Drylands Programme

ISSUES PAPER

The IUCN Sahel Programme

Food and Agricultural Production in the Sahel

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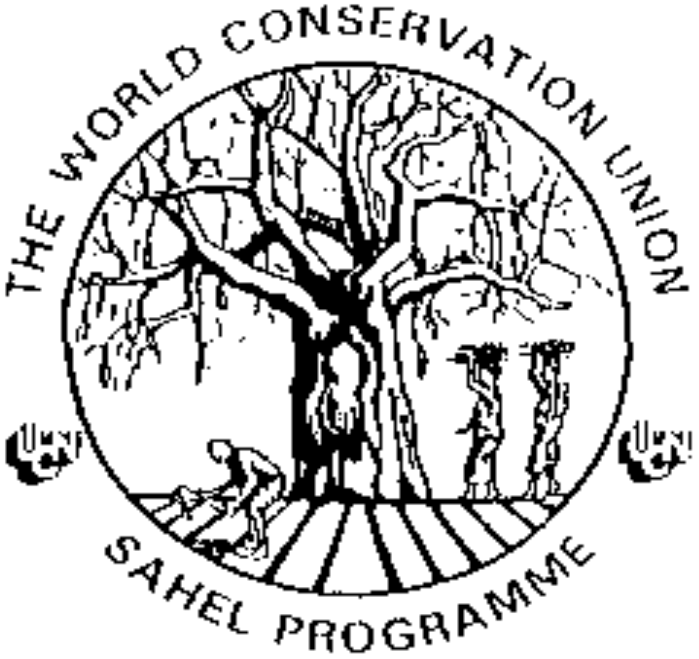

The IUCN - the World Conservation Union - has published the IUCN Sahel Studies 1989, as part of its Sahel Programme. Running to 152 pages, the Sahel Studies includes sections on Rainfall, Population, Food and agricultural production, Conservation areas, Agricultural prices and natural resource management, Sustainable development, Supply and provision of firewood, and Pastoral land tenure. The report provides reviews of recent research on sustainable development issues by leading experts in the various fields.

Under an agreement between IUCN and IIED, Naramata is publishing four edited papers from the Sahel Studies in the Issues Envelope series - two in each of the September and December 1989 editions. In this Issues Envelope are included papers on Food and Agricultural Production and on Sahelian Rainfall. The original version of the Agriculture and Food paper was written by Dr. M. Norton-Griffiths formerly of IUCN, Nairobi and that on rainfall by Dr. G. Farmer of the Climatic Research Unit, University of East Anglia, UK. Naramata has been responsible for the editing of the original text.

Copies of the full IUCN Sahel Studies 1989 are available in English and French and can be obtained from the IUCN Publications Unit, 219c Huntingdon Road, Cambridge CB3 0DL, UK (price UKstg.12.50 or US$25).

FOOD AND AGRICULTURAL PRODUCTION IN THE SAHEL

1. Introduction

Food production is an emotive issue in the Sahel. Reports emphasise declining per capita production, widespread drought and famine, dislocation of supplies by civil strife, plagues of locusts, extensive overgrazing by livestock and emergency food aid programmes; all of which create an impression of an agricultural production system under extreme stress and in the process of degeneration.

In this paper we aim to present an objective assessment of agricultural and food production in the Sahel, of the major influences on production, and of food self-sufficiency. The picture that emerges is by no means a reassuring one, for there are many indicators that the very real gains in agricultural production are not keeping up with the increase in population. Indeed, there appears to be a declining capability of the natural resource base to sustain economic development at current population levels and at current population growth rates.

Neither, however, is the picture entirely discouraging for there have been major advances in production over the last twenty or so years. The situation has become really bad only during the last very few years, and yet last year, 1988, has seen another strong recovery in response to above normal rainfalls. Agricultural production throughout the Sahel is much more robust than is widely realised.

The paper analyses major influences on production, namely climate, cultivated areas, yields, and the productive efficiency of the agricultural labour force. A major contradiction is revealed. On the one hand we see the value of agricultural production, cereal production and livestock numbers all increasing; on the other hand we see a long-term pattern of below average rainfalls and declining available soil moisture. Although production has been increased primarily by planting more hectares, real gains in yields are also apparent.

