed between the two locations.

We can represent these profiles graphically in three dimensions, with as axes participation of migrants (MIG_), purchase by the *Borom njël* (ACH_) and consumption of home production (AUTOF_).



Family typology in three profiles

Given this typology, we can conclude that there are no longer any fully autonomous families (production-consumption groups) operating entirely according to the social rules outlined above (section 2). In other words, the *Borom njëls* can no longer rely on farming to meet all the family food needs, by millet or maize production and rice purchase through groundnut sales. However, in profiles 2 and 3, the *Borom njël* is better able to ensure cereal supplies than in profile 1. We set out to determine what factors determined whether a family fitted one or another of these three profiles, i.e. what factors enabled some *Borom njëls* to ensure cereal supplies and others not?

Before describing our estimation method, we summarize in the following table some basic family characteristics for each of these profiles.

Table 1 Family characteristics

Profile	**1**	**2**	**3**
Profile description	Cereal supplies ensured by **market purchase** through **migrants' remittances**	Cereal supplies ensured by **Borom njël' agricultural production**	Cereal supplies ensured by **market purchase** through **Borom njël' s own resources**
Number of families	37	23	29
Average age of *Borom njël* (years)	59	49	51
Average family composition			
- Number of seniors (age > 60)	0.62	0.56	0.38
- Number of children (age < 15)	8	7	6
- Number of adults	12	10	6
Farm characteristics			
- Average farm size (ha)	10	14	9
- Family labour	7	9	7
- Wage labour employment	13%	83%	41%
- Average number of draught animals	2	4	2
-Average number of agricultural equipment items	6	7	5
***Borom njël'* s income composition**			
- Average proportion of farm income*	36%	77%	75%
- Average proportion of non farm income	6%	11%	20%
- Average proportion of remittances	58%	12%	5%
Origin of consumed cereals			
- home production	6%	55%	21%
- paid for by Borom njël	29%	27%	74%
- paid for by migrants	65%	18%	5%

* Farm income is total crop income and livestock income.

4- Estimation method and results

4-1 A multinomial logit model for the determinants of *Borom njël's* ability

We used a multinomial logit model to empirically explore the determinants of the *Borom njël's* ability to ensure cereal supplies. In other words, we looked for the determinants that explained why a given family or production-consumption group fitted one or another of the three profiles described above.
The underlying equation for the multinomial logit model is:

$$\mathbf{Y_i^k = X_i^k \mathcal{B}_X^k + D_i^k \mathcal{B}_D^k + F_i^k \mathcal{B}_F^k + e_i^k}$$

k = {1, 2, 3}, i = {1 … 89}

Where $\mathbf{e_i^k}$ is the term error which is independent of explanatory variables, namely $\mathbf{X_i^k}$, $\mathbf{D_i^k}$ and $\mathbf{F_i^k}$.
$\mathbf{Y_i^k}$ is a latent variable for the *Borom njël* **i** to be in profile **k**.
k is equal to:

- 1 if the *Borom njël* **i** relies heavily on the market to purchase cereals using migrants' remittances;
- 2 if the *Borom njël* **i** depends mainly on home production to ensure cereal supplies;
- 3 if the *Borom njël* **i** relies heavily on the market to purchase cereals with his own resources.

For explanatory variables, $\mathbf{X_i^k}$ is a set of the *Borom njël's* individual characteristics; $\mathbf{D_i^k}$ is a set of demographic characteristics that also stand for family consumption needs and $\mathbf{F_i^k}$ is a set of farm characteristics comprising production means.

For the first set $\mathbf{X_i^k}$, we used the *Borom njël*'s age - divided into three categories - and his agricultural income including livestock (*agrlive_inc0*). We included a dummy variable (*extragr0*) that took value 1 if the *Borom njël* was engaged only in agricultural activity or livestock and 0 if he practiced a non-agricultural activity. We expected these two last variables to increase the likelihood of *Borom njël* being able to respond to family food needs. By contrast, we expected greater age to decrease that likelihood.

