

# **SUPPLY RESPONSE WITHIN A FARMING SYSTEM CONTEXT**

## **WEEK 3: DAY 5**

### **THE IMPACT OF AGRICULTURAL PRICE POLICY ON FOOD AND EXPORT CROP PRODUCTION IN CAMEROON: A FARMING SYSTEMS BASED ANALYSIS**

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#### **CONTENTS**

1. THE FARMING SYSTEMS APPROACH AND ITS ADVANTAGES
2. ROLE OF THE AGRICULTURAL EXPORT- AND FOOD SECTOR IN CAMEROON
  - 2.1. Cameroon's Agro-Ecological Zones
  - 2.2. Demographic Development
  - 2.3. The Agricultural Sector in Cameroon
3. CHARACTERISATION AND CONSTRAINTS OF THE SURVEYED PRODUCTION SYSTEMS
  - 3.1. Cotton based farming systems
  - 3.2. Coffee based Farming systems
  - 3.3. Cocoa based farming systems
  - 3.4. Comparison between the farming systems
4. METHODOLOGY OF THE STUDY
  - 4.1. Farm surveys
  - 4.2. Data preparation and analysis
  - 4.3. Farm-Modelling
  - 4.4. Development of different scenarios
5. IMPACT OF AGRICULTURAL PRICE POLICY
  - 5.1. Short-term Price Impact on Production
  - 5.2. Longer-Term Development Perspectives

## **6. AGRICULTURAL PRICE POLICY, LINKAGES TO OTHER POLICY INSTRUMENTS AND FURTHER RESEARCH NEEDS**

- 6.1. Priority Setting in Agricultural Research Policy
- 6.2. Agricultural Finance
- 6.3. Agricultural Inputs and Services for Women
- 6.4 . Environmental Issues
- 6.5. Rural Development Activities
- 6.6. Liberalisation and Agricultural Services

## **REFERENCES**

### **LIST OF TABLES**

- Table 1. Basic demographic data for Cameroon
- Table 2. Agriculture in the Cameroonian Economy
- Table 3. Relative importance of agricultural production for the farm cash income
- Table 4. Food crop production in Cameroon
- Table 5. Cotton production in the northern region of Cameroon
- Table 6. Arabica and Robusta coffee production in Cameroon
- Table 7. Importance of cocoa production in Cameroon
- Table 8. Comparison between different export crop based farming systems
- Table 9. Comparison of the farm resources in the different farming systems
- Table 10. Sample Size for the Agricultural Price Policy Analysis in Cameroon

### **LIST OF FIGURES**

- Figure 1. Cameroon's climatic zones
- Figure 2. Traditional agricultural export crop areas in Cameroon
- Figure 3. Share of different commodities on total exports in Cameroon
- Figure 4. Share of agricultural exports commodities in Cameroon
- Figure 5. Development of food production per capita in Cameroon
- Figure 6. Location of survey areas

## 1. THE FARMING SYSTEMS APPROACH AND ITS ADVANTAGES

With the decline in oil revenues, Cameroon's economy faces an adjustment process in which the importance of agriculture as a source of foreign exchange and as a supplier of food and employment has increased considerably. An accelerated development of agriculture requires addressing, inter alia, the issue of agricultural prices. The traditional agricultural export sub-sector, especially coffee and cocoa, as a result of heavy taxation performed poorly during the last two decades<sup>1</sup>. Overaged coffee and cocoa plantations, inadequate investments as well as low levels of use of modern inputs are generally held responsible for this decline in production. Various institutions involved in the policy dialogue with Cameroon have demanded a reduction in traditional export crop taxation with a resulting rise in producer prices.

The effects of raising export prices are far from being clear. Traditional export crops are being grown largely by small family farms. They are part of an integrated household-farming system, with close linkages between export and food crop production through the common use of resources, such as land, labour and modern inputs. Depending on the ease of substituting production factors between export and food crop production, the effect of raising prices on both sub-sectors are different.

Thus, where resources can easily be switched between export and food crops, a rise in export prices for producers leads to a shift of resources from food to export production. Lower food supply and rising food prices result, as food crop prices are not controlled by the Government. Productivity raising innovations, on the other hand, dampen possible food price increases.

These interdependencies are, however, not generally valid. Other factors complicate the competitive relationships between the traditional export and food crop sub-sectors. These include, first, the traditional division of labour between men and women. Women are responsible for food crops, while men still deal with traditional export crops. The degree to which this separation of responsibilities exists differs by region. In fairly remote areas, the traditional division of labour still prevails while in other areas, particularly those with better access to urban centres, men are also observed to enter the food sector and women, the traditional export crop sector. Thus, the possibility of shifting resources between food and traditional export crops differ. Of importance are also specific ecological constraints, additional availability of land and labour, technological innovations and cropping pattern requirements.

These factors, that determine farmers reactions to policy changes, cannot be captured in a macroeconomic approach to policy analysis. Here, the microeconomic approach has significant advantages. It is based on farming system research (FSR) which is a scientific method that focuses on farmers' circumstances and seeks to integrate farmers into the research process. It adopts a farmer-oriented and problem-solving approach to agricultural research. Advantages of the FSR method are:

- the system perspective instead of a reductionist, partial approach,
- the emphasis on the farm-household that facilitates a bottom-up view of development,

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<sup>1</sup> In the 80s the taxation has been estimated to be up to 85% for Cocoa, 74% for Arabica and 80% for Robusta.