The most widely used index of self-sufficiency shows a bleak picture with all countries slipping irrevocably towards dependence on food imports and food aid. Yet each region appears to be producing more food than it is consuming and there are no trends of declining nutritional status among the population; another contradiction remaining to be resolved.

The raw data for these analyses come from two major FAO data bases, AGROSTAT and WCARRD. Wherever possible we have used the full 26 years (1961-87) time series from AGROSTAT. We adopt a regional approach here and have grouped the ten countries as follows:

Western	Senegal, Mauritania, Niger, Mali
Central	Burkina Faso, Chad, Sudan
Eastern	Ethiopia, Somalia, Djibouti

There are strong regional patterns in climatic variability, with the Western, Central and Eastern regions of the Sahel undergoing quite different regimes. The influence of climatic factors is strong in many of the Western time series, but weaker in the Central region and very weak, or absent, in the Eastern region.

2. Regional Perspectives

In this first section, time series of population, Gross Domestic Product (GDP), trade balance and agricultural production for the 26 years between 1961 and 1987 are described from the perspective of the three regional groupings. In each region populations are rising, the real value of per capita GDP is falling and trade balances are worsening. Yet a number of indicators of agricultural production, including the Gross Value Product (GVP, 1) livestock numbers and cereal production, all show significant improvement in performance. However, any improvement in these sectors is too often offset by the rate of population growth. Between 1960 and 1987, the total population has increased from some 60 million to some 107 million.

The time series analyses highlight clear regional characteristics with the Western region in general performing more poorly than the others and being more susceptible to droughts. All regions show similar trends in their rates of population increase, and the proportions of the population falling in each are unlikely to change. The Eastern region will always be the most populous and hold some 50% of the total.

The Eastern region has also shown sustained gains in GDP and modest losses in per capita GDP, compared with the Western and Central regions, which have demonstrated spectacular declines since 1980. The trends in exports, imports and trade balance reflect this. The Western and Central regions have shown severe setbacks in their trade balances, with recent improvements due more to import compression than to export expansion.

of the rainfall time series.

These lagged relationships between livestock numbers and rainfall are widespread throughout Africa and demonstrate the way in which livestock production systems dampen out the effects of climatic perturbations. Livestock are more susceptible to long 'chronic' droughts, such as in the early '70s in the Western region, than they are to short, sharp droughts as in 1983. Crops, however, always recover more quickly.

The overall trend in the time series for available soil water was negative, with the index decreasing by 2.11% per annum in the three countries of the Western region and by 1.99% per annum in the countries of the Central region. Not only have rainfalls been below average for 26 years, but the soil water available for plant growth has also decreased.

There are, nonetheless, significant correlations between deviations in cereal production and deviations in both available soil water and rainfall. Cereal production is, therefore, definitely responding to variations in both total rainfall and available soil moisture.

The strength of the statistical correlations between rainfall and soil water on the one hand and GVP production, livestock numbers and cereal production on the other show that climatic factors are indeed a powerful influence on agricultural production. These relationships are strongest in the Western region and are weakest in the Eastern region. The Western region is the most susceptible to climatic factors, while the Eastern region has the greater dependency on irrigation, especially in Somalia, which may be lessening the impact of climatic fluctuations.

However, the basic contradiction between an overall increase in agricultural production in the face of below average rainfalls and declining soil moisture availability remains unresolved. The below-average rainfalls and the associated lowered soil moistures stem primarily from deficits in the August rainfalls. This suggests that the distribution of rainfall within the season is at least as important as is the total amount.

3.2 Area planted and yields

Production can be increased by planting more area and by increasing yields. While data on areas planted can be obtained from primary sources, data on yields can be obtained only by dividing production by the area planted. While this gives some indication of yields it is not an independent estimate; this makes interpretation difficult (Figure 2).

In the Western region, all of the increase (37%) in GVP production can be accounted for by the 33% increase in planted

Indices of agricultural production also show clear regional trends. GVP and livestock have shown poor performance in the west with marked influences from drought years while the Central region has shown steady growth with livestock populations doubling over 26 years. The Eastern region has shown steady gains in GVP production, but until quite recently only poor progress in livestock. Cereal production in the Western and Central regions has been unspectacular but steady, with modest but real gains over the preceding 26 years (see Table 1).