For the second set $\mathbf{D_i^k}$, we used three demographic variables, namely the number of children (*child*), and the number of adult men (*menadult*) and adult women (*womadult*) in the family. Normally, adult members, particularly men, should contribute significantly to home production managed by the *Borom njël* in the common field. Consequently, we expected the numbers of adult men and women to have a positive impact on *Borom njël*'s likelihood to ensure cereal supplies. Conversely, we expected the number of children in the family to decrease this likelihood. We considered that demographic variables also represented family labour, especially adult men and women.

For the third set $\mathbf{F_i^k}$, we took into account the amount of land cultivated by the *Borom njël* divided into three categories: (*total_shc*), (*cereal_slc*) and (*ara_slc*). The first variable (*total_shc*) corresponded to the total amount of land owned through inheritance and cultivated by the *Borom njël*. The other variables (*cereal_slc*) and (*ara_slc*) represented land rented and cultivated by the *Borom njël*, respectively for cereals and groundnuts. We expected these land

variables to be positively correlated with the *Borom njël*'s probability of ensuring cereal supplies. To take into account the possibility of resorting to non-family labour, we included two variables (*mos*) corresponding to wage labour and (*santane*) corresponding to assistance from other families for agricultural work. These two variables were defined as dummies. Also, we used agricultural equipment for which three categories were defined (*equipagr_low*, *equipagr_moy* and *equipagr_high*) corresponding respectively to a low level, an average level and a high level of agricultural equipment use. We expected agricultural equipment to have a positive effect on the probability of *Borom njël* being able to ensure cereal supplies, and so meet family food needs.

4-2 Empirical results

The multinomial logit results are reported in Table 2. The second column corresponds to profile 2, where the main share of cereals is ensured by the *Borom njël* through home production, and the third column corresponds to profile 3, in which most of the cereals provided by the *Borom njël* are obtained through market purchase. The remaining profile, profile 1, is considered as the reference profile, in which the *Borom njël* relies heavily on migrants' remittances to purchase cereals.

Table 2 Multinomial logit results

Second column: Estimation results for profile 2 (standard errors in brackets)
Third column: Estimation results for profile 3 (standard errors in brackets)

Y	2	3
ageb1	1.726 (2.122)	-1.196 (1.941)
ageb2	2.606 (2.075)	0.568 (1.744)
agrlive_inc0	6.168 (2.552) **	0.620 (2.308)
extragr0	-48.609 (1.07^{9})	-7.690 (2.933) ***
child	-0.762 (0.336) **	-0.179 (0.239)
menadult	0.022 (0.426)	-0.809 (0.406) **
womadult	-0.856 (0.602)	-1.682 (0.619) ***
total_shc	0.750 (0.286) ***	0.872 (0.288) ***
cereal_slc	27.229 (.)	27.996 (1.906) ***
ara_slc	33.825 (.)	35.444 (1.723) ***
equipagr_low	10.587 (4.519) **	6.973 (3.871) *
equipagr_moy	11.311 (4.407) ***	6.856 (3.533) **
santane	2.945 (1.887)	1.422 (1.403)
mos	3.406 (1.804) *	3.150 (1.561) **
_cons	-17.827 (6.727)	-3.798 (4.250)

* Indicates 10% level of significance
** Indicates 5% level of significance
*** Indicates 1% level of significance
Number of observation: 89
Pseudo-R^2: 0.6769
Y = 1 is the reference profile

Concerning individual characteristics, in profiles 2 and 3 the *Borom njël*'s age did not have a statistically significant effect on his likelihood of ensuring cereal supplies. As expected, the *Borom njël's* agricultural income - including livestock - increased this likelihood, especially for those in profile 2. In other words, with a higher agricultural income level, *Borom njël* in profile 2 were better able to meet family food needs than those in profile 1. This finding is consistent with the fact that agricultural income can permit the *Borom njël* to obtain non-produced cereals through market purchase.
For profile 3, we expected the effect of this income variable to be positive and significant on the probability of *Borom njël* to ensure cereal supplies, but it proved to be non-significant. Also, in this profile results show that the dummy variable *extragr0* decreased the probability of *Borom njël* of ensuring cereal supplies. In other words, *Borom njëls* who are not engaged in non-agricultural activities are less likely to meet family food needs than those in profile 1. Therefore, the practice of a non-agricultural activity is a way for *Borom njël* in profile 3 to earn additional income and so ensure cereal provision by market purchase.