- a problem-solving methodology that attempts to raise the living conditions of rural inhabitants rather than simply solving a specific technical problem or achieving an isolated production target,
- integration of interdisciplinary work methods that combines a range of disciplines including the social sciences.

The main objective of the study is to analyse the economic impact of agricultural price policy on the production of traditional export and food crops at the micro level. More specifically, this case study attempts:

- to describe and model the typical cocoa, coffee and cotton based farming systems,
- to analyse the factors determining the production of cocoa, coffee, cotton and food crops,
- to evaluate the effect of the introduction of innovations on the production of cocoa, coffee, cotton and food crops, on farm income, farm resource management and the risk behaviour,
- to identify under which conditions agricultural price policy can encourage farmers in the long run to increase traditional export crop production without reducing the supply of food crop production.

## **2. ROLE OF THE AGRICULTURAL EXPORT- AND FOOD SECTOR IN CAMEROON**

### **2.1. Cameroon's Agro-Ecological Zones**

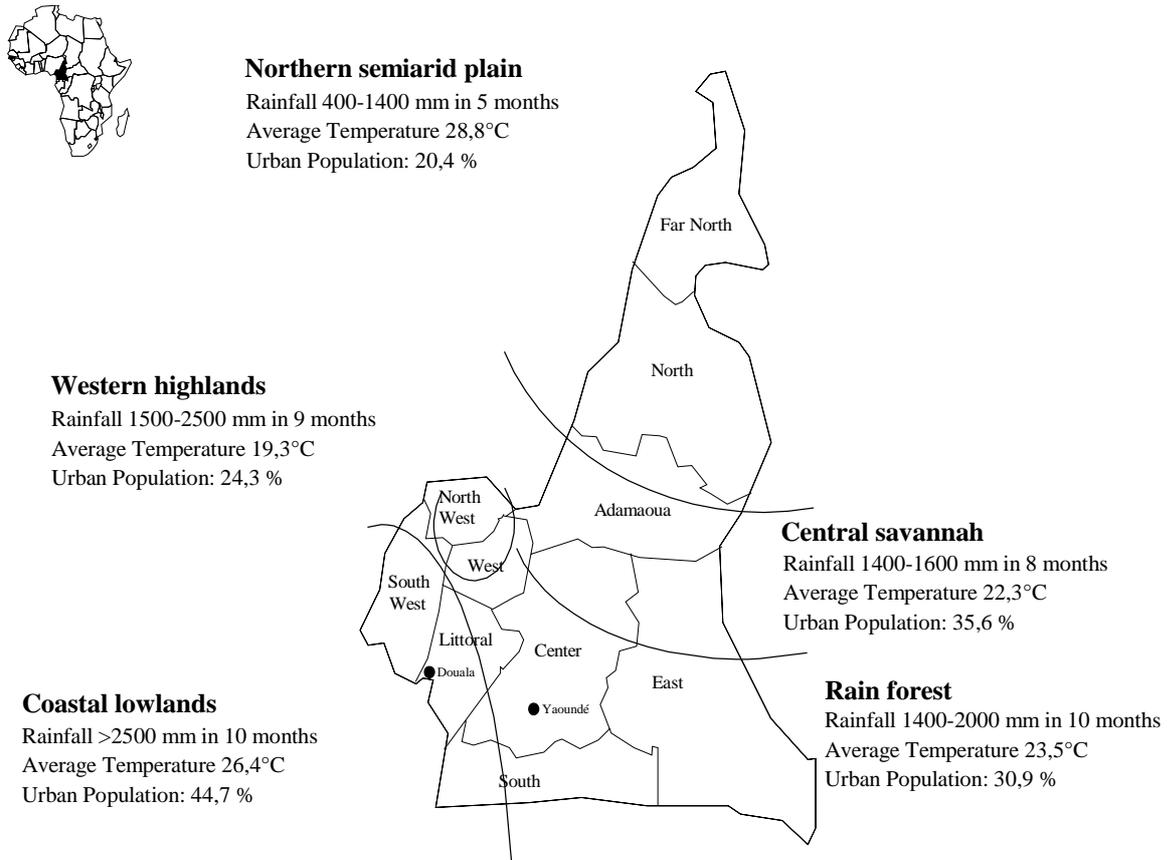
The Republic of Cameroon is known for its diverse countryside, the wide range of climatic zones, ecological conditions, natural resources and ethnic groups and their traditions. Cameroon is located in Central-Africa and shares the border with Nigeria, Chad, Central African Republic, Gabon, and Equatorial Guinea. Cameroon's eco-climatic zones range from tropical rain forests in the south, to mountain chains in the west, and Sahelian plains in the north. Five major regions can be distinguished based on climatic conditions: the semiarid northern plain, the sparsely populated Adamaoua plateau, the densely populated and intensively used western highlands, the coastal lowlands, and the humid rain forest in the southern part of Cameroon.

The agricultural production patterns follow the specific climatic conditions in each region, consisting of a traditional export crop and several key food crops. The main production systems are:

1. Cotton production combined with millet, sorghum, and livestock activities in the northern semiarid plain.
2. Cocoa production combined with cassava, plantain, cocoyam in the southern part of the rain forest area and the western and coastal lowlands.
3. Arabica coffee production combined with maize, cocoyam, plantain, beans, yams, Irish potatoes, and livestock activities in the western highlands.
4. Robusta coffee production combined with cassava, plantain, cocoyam in the northern part of the rain forest area and the western and coastal lowlands (see figure 1 and 2).