3. Influences on Production

These time series present interesting contradictions. On the one hand, GVP production, livestock numbers and cereal production have all been increasing over the last 26 years, albeit at rates not always adequate to compensate for population growth. On the other hand, the Sahelian countries have experienced below average rainfalls over this same period with occasional widespread droughts, particularly in the west. Rainfall is not, of course, the only influence on production, for technology, crop varieties, areas planted, yields and commodity mixes can all play important roles.

3.1 Rainfall

This analysis of the influence of rainfall on agricultural production concentrates on year-to-year deviations from long-term trends rather than on the trends themselves (2).

The rainfall data were derived from the annual deviations for each of the Western, Central and Eastern regions for the 1961-87 time period. Also used were 26-year time series of an index of available soil water calculated by the FAO Plant Protection Division. These time series for available soil water apply to the same countries for which data on cereal production had been gathered.

The correlations between rainfall deviations and GVP production are very strong in the Western region, less so in the Central region, and are not significant (statistically) in the Eastern region.

The correlations between rainfall deviations and deviations in livestock numbers are completely different in that none are statistically significant. However, strong lagged effects are clear in the Western and Central regions where livestock numbers are highly correlated with rainfalls three years previously, the effect being stronger in the Western region (see Figure 1). No such lagged correlations are seen in the Eastern time series, which is not surprising in view of the almost stochastic nature

Table 1 : Trend change and rates of change (% per annum) in agricultural production and livestock numbers, 1961-1987.

	1961/65	1985/87	% change	%p.a.	p
Western					
Population (m)	53	75	77	2.7	<0.001
GVP production (m$)	1825	2502	37	1.3	<0.001
GVP per capita	144	108	-25	-1.4	<0.001
Livestock (m)	37	45	22	0.6	<0.01
Cereals * (mt)	29	45	55	1.8	<0.001
Central					
Population (m)	19	34	79	2.4	<0.001
GVP production (m$)	2516	4544	79	2.6	<0.001
GVP per capita	131	132	<1	0.1	ns
Livestock (m)	38	76	100	3.0	<0.001
Cereals (mt)	33	56	70	2.0	<0.001
Eastern					
Population (m)	28	50	79	2.4	<0.001
GVP production (m$)	3020	4309	39	1.4	<0.001
GVP per capita	108	85	-21	-1.1	<0.001
Livestock (m)	93	112	20	0.6	<0.01

*GVP - gross value product of agricultural production in millions constant $; population and livestock in millions; cereals in millions of tonnes; %p.a. and p values from regression analysis of 1961/87 time series; * not Mauritania*