Concerning demographic variables, our results show that the number of children in the family decreases the probability that the *Borom njël* in profile 2 will be able to ensure cereal supplies, compared with those in profile 1. *Borom njëls* in profile 2 rely heavily on their own production to ensure cereals provision and this result suggests that children's contribution in agricultural work falls short of their consumption needs. Therefore, taking into account their share (55%) in family size, it is not surprising to find that the number of children has a negative impact on the probability of a *Borom njël* in profile 2 meeting family food needs, compared with those in profile 1.
For *Borom njëls* in profile 3, number of children is not a significant variable for their likelihood to be able to ensure cereal supplies.
Results also show that numbers of adult men and adult women are negatively correlated to the probability of *Borom njël* in profile 3 meeting family food needs, compared with those in profile 1. This is consistent with the fact that the participation of adult men and adult women in family labour is not important for this profile because *Borom njëls* depend more on market purchase than own production. In other words, their contribution to the *Borom njël's* production is lower than their consumption needs meet by the *Borom njël.* This imbalance explains the negative correlation between the number of adults – men and women - and the probability of *Borom njël* in profile 3 meeting family food needs, compared with profile 1. We note that some income earned by adult men and adult women is not used for cereal purchase.

Concerning farm characteristics, results were as expected for land owned through inheritance and cultivated by the *Borom njël* in both profiles. Thus the greater the amount of land inherited and cultivated by the *Borom njël* in profiles 2 and 3, the higher the probability that they met family food needs, compared with those in profile 1. We had the same positive effect of land rented and cultivated by the *Borom njël* on his likelihood of ensuring cereal supplies, but only for profile 3. We can identify two categories of rented land: one used for cereal crops and one for groundnuts. However, although we expected positive significant effects for both we note that this effect was higher for groundnuts (35,444) than for cereals (27,996). Consequently, we can argue that the *Borom njël's* probability of ensuring cereal supplies in profile 3 increases with groundnut production, because groundnut sale is a way for him to earn income and purchase cereals. Allowing for agricultural equipment in farm characteristics, we find an expected positive effect of agricultural equipment in both profiles. This positive effect implies that as the level of agricultural equipment increases, the *Borom njëls* in profiles 2 and 3 are more likely to ensure cereal supplies versus those in profile 1.

Despite the same positive effect of the agricultural equipment variable in both profiles, our results show that this effect was greater in profile 2 than in profile 3. This finding is consistent with the importance of farming for the *Borom njëls* in profile 2, who rely heavily on their own production to ensure cereal supplies, compared with those in profile 3.
We introduce non-family labour in the explanatory variables by including mutual assistance labour called '*santane*' and wage labour. The first one proved non-significant, but wage labour increased the likelihood of the *Borom njël* in profiles 2 and 3 being able to ensure cereal supplies, compared with those in profile 1.

Conclusion

The operation of production-consumption groups has been the subject of much debate in studies concerning rural areas. These studies emphasize the major role of the *Borom njël* or group chief in making sure family food needs are met and managing agricultural production at the family level. Taking into account the different changes that have occurred in the Senegalese rural economy, we set out to study the *Borom njël's* responsibility on the consumption side, by analysing his ability to ensure cereal supplies.

We used data from a survey conducted in the Groundnut Basin of Senegal and adopted two methodological frameworks. Using multivariate analysis, we found three profiles of production-consumption groups according to cereal supplies. These profiles imply three *Borom njël* types, some of whom show ranging abilities to meet family food needs in the traditional way, while others rely for a large part on migrants' remittances.
We also used a multinomial logit model to study the determinants that explain the ability of some *Borom njëls* to ensure cereal supplies, despite all the changes that have occurred in their environment, compared with others that are unable to do so.

Our empirical illustration from Senegal indicates that the *Borom njël'*s ability to ensure cereal supplies involves an equilibrium between production means and consumption needs. In determining the probability that the *Borom njël* can ensure cereal supplies, we find three types of impact which differ widely among production-consumption groups: The impact of the *Borom njël*'s individual characteristics, the impact of farm characteristics and the impact of demographic characteristics.