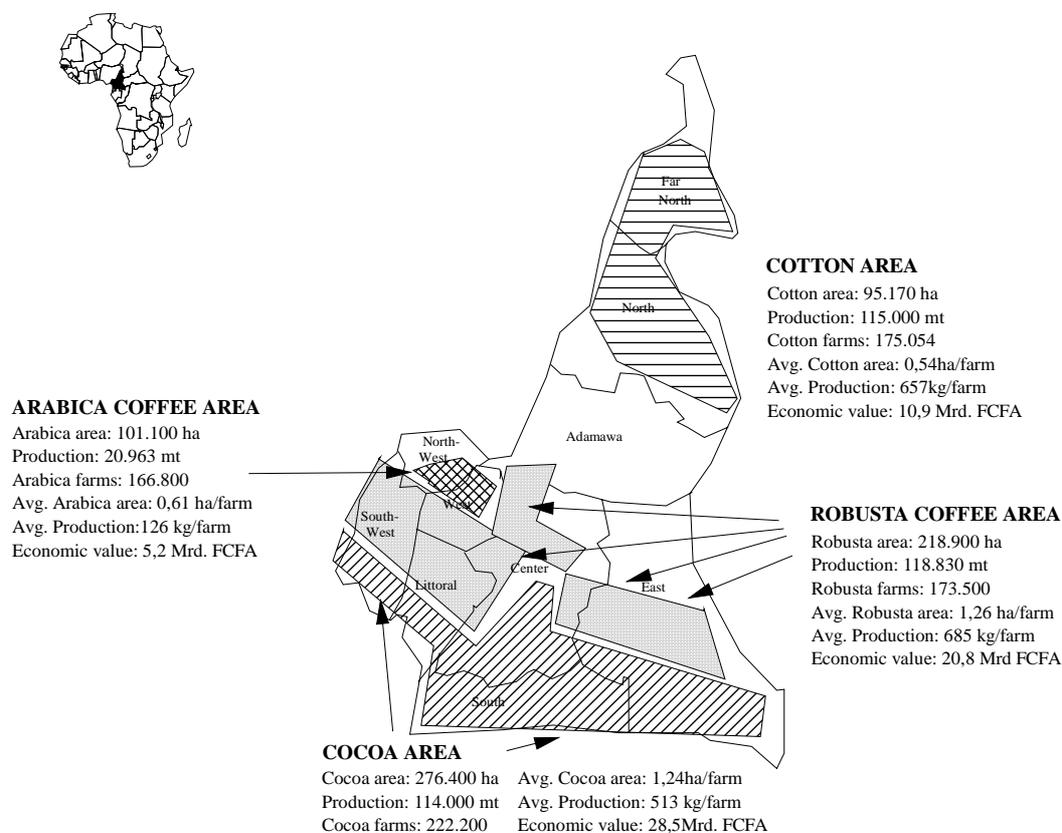
The Adamaoua plateau, a central savannah region, consists mostly of tree savannah and grassland, and is used for ruminant production and does not offer suitable conditions for any of the traditional export crop production.

Figure 1. Cameroon's climatic zones



Source: Eurostat, 1993; MINPAT, 1990; compiled by Author.

Figure 2. Traditional agricultural export crop areas in Cameroon



Source: Ministry of Agriculture, 1987; compiled by Author.

## 2.2. Demographic Development

Cameroon's population has more than doubled since the country's independence in 1960 (see table 1). By the year 2000, it is expected to increase up to 15 million<sup>2</sup>. The high population growth represents a heavy burden for the country in terms of unemployment and social services such as health system, education system, etc. The population is very unevenly distributed. The Far North, West and North-West Provinces have relatively high population densities (200-400 inhabitants per km<sup>2</sup>) while the North, Adamaoua and Eastern provinces are nearly empty (5-50 inhabitants per km<sup>2</sup>).

The importance of the rural population is declining, but it is still the dominant proportion of the country's society. For the Cameroonian labor force agriculture is still the most important sector of the economy. But the economically active labor force does not grow at the same pace as population, which implies an increase in the dependent population, mostly children. Altogether, much will depend on the country's capability to reinforce the agricultural sector to assure the food supply for the immensely growing population.

Table 1. Basic demographic data for Cameroon

	1961	1976	1992
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Total population	5.401.000	7.735.000	12.198.000
Annual population growth rate (%)	2,24	2,62	3,20
Share of rural population (%)	85,80	79,0	66,10
Total labour force <sup>1</sup>	2584000	3295000	4389000
Annual growth of labour force (%)	1,51	1,63	2,42

<sup>1</sup> Economically active population between 15 and 55 years

Source: FAO Yearbook, 1993.

## 2.3. The Agricultural Sector in Cameroon

Up to the mid 1980s, Cameroon's economy performed successfully with very high growth rates up to 10 percent. From the 1960's to 1978, the agricultural sector was the engine of economic growth. The traditional export crops, coffee, cocoa and cotton were the most important source of state revenue. In 1977, when Cameroon became an oil exporting country the importance of agriculture in the economy declined. Since 1985, the overall economic growth slowed down as a result of falling export commodity prices (petrol and traditional export crops) and the overvaluation of CFA Franc to the US Dollar. The severe financial and economic crisis forced the government of Cameroon to accept an economic adjustment plan in 1989.