Central data for Eastern region not available

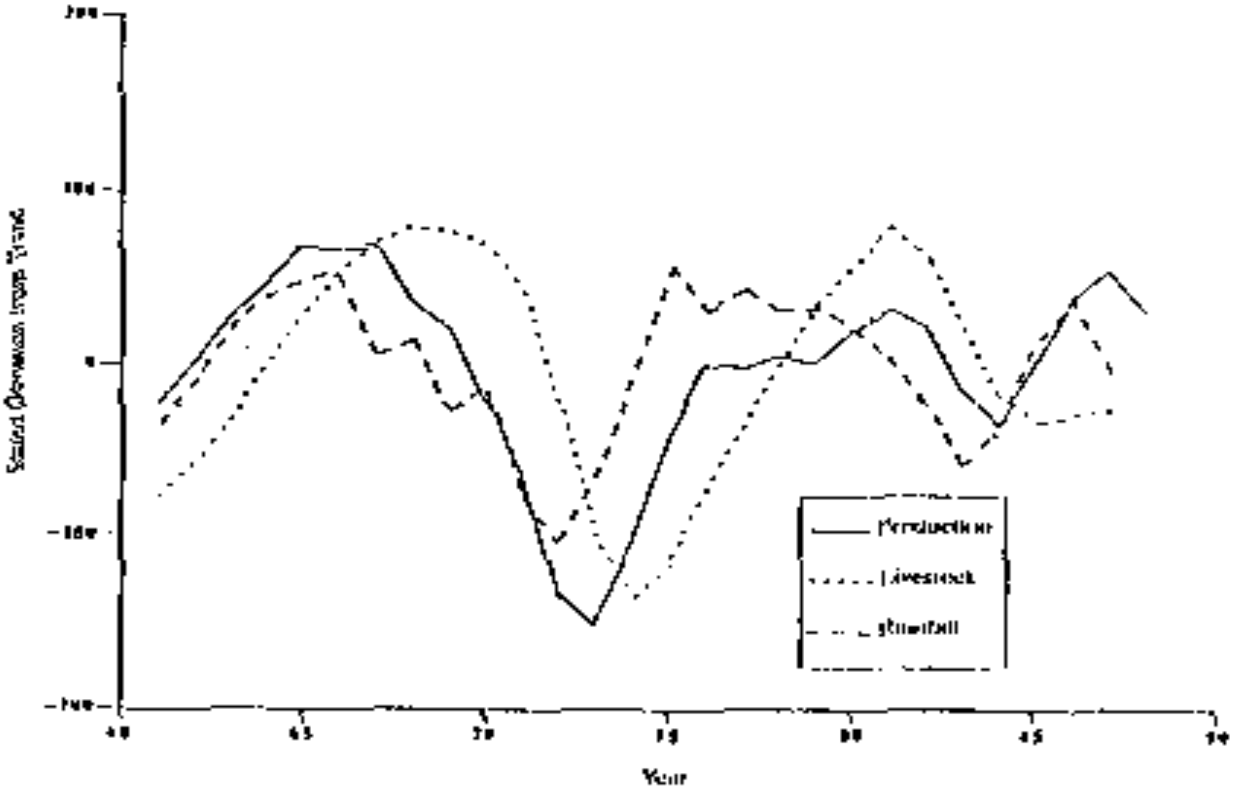

Fig 1 : Influence of rainfall on agricultural production. Detrended series of rainfall, GVP of agricultural production and livestock numbers.