Concerning the *Borom njël'*s individual characteristics, our results suggest that when home production represents a large proportion of cereal supplies, a *Borom njël* with a higher agricultural income is more likely to meet family food needs than one who relies on market purchase. This finding is consistent with the traditional operation of production-consumption groups in which agriculture allowed the *Borom njël* to satisfy most of the family food needs. We also find that for a *Borom njël* who depends heavily on market purchase to ensure cereal supplies, the practice of a non-agricultural activity has a positive effect on his likelihood of being able to meet family food needs.
Concerning farm characteristics, we find that physical assets - land and agricultural equipment - controlled by the *Borom njël* and wage labour employment increase his likelihood of ensuring cereal supplies.
Finally, concerning demographic characteristics a *Borom njël* is less likely to be able to ensure cereal supplies with a higher number of children or adults – both men and women - depending respectively on the proportion of home production or market purchase.

A study of the *Borom njël's* ability to ensure cereal supplies and meet consumption needs thus reveals changes in the traditional operation of the production-consumption group. We note that for some rural families, the *Borom njël's* role may be challenged, particularly when some family members migrate. In some situations in which migrants' remittances allow the *Borom njël* to ensure cereal supplies, his traditional responsibility for meeting family food needs is at undermined. To devise more finely targeted agricultural policies, it will be useful to carry out more thorough research on the families in which migrants are responsible for much of the consumption expenditure of those remaining in the village.

References

Akobundu, E., (1998). "Farm-Household Analysis of Policies Affecting Groundnut Production in Senegal", MS Thesis, Virginia Polytechnic Institute and State University

Benoit-cattin, M., (1991). "Ideological and institutional antecedents of the new agricultural policy", in. "The Political Economy of Senegal under Structural Adjustment", Delgado C.L. and S. Jammeh, New York, London

Benoit-cattin, M., Faye, J. (1982). "L'exploitation agricole familiale en Afrique Soudano-Sahélienne", Presses Universitaires de France, techniques vivantes, Paris

Diagne, A., (1998). "Economic Policies and Agriculture in Senegal", in. Tshibaka, T.B., (ed.), "Structural adjustment and agriculture in West Africa". CODESRIA, Dakar

Dieng, A., (1998). "Cereal Supply and Demand in Senegal, 1960-95: Implications for Food Self-Sufficiency", MS thesis in Agricultural Economics, Tuskegee University, May 1998

Gastellu, J.M., (1980). "Mais où sont donc ces unités économiques que nos amis cherchent tant en Afrique ?", Cahiers ORSTOM, série Sciences Humaines, vol 17, No.1-2

Gaye, M., Kelly, V., (1996). "L'Utilisation des Terres Agricoles dans le Bassin Arachidier du Sénégal : Facteurs Déterminants des Combinaisons Culturales et des Systèmes de Rotations", ISRA/URR, Sud Bassin Arachidier

Kelly, V., Diagana, B., Reardon, T., Gaye, M., Crawford, E., (1996). "Cash Crop and Food Grain Productivity in Senegal: Historical View, New Survey Evidence, and Policy Implication", *MSU International Development Paper* No.20, East Lansing, Michigan

Kleene, P., (1976). "Notion d'exploitation agricole et modernisation en milieu wolof Saloum (Sénégal)", Agronomie Tropicale XXXI, No.1, January-March 1976

Ly, C., (2000). "Région de Diourbel: Evolution de la Commercialisation Agricole". Drylands Research Working Paper 18, Royaume-Uni

Martin, F., Crawford, E., (1991). "The New Agricultural Policy: its Feasibility and Implications for the Future", in. "The Political Economy of Senegal under Structural Adjustment", Delgado C.L. and S. Jammeh, New York, London

République du Sénégal - Ministère du Développement Rural (1984). "La Nouvelle Politique Agricole", Dakar.

République du Sénégal - Ministère de l'Agriculture et de l'Élevage (2001). "Élaboration des Stratégies de Développement du Secteur Agricole", Dakar, September 2001.