### 2.3.1. Importance of the Agricultural Sector

Cameroon's economy is still fundamentally based on agriculture. However, structural problems have limited the overall development of the sector. The annual growth rate of agriculture which averaged 7.3% between 1976 and 1985 tended, in the late 1980s, toward stagnation mostly because of the decline of export crop production. Between 1986 and 1990 agriculture contributed still 26.3% to the gross national product (GNP), and agricultural exports accounted for 41.1% of total national exports. Agriculture provides employment to nearly three-quarter of the working population, and contributes between 10% and 20% to state revenue. Cameroon's annual population growth of 3.2% on average, is significantly higher than the average annual growth rate of agricultural production. This implies that food self-sufficiency is declining and food supply has to be assured increasingly by imports. Agricultural GNP has been growing at a rate lower than total GNP. The poor performance of the agricultural sector in the 1980s is a result of stagnating export production and unfavourable prices<sup>3</sup>. Average GNP per capita in the agricultural sector accounts for only a quarter of average GNP per capita. This explains why the agricultural sector has a poor reputation as income source, and can not attract skilled workers while migration from rural areas to urban areas is high.

Table 2. Agriculture in the Cameroonian Economy

	1970-75	1976-85	1986-90
Share of GNP (%)	34,10	29,0	26,30
Share of exports (%)	90,60	56,80	41,10
GNP growth rate p.a. (%)	4,1	9,70	-2,40
GNP growth rate from agriculture p.a. (%)	4,90	7,30	0,70

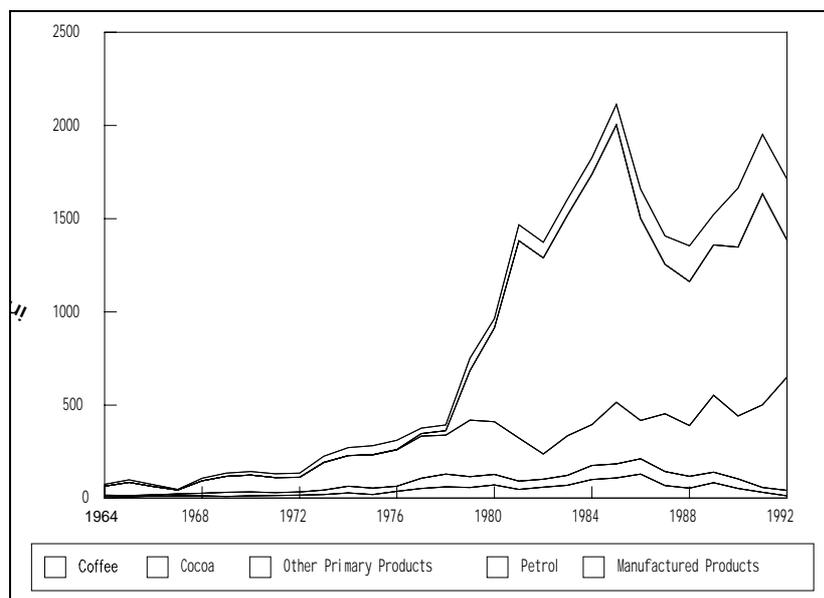
<sup>3</sup>WORLD BANK, 1989. Cameroon Agricultural Sector Review, Occidental and Central Africa Department, p.4.

Share of employment in agriculture (%)	79,90	75,40	70,50
Average GNP per capita (in US-\$)	222,00	693,00	954,00
Average GNP per capita in agriculture (in US-\$)	76,00	192,00	252,00

Source: World Bank, World Bank Tables, 1992.

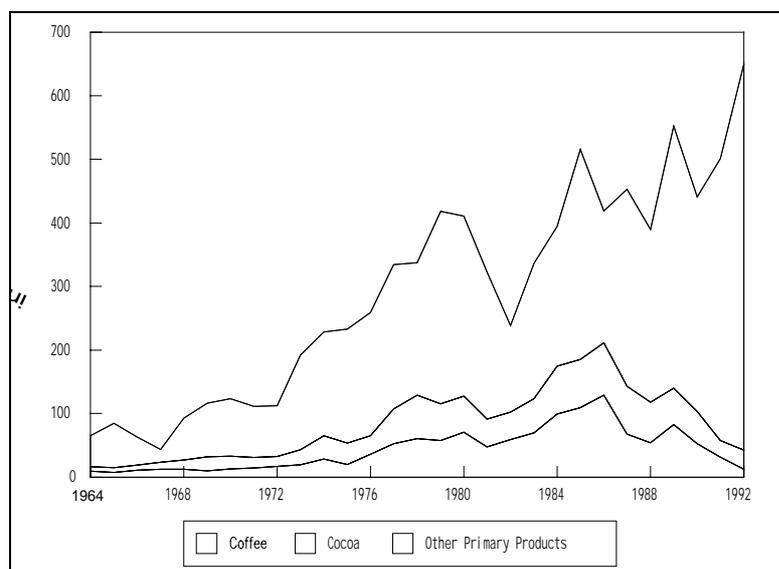
The performance of the traditional export crops has varied over the last 20 years. Cotton and Robusta coffee production showed a significant increase, while cocoa and Arabica coffee production declined. Production of other agricultural export commodities such as rubber, palm oil, and tropical fruits have significantly increased as a result of public investment in these sectors. Exploitation of forest resources has also accelerated contributing to increased primary export revenues. The development of export revenues is shown in figures 3 and 4.

Figure 3. Share of different commodities on total exports in Cameroon



Source: SOFRECO, 1992.

Figure 4. Share of agricultural exports commodities in Cameroon



Source: SOFRECO, 1992.

### 2.3.2. Agricultural Production

In Cameroon, traditional export and food crops are part of an integrated household-farming system, where both activities are simultaneously practiced. Agricultural production is mainly based on small scale farms which generally depend on household labour. Priority is given to sufficient production of food for household consumption. Export crops play an important role for the integration of rural households into the market economy. In 1984, export crops were one of the main sources of cash income for more than 718,000 rural households in Cameroon. That means, more than two thirds of all farms in Cameroon cultivated export crops (see Table 3). In the North, West, Centre, West, Littoral, East and South-West provinces, agricultural activity is dominated by export crop production. For the whole country, the contribution of export crops to average farm cash income varies between 13% to 81.7%. Food crop production generates another important part of farm revenues. Income from animal husbandry is of considerable importance only in the northern part of Cameroon. Export crop production is necessary for agricultural income generation and export crop price changes have a significant impact on farmers' income.

Table 3. Relative importance of agricultural production for the farm cash income

Province	Total number of farms	Export crop growing farms	% of all farms	Average farm cash income <sup>a</sup> (FCFA)	% Total export crops	cash from food crops	income from live-stock
Far North	268,500	87,200	32.5%	53,000	26.30	26.50	47.30
North	96,700	49,200	50.9%	108,000	60.0	27.70	12.20
Adamaoua	53,900	3,700	6.9%	167,000	13.0	68.30	18.70
Centre	162,000	133,500	82.4%	229,000	59.30	39.0	1.70
East	66,700	49,200	73.8%	253,000	57.60	40.50	1.90
South	55,000	47,900	87.1%	195,000	76.90	21.40	1.70
Littoral	64,000	50,100	78.3%	349,000	81.70	17.30	1.0
North-West	131,200	100,400	76.5%	226,000	19.10	64.80	16.0
South-West	73,500	53,700	73.1%	464,000	50.90	47.0	2.0
West	158,700	143,200	90.2%	130,000	61.70	35.0	3.30
TOTAL <sup>b</sup>	1,130,200	718,100	63.5%	180,000	51.20	40.30	8.50

<sup>a</sup> Average farm cash income for all farms in the respective province;

<sup>b</sup> for all farms in the respective provinces

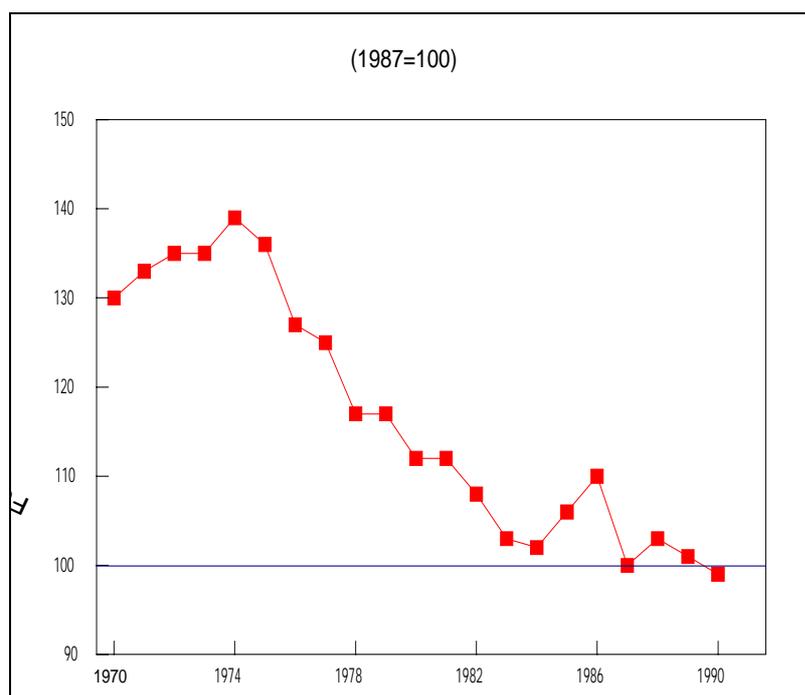
Source: Ministry of Agriculture, 1986, p.14 and 254f.

Food crop production for self-sufficiency has the highest priority in practically all farming systems in Cameroon<sup>4</sup>. In the 70's and 80's growth of food production had been recognised to be still sufficient to keep pace with the demand of the growing population and generally providing satisfactory nutrition level<sup>5</sup>. The indicator of this sufficient growth is largely the relatively stable food prices. However, the agricultural data about the food crop production in

<sup>5</sup>Heidhues, Franz and G. Weinschenck, 1986. Rural Finance Sector Study-Cameroon, p. 85; World Bank, 1989. op. cit., p.5.

Cameroon is not entirely reliable, because of the high amount of non-commercialised products used for household consumption and the diversity of markets without statistical data.

Figure 5. Development of food production per capita in Cameroon



Source: World Tables, 1992.

The main food crops in the southern part of the country are, tubers as cassava, yams, and potatoes and maize and plantain, whereas those in the northern regions are, sorghum, millet and rice. An analysis of national food crop production data for the 1971 to 1990 period indicates that the development of food crop production is heterogeneous (see table 4). As already mentioned, the time-series database on food crop production is poor. While some data show that food crop production per capita reached its peak in mid-1970s', and since then declined (see figure 5), others indicate that it is not clear whether food production matches population growth or not. However, imports of food have been increasing. The imports of cereals (rice, wheat and maize) expanded by more than 200% partly as a result of lack of local production and also, partly encouraged by an overvalued FCFA.

Table 4. Food crop production in Cameroon

Crop	Period	Growth Rate	Production (1000 mt.)	Area <sup>a</sup> (1000 ha)
Cassava	1971-90	3.60	1435.20	94.50
Plantain	1971-90	0.70	1079.30	63.60
Maize	1971-90	-1.60	366.80	191.0
Sorghum	1971-90	2.00	346.80	436.9
Potatoes	1971-90	-0.80	38.50	17.20
Rice	1971-90	8.90	16.40	6.70

<sup>a</sup> Production and area in 1990

Source: MINAGRI. Agricultural Census. 1991; FAO. Yearbook. 1992; F. Varlet. 1993.

### 3. CHARACTERISATION AND CONSTRAINTS OF THE SURVEYED PRODUCTION SYSTEMS

In Cameroon, eco-climatic zones range from tropical rain forests in the South to mountain chains in the West and Sahelian plains in the North. The diversified ecological conditions are reflected in the regional structure of agricultural production. Cotton, coffee and cocoa based farming systems represent nearly two third of all farms in Cameroon. These are dominated by traditional smallholders who need a careful analysis of their farming system such as to identify their potentials and limits.

### 3.1. Cotton based farming systems

Cotton production is located in the northern provinces. Table 5 shows the importance of cotton farms, their production, area and average cotton sales per farm. Cotton production is supported by the parastatal SODECOTON (Société de Développement du Coton), which provides inputs (seeds, fertiliser, and pesticides), short-term credits for the purchase of these inputs and extension services.

Table 5. Cotton production in the northern region of Cameroon

	Far North	North	Total
Number of cotton farms	81,105	52,829	133,934
Share of cotton farms in the specific area	51.2%	32.5%	41.2%
Total cotton area (ha)	45,821	44,076	89,897
Cotton area per farm (ha)	0.57	0.83	0.67
Total production (Mt.)	40,312	52,479	92,790
Avg. cotton yield (kg/ha)	879	1,193	1,029
Value of sales (1000 FCFA)	4,725,800	8,063,000	12,788,800
Value per farm (FCFA/farm)	57,477	151,402	94,000

Source: MINAGRI, 1985-1990.

In the northern provinces, cotton competes with sorghum, millet, maize, groundnuts, and cowpea. The cropping structure of cotton based farms in the different survey areas in the Northern and Far North provinces is based on an average of three to four crops. The surveyed farms have an average farm size of 4.4 hectares. This is very high compared to the average cultivated area per farm of 1.5 to 2.2 hectares in the northern region<sup>6</sup>. This can be partly explained by the use of ploughs in surveyed farms.

Four major cotton based farm types were identified in the northern region:

- farms with manual cropping of cotton and food crops,
- farms with hired animal traction for cotton and food production,
- farms with own animal traction for cotton and food production, and
- farms with tractor use for cotton and food production.

While cotton based farms with hired animal traction are rarely found today, tractors for cotton production are only used in the southern part of the North province. Both systems were excluded from the analysis, because there have not been sufficient observations to integrate them. The Far-North province was selected for the continuous surveying. Here, based on manual cropping and animal traction four main farm types were identified:

- farms with manual cropping of cotton and food crops,
- farms with one plough for cotton and food production,
- farms with two and more ploughs for cotton and food production, and

- farms with cotton, food and specialised onion production.

In the cotton based farming systems in the Far-North province, the household size varies from 7.5 to 13.3 with 3.4 to 7 active members. While the relation of active men and women is nearly one to one, men work two to three times more in agriculture than women. Distribution of agricultural household work has two main peaks, one during the seeding period after the first rain (May and June), and the other during harvesting of cotton and cereals (November).

The average cultivated area for manual cropping farms is 2.5 hectares. With integration of draught animals and ploughs the cultivated farm area increases to 4 to 5.6 hectares. This is due to the expansion of the cultivated cotton and food crop area, mainly for sorghum production.

Self-sufficiency is of highest importance for the farms in the northern regions and is ensured through cereals production. Surplus production is mainly destined for local markets. Cereals are sold only in small quantities on the market mainly because of yield uncertainty. Average total farm production increases with the use of animal traction through expansion of the total cropping area. Commercialisation of food crops does not significantly vary for the different farm types, because household size is strongly related to food crop production.

Cotton was found to be the major cash crop in the majority of the surveyed cotton based farm types. Only in cotton farms with specialised onion production, the importance of cotton for the total agricultural cash income is reduced because of the high returns from onion sales. Sales of animals contribute around 2% to 20% to farm cash income, while sales of food crops account for only 7% to 14%. Income from off-farm activities represents 12% to 36% of all household cash income for the respective farm types. These are mainly seasonal activities in the dry period, when there are no agricultural activities. Only in cotton farms with onion production, irrigation via motor-pumps allow agricultural activities also during the dry season. The average cash income from agricultural activities varies from 78,000 FCFA to nearly 700,000 FCFA for cotton based farms. In the northern region, the average regional cash income for all farms is estimated at 79,000 FCFA<sup>7</sup>. The higher average cash income of cotton

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<sup>7</sup>MINAGRI, Agricultural Census, 1984 . The aggregation issue is extensively discussed in DAY (1963), WEINSCHENCK (1967) and HAZEL and NORTON (1986).

based farms with animal traction or specialised vegetable production as onions, demonstrates the potential for farm development.

Total variable costs of purchased inputs and the use of hired labour is significantly related to cultivated farm size. Inputs for cotton production are fertiliser and pesticides from SODECOTON. Food crop production utilises negligible amount of purchased inputs (seeds and fertiliser). By contrast, modern vegetable production, such as onion cultivation, requires a very high amount of modern inputs (seeds, fertiliser, pesticides, transport), thus increasing costs up to nearly 250,000 FCFA. Inputs for livestock activities (purchased animal feed and medical treatment) account for nearly half of all variable cost except in cotton farms with modern vegetable production. Draught animals have to be physically in good condition at the beginning of the rainy season when they are needed for ploughing. Therefore, farmers purchase straw and concentrated feed (cotton seed cake). Use of hired labour is the highest during weeding and harvesting period in cotton production.

The productivity of farm resources in the surveyed cotton based farms differ according the production technique in use. Cropping with only manual techniques as hand hoes, has the lowest land and labour productivity. Given the same level of land productivity, farms with animal traction nearly double their labour productivity compared to manual cropping farms. Cotton based farms with specialised onion production have the highest labour and land productivity.

Main constraints for the cotton based farms are the yield uncertainty due to the high variability of amount and distribution of annual rainfall, the household labour shortage during seeding and harvesting and the marketing limits of modern food crops as onions.

### 3.2. Coffee based Farming systems

In Cameroon, both Arabica and Robusta coffee are cultivated. Coffee is a main source of cash income for nearly 400,000 rural households in Cameroon.

Table 6. Arabica and Robusta coffee production in Cameroon

	Arabica	Robusta
Number of coffee farms	184,402	215,164
Share of coffee farms	59.50%	33.27%
Total coffee area (ha)	87,967	157,605
Coffee area per farm (ha)	0.48	0.74
Total production (Mt.)	29,791	111,535
Avg. coffee yield (kg/ha)	329.00	736.00
Value of sales (1000 FCFA)	5,660,000	11,664,809
Value per farm (FCFA/farm)	30,129	54,214

Source: MINAGRI, 1985-1990.

Due to favourable climatic conditions, Arabica coffee production is concentrated in the West and North-West provinces, covering only 6 per cent of the country's land area, but inhabited by 30 per cent of the total population. The main characteristic of Arabica production is the intensive mixed cultivation with a variety of food crops. Three main zones for the Arabica coffee production can be distinguished: the Bamileke plateau, the Grasslands, and the

Bamoun plateau. They represent relatively densely populated (150 to 400 inhabitants per km<sup>2</sup>) rural areas with close linkages to local urban areas.

Robusta coffee production is spread like a belt over the whole southern part of the country. The two main areas of Robusta production are, the Mounjo basin in the Littoral, West and the South-West provinces and the area of the Haut-Nyong Division in the East province. In 1984, the share of the two areas accounted for more than 74% of the total Robusta production. The main characteristic of the Robusta coffee plantations is that they are rarely inter-cropped with food crops. Land close to villages or along the major roads is most often reserved for coffee plantations, whereas food crops are cultivated farther away in the forest. Population density is relatively low: in the rural areas of the Mounjo basin, it is less than 80 inhabitants per km<sup>2</sup> and in the East province coffee areas less than 30 inhabitants per km<sup>2</sup>.

Arabica coffee farms were differentiated into four farm types by the degree of specialisation in agricultural activities and the importance of off-farm activities:

- a farming system, consisting of mixed-cropped Arabica coffee and food crop plots, including traditional animal raising and palm wine tapping (58% of all surveyed farms),
- the system with dominant off-farm activities (18% of all surveyed farms),
- the system with modern animal husbandry (15% of all surveyed farms), and
- the system with intensive crop production (8% of all surveyed farms).

The observed Arabica coffee production does not vary significantly between the different farm types, but the relative importance of coffee production in each system is different. For traditional farm types, coffee represents the major cash income source, while for the other farm types, coffee has lost this position but is still essential for the overall functioning of the system. The structure of food crop production is relatively homogenous in all Arabica coffee based farming systems.

In Arabica coffee based farms, there exists a clear division of labour between the sexes. Men are responsible for coffee and plantain production and palm wine tapping, whereas women cultivate tubers, maize, beans and traditional vegetable. This limits the possible use of total household labour to the use of only the labour force responsible for the respective crop. The average household consists of a farmer, two wives and their children. Total average household labour force is 4.5 man-equivalents. Main constraints for the household are, the labour shortages during land preparation, first weeding (February/May) and coffee harvesting (November/December). Agricultural production technology is based on manual labour, hoes and machetes being the most important agricultural tools.

Average cultivated area is 2.3 hectares per farm, where 1.5 hectare represent a mixed cropping of coffee with food crops. Pure food crop area is limited to one quarter of the total available farm land. Land availability is a main constraint in the densely populated western highlands. Furthermore, the Arabica coffee plantations are relatively old, and as a consequence, productivity of coffee plantations is relatively low. Commercialisation of food crops in the surveyed farms is relatively limited except for plantain sold by men. Nearly all farms raise animals for household consumption and special ceremonies. Modern animal husbandry consists of intensive poultry or pig production for the urban markets. Modern vegetables, as potatoes, cabbage, tomatoes, carrots, etc., are grown by the men in coffee based farms in sole cropping and with a high level of modern input use. Off-farm activities complete and balance household income of the farms. The large majority of coffee based farms depend

on agriculture as the main source of income, but off-farm activities by household members are common in all farms.

Agricultural inputs such as fertilisers or pesticides are mainly used for coffee and livestock production. Food crops are produced practically without purchased inputs, coffee being the main source of cash income for the farms (43.2%). Food production for household consumption is of highest importance in the coffee based farms. It is estimated to be on an average, the double of all agricultural cash incomes.

The typology of Robusta coffee farms is based on two elements: a) the intensity of the use of modern inputs in agricultural farm production in the Mounjo basin and b) the competition between coffee and cocoa production at farm level in the East Province. Robusta coffee plantations mainly determine the total farm size, while food crop area per household member is relatively constant. In the Mounjo basin chemical fertiliser and hired labour are the main inputs responsible for different levels of intensity in coffee production. One group of farmers have a higher intensity in coffee production. Compared to the majority group of farmers, they use more than three times the amount of fertiliser and more than six times the quantity of hired labour for coffee production. Robusta coffee farms with intensive production are larger than the farms with low level production. A reason for the difference can probably be that the farms with intensive production are situated on the most fertile land.

In the East Province, coffee and cocoa production was promoted by the parastatal ZAPI-Est (Zone d'Actions Prioritaires Intégrées de l'Est) between the '60s and '70s. 50 -90 per cent of all farms in this zone had mixed plantations of Robusta coffee and/or cocoa and food crops in 1984. Since 1986, input supply has become insecure (especially fertiliser for coffee and pesticides for cocoa production). The parastatal ZAPI-Est was responsible for distribution of inputs. As a result of insufficient input supply, coffee production became less intensive. Reduction of pesticides in cocoa production is not really feasible. As there is a high risk of total losses in cocoa production (e.g. attacks of black pod disease), farmers tend to abandon their cocoa plantations. More and more farmers have, therefore, started specialising in coffee production where disease control is not necessary.

Productivity of Robusta coffee and cocoa is relatively low. This is a result of the low degree of modern input use. Fertiliser use has been abandoned since 1986 when ZAPI provided it for the last time to farmers. A major constraint for the farms is the family labour. As hired labour use is rare and expensive, farm organisation is mainly determined by seasonal demand for family labour and its availability.

The productivity of farm resources in the surveyed Arabica coffee based farms differs according to the dominant farm activity. Highest labour and land productivity is seen in the system with modern vegetable production. Here, the modern vegetable production generates gross revenues that are three to four times higher than the coffee production. Lowest labour productivity on the other hand, is prevalent within the system with modern animal production because of high labour demand for livestock activities. Farms with dominant off-farm activities have the lowest land productivity. This can be partly explained by the fact that these households have external income which allows them to purchase food. Traditional Arabica coffee based farms have the highest capital productivity as a result of the low level of modern input use. A comparison between Arabica and Robusta coffee based farms shows that Arabica coffee based farms have, on an average, higher productivities of their farm resources. The productivity of farm resources in the surveyed Robusta coffee based farms indicates

(confirming other observations) that farms using higher level of inputs have higher labour and land productivity than farms with low levels of input use.

A major constraint in the coffee based farms is the shortage of available household labour during land preparation and weeding and during coffee harvest. Labour division in both, land constraint in the Arabica coffee based farms and market access in the Robusta coffee based farms are other important limitations. High risk of vegetable and modern husbandry production and marketing still hamper access for the majority of farmers.

### 3.3. Cocoa based farming systems

Cocoa production is located in the rain forest zone in Cameroon. In mainly two production zones, cocoa is of high importance: the Centre/South provinces, that represents the traditional production, and the South-West province where production increased significantly during the last 15 years. Table 7 indicates the main characteristics of the two zones.

Table 7. Importance of cocoa production in Cameroon

	South-West	Centre/South	Total
Number of cocoa farms	41,958	143,944	241,763
Share of cocoa farms in the specific area	57.09%	66.33%	45.00%
Total cocoa area (ha)	62,671	177,609	292,053
Cocoa area per farm (ha)	1.50	1.23	1.20
Total production (Mt.)	34,415	68,362	103,659
Avg. cocoa yield (kg/ha)	569.00	398.00	356.00
Value of sales (1000 FCFA)	12,895,000	22,381,600	39,472,000
Value per farm (FCFA/farm)	306,330	153,586	161,501

Source: MINAGRI, 1985-90.

The total area used by cocoa farms in the rain forest varies, on an average, between 4.4 and 8.6 hectares. The farm size is mainly determined by the size of the cocoa plantation, while average food crop area per active household member is nearly constant. In the South-West Province, the success of cocoa plantations results from the dynamics of pioneer farms induced by migrations from the West and North-West Province and Nigeria. Three periods can be differentiated: a first period in the 50's and 60's with an extension of the cocoa area as a result of share-cropping (Department Mémé). A second phase during 70's and 80's, when pioneers settled in the Department of Fako and created Farm-Enterprise units which were mainly based on the mobilisation of cheap Nigerian labour force. Finally, the actual period since 1985 when extension of enterprise farm units was stopped because of increasing population pressure.

A farm typology for cocoa based farms in the South-West province consist of four defined farm types:

- cocoa based family farms, based on family-household labour,
- cocoa based farm-