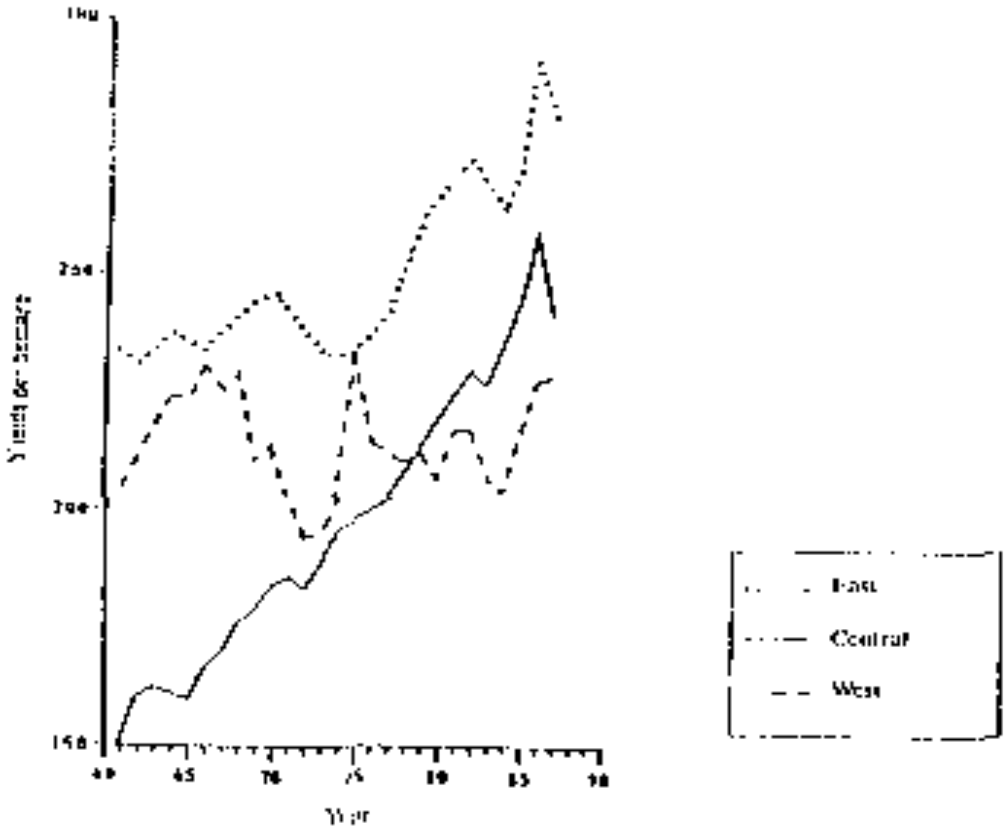

Fig. 2 : Gross value product of agricultural production per hectare, constant dollars.

Table 2 : Structure of agricultural production in the Sahel by % share of value of output in 1970/81 prices.

	1969/73 %	1978/81 %
Crops	45	51
Livestock	55	49
	100	100
Crops		
Cereals	35	39
Roots and Tubers	4	5
Nuts and Oilseeds	26	20
Fruits and Vegetables	9	11
Non food crops	6	8
Other crops	19	17
	100	100
Livestock		
Beef and Veal	35	35
Sheep and goats	22	19
Poultry and eggs	6	7
Dairy	24	28
Others	13	11
	100	100

may indeed be one factor underlying the improvements in yields. However, the productive efficiency of the agricultural labour force, expressed as GVP production per agricultural labourer, is disappointing. Productive efficiency shows a strong downward trend in the Western region with marked short-term variations associated with drought years. The trend in the Eastern region is also negative, but not nearly so strong, and it is only in the Central region that a positive gain in productive efficiency is apparent.

These patterns of productive efficiency support to some extent the analysis of area planted and yields. Labour efficiency has fallen in the Western region where gains in production have come solely from planting more hectares rather than by adopting new technology. In contrast, labour efficiency improved in the Central region where new technology led to a striking improvement in yields. The Eastern region presents a contradiction. Yields have improved sharply over recent years, indicating the adoption of new technology, but without any accompanying improvement in labour efficiency.

3.4 Commodity mix

The GVP of agricultural production is quite sensitive to the relative importance of crops and livestock, and to the mix of crops being grown. Shifts towards high value crops such as oilseeds or cotton at the expense of low value crops such as sorghum will cause the GVP to rise even if yields, hectares planted and rainfalls remain unchanged. Similarly, the GVP will decrease following a move out of high value cash crops and into lower value food crops, for example from cotton into sorghum after an extended period of drought.

Analysis of the structure of agricultural production in the entire Sahel region for the periods 1963-65 and 1985-87 shows the contribution of livestock has fallen compared to crops. Within crops, cereals, roots and tubers, fruit and vegetables and non-food crops (mainly cotton) have all gained at the expense of nuts, oilseeds and other crops. Within livestock, dairy and poultry have gained at the expense of the other categories with the beef and veal sector unchanged (Table 2).

Apart from the shift from livestock to crops, none of these changes are particularly dynamic and only modest changes have occurred to the overall structure of agricultural production. There has certainly been no major shift towards export crops and away from food crops.

Over the region as a whole, the livestock sector (especially in the Western region) made greater contributions to agricultural growth than did the crop sector up to 1982, after which the crop sector made by far the greater contribution.

area. Yields have shown no long term trend and have probably contributed little to the gains in production. The situation is quite different in the Central region where the 36% increase in cultivated land cannot by itself account for the 79% increase in GVP production. Yields have shown significant long-term improvement with none of the short-term fluctuations characteristics of the Western series.

The Eastern region appears to be intermediate with increases in planted hectares and yields of equal importance. However, data suggests that yields remained constant up to 1975 before demonstrating rapid improvement. Gains in production before 1975 were therefore probably due to expanding the area under cultivation, while post 1975 gains are more likely to have been associated with increasing yields.

Gains in cereal production in the Western and Central regions have been due primarily to increasing the hectares cultivated. Yields have not changed in the Western region and have even shown a marginal decline in the Central region.

The influence of cultivated area and yields on year-to-year fluctuations in production, rather than on long-term trends, in production, were examined by correlating the detrended time series. For GVP production, yields were more important than were cultivated area in all regions, while they were of about equal importance for cereal production. Yields can obviously respond very quickly to climatic and other factors. In contrast, the land under production can change only more slowly.

In summary, the long-term gains in production in the Western region appear to be related to long-term increases in area of land under cultivation, while in the Central and Eastern regions improvements in yields may also have been important. In terms of year-to-year variation in production, fluctuating yields are more important than are changes in planted areas, apart from cereals where they are of about equal importance.

3.3 The agricultural labour force

Yields can be influenced by new farming technology, by the increased use of fertilizer, by improved crop varieties and by better training among the agricultural labour force.

The agricultural labour force has shown steady increase over the 26 years of the time series, growing overall at between 1.4% and 1.8% per annum. This increase in labour force has been faster than has the overall increases in land under cultivation so the area per agricultural labourer has shown a steady decrease. Each labourer is therefore looking after less land today than in earlier years, a trend that should lead to increased efficiency and output since more care can be given to each unit area. This

Although it is again unwise to merge all regional complexity within a single analysis, the general patterns that emerge are tangible. Crops are now much more important than are livestock in their contributions to growth in agricultural production, while within the crop and livestock sectors cereals and meat are the most important contributors.

Analysis of the growth in production by commodity group for each region and for the whole Sahel shows that crop production is now growing faster than is livestock and is now contributing most to growth. Within crops, growth in cereal production is sustained everywhere at the expense of other commodities. The livestock sector is more confused. The Western region saw strong growth in all commodities up to 1983 after which only poultry has shown gains. In the Central region all meat production is growing well, while it is beef and dairy production that is growing in the Eastern region.

These analyses of commodity mixes are by no means clear cut. Nonetheless, two important points emerge. First, there appears to be no major shift in the structure of agricultural production, especially in terms of ignoring food, subsistence and cereal crops in favour of export oriented cash crops. Structural changes in the production mix seem quite modest. Second, crop production, especially of cereals, now contributes most to both agricultural production and growth.

4. Trends in self-sufficiency

Figures 3a and b show indicators of food self-sufficiency in each of the three Sahelian regions in terms of food calories per capita per day. No region remains self-sufficient in this most basic of commodities. The Western region has shown the most precipitous decline, from 116% to 82% over the 26 years at an annual rate of -1.6%. The Central and Eastern regions were more or less self-sufficient in food up to 1975 after which their situation also showed a marked decline. Both are now around 90% self-sufficient. Trends in cereal self-sufficiency show similar patterns with the three regions now being around 70% - 80% self-sufficient, down from 90% - 100% 26 years ago.

Food consumption levels expressed in calories have been broadly maintained or even increased but barely so in the case of the Eastern Region, and food imports have been supplying a rising share of food supplies. Food aid now accounts for a significant proportion of food imports measured in calorie terms. Such a situation is inevitable as food production growth is not keeping pace with population growth. This is a cause for grave concern but it should not be interpreted as a catastrophic collapse of agricultural production systems in the Sahel but of systems subject to severe pressures.

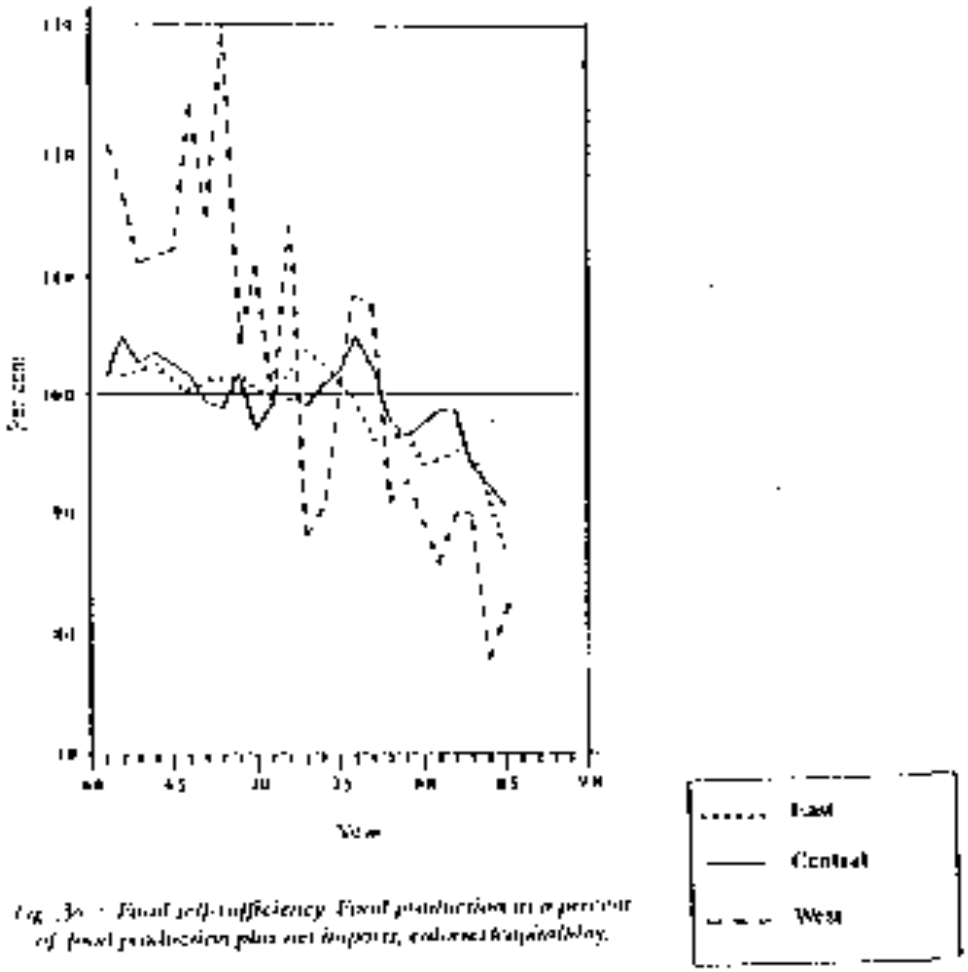

Fig. 3c - Food self-sufficiency. Food production as a percent of food production plus net imports, calories equivalent/day.

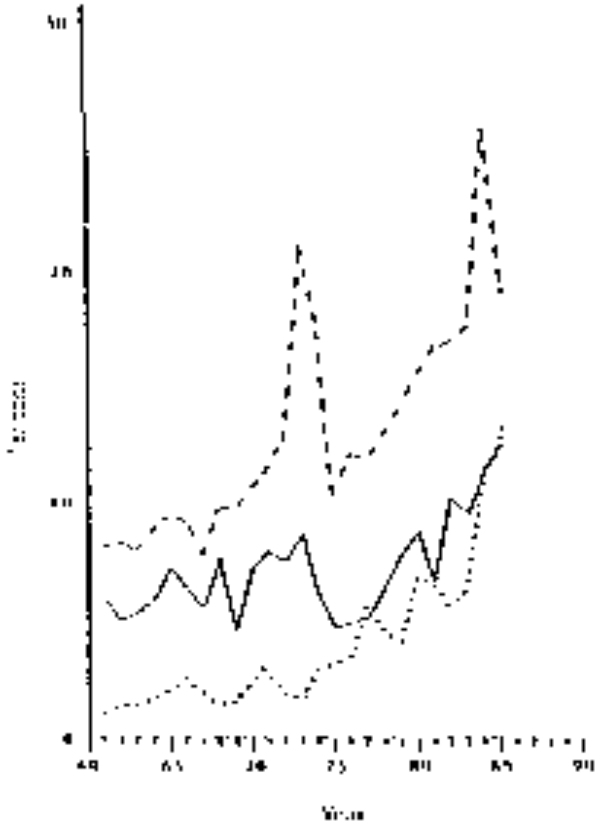

Fig. 3d - Food imports as a percentage of total food supply: calories equivalent/day

Footnotes

1. Gross Value Product (GVP) takes the local currency value of all agricultural production for a given year, including subsistence and livestock production, and converts it to dollars using a constant (1979/80) exchange rate.

2. If two variables show strong time-related trends then any correlation between them need not imply any causal relationship, for both might be responding independently to some third variable. If, however, deviations about the trend in one variable are correlated with deviations about the trend in the other, then a causal relationship is much more likely. The time series must, therefore, be first detrended and the data transformed to variations about the trend before any meaningful analysis can be carried out.

Programme des Zones Arides

DOSSIER

LA FORESTERIE PARTICIPATIVE

Séminaire national pour ONG maliennes
- Segou, Mali, 19-21 septembre 1988

(Résumé)

IIED
INTERNATIONAL INSTITUTE FOR ENVIRONMENT AND DEVELOPMENT

Document No. 3
Novembre 1988

Un séminaire sur la foresterie participative a été organisé par le Comité de Coordination des Actions des ONG (CCA-ONG), avec le soutien du programme "Foresterie et Utilisation des Terres" de l'IIED, à Ségou, Mali, du 19 au 21 septembre 1988.

Parmi les 28 participants présents, on notait des représentants de onze ONG maliennes, d'une ONG burkinabée, et de deux ONG internationales: deux organisations internationales de volontaires et la communauté agricole avec laquelle elles travaillent; et deux agences gouvernementales.

Le premier jour, les participants ont présenté et discuté leurs activités forestières et autres activités associées qui dans de nombreux cas venaient juste de commencer et n'en sont encore qu'à leurs toutes premières réalisations.

Puis, pour illustrer les possibilités d'activités ONG dans ce domaine, M. Yaya Ouédraogo, cadre de l'ONG Six S du Burkina a parlé des travaux entrepris de longue date par son Organisation avec les paysans, notamment la construction de digues toutes en pierre pour accroître l'infiltration de l'eau et réduire l'érosion dans la région de Yatenga au Burkina Faso.

Le programme de la seconde journée a consisté en une visite du périmètre de reboisement du village de Passou dans le district de Niono. Les participants ont également rendu visite à un paysan près de Markala qui a, de sa propre initiative, interplanté son champ de sorgho de palmiers Borassus et gagne actuellement un million de francs CFA par an en écoulant les produits dérivés de cette culture - éponges, bois, fruits et nattes.

Le dernier jour, divers exposés ont été présentés et suivis de discussions sur les diverses stratégies utilisées au Mali dans la lutte contre la désertification; les liens entre pastoralisme et sylviculture et leur pertinence dans le cadre des projets ONG; et le rôle possible des ONG maliennes dans l'élaboration du Plan d'Action des Forêts Tropicales au Mali.

Les conclusions et recommandations du séminaire sont les suivantes:

- Il existe parmi les ONG maliennes une insuffisance de compétences techniques dans le domaine forestier. La formation dans le domaine de la sylviculture devrait donc être entreprise en coopération avec les services ministériels concernés et les ONG des pays voisins.

- Il convient de coordonner de toute urgence les activités des ONG de façon à leur permettre de tirer mutuellement parti de leurs expériences. Le fait que les structures de coordination déjà en place ne soient pas exploitées de façon optimale tient davantage à des attitudes personnelles qu'à des carences institutionnelles.

- Toute intervention ONG devrait débuter par une identification minutieuse des besoins, problèmes et possibilités de la population concernée, de façon à permettre aux ONG de formuler des projets concrets qui s'attaquent aux problèmes réels et qui soient adaptés au contexte local. Les connaissances indigènes doivent jouer un rôle important dans ce processus.

- Les fonds pour les études préliminaires sont quasiment inexistants; les agences de financement devraient subventionner les ONG pour exécuter de telles études.

- Le séminaire recommande la participation des CCA-ONG à la prochaine table ronde qui réunira es bailleurs de fonds du secteur forestier de façon à mettre en valeur le rôle que pourraient jouer les ONG dans la mise au point et l'exécution du Plan National de Lutte contre la Désertification et du Plan d'Action des Forêts Tropicales.

- Par ailleurs, les ONG maliennes n'ont qu'une capacité assez limitée de définition des problèmes, tant à cause d'un manque d'expérience des méthodologies d'intervention en participation telle l'Evaluation Rurale Rapide, que de l'absence de fonds pour cette phase du cycle des projets (les organismes de financement préférant avancer des fonds pour des réalisations concrètes: nombre d'arbres plantés etc..- plutôt que pour des études préliminaires précises, pourtant bien nécessaires).