République du Sénégal (2005). "Situation Economique et Sociale du Sénégal". Ministère de l'Economie et des Finances, Agence Nationale de la Statistique et de la Démographie, http://www.ansd.org

United States Agency for International Development – USAID - (1991). "Agricultural Sector Analysis". Dakar: USAID/ Senegal, Agriculture and Natural Resources Office. Mimeo

Appendix 1. Description of variables

Name of variable	Description of variable
age	Age (years) of the family head with three levels
ageb1	Family head whose age is less than or equal to 50
ageb2	Family head whose age is strictly greater than 50 and less than or equal to 60
ageb3	Family head whose age is strictly greater than 60
child	Number of children in the family
menadult	Number of adult men in the family
womadult	Number of adult women in the family
total_shc	Average amount of inherited and cultivated land (ha)
cereal_slc	Average amount of rented land cultivated for staple crops (cereals) (ha)
ara_slc	Average amount of rented land cultivated for cash crops (groundnuts) (ha)
mos	Wage labour
santane	Mutual assistance labour from other families
equipagr_low	Low level of agricultural equipment
equipagr_moy	Average level of agricultural equipment
equipagr_high	High level of agricultural equipment
agrlive_inc0	Income from cash crops and livestock (10^6 Fcfa)
extragr_inc0	A dummy variable that takes 1 if the *Borom njël* has no non-agricultural activity and 0 otherwise

Appendix 2 Summary of statistics

Y=1

Variable	Obs	Mean	Std. Dev.	Min	Max
ageb1	37	0.243	0.435	0.000	1.000
ageb2	37	0.270	0.450	0.000	1.000
ageb3	37	0.486	0.507	0.000	1.000
Child	37	8.189	6.231	0.000	24.000
menadult	37	6.162	2.863	2.000	14.000
womadult	37	5.649	3.368	1.000	17.000
santane	37	1.486	0.507	1.000	2.000
mos	37	0.135	0.347	0.000	1.000
total_shc	37	6.549	5.251	0.000	25.000
cereal_slc	37	0.000	0.000	0.000	0.000
ara_slc	37	0.000	0.000	0.000	0.000
equipagr_low	37	0.405	0.498	0.000	1.000
equipagr_moy	37	0.541	0.505	0.000	1.000
agrlive_inc0	37	0.341	0.437	0.000	2.464
extragr0	37	0.378	0.492	0.000	1.000
Y=2					
ageb1	23	0.565	0.507	0.000	1.000
ageb2	23	0.261	0.449	0.000	1.000
ageb3	23	0.174	0.388	0.000	1.000
child	23	7.696	3.649	3.000	16.000
menadult	23	5.522	2.313	2.000	11.000
womadult	23	4.348	2.790	1.000	11.000
santane	23	1.739	0.449	1.000	2.000
mos	23	0.826	0.388	0.000	1.000
total_shc	23	11.287	8.759	5.000	46.500
cereal_slc	23	0.261	0.449	0.000	1.000
ara_slc	23	0.391	0.499	0.000	1.000
equipagr_low	23	0.217	0.422	0.000	1.000
equipagr_moy	23	0.478	0.511	0.000	1.000
agrlive_inc0	23	1.639	1.228	0.287	5.020
extragr0	23	0.000	0.000	0.000	0.000
Y=3					
ageb1	29	0.552	0.506	0.000	1.000
ageb2	29	0.310	0.471	0.000	1.000
ageb3	29	0.138	0.351	0.000	1.000
child	29	6.517	3.719	2.000	17.000
menadult	29	3.414	1.524	1.000	6.000
womadult	29	3.138	1.787	1.000	7.000
santane	29	1.690	0.471	1.000	2.000
mos	29	0.414	0.501	0.000	1.000
total_shc	29	7.579	7.495	0.000	32.000
cereal_slc	29	0.069	0.258	0.000	1.000
ara_slc	29	0.138	0.351	0.000	1.000
equipagr_low	29	0.483	0.509	0.000	1.000
equipagr_moy	29	0.414	0.501	0.000	1.000
agrlive_inc0	29	0.500	0.578	0.019	1.905
extragr0	29	0.034	0.186	0.000	1.000

Appendix 3 Three profiles of production-consumption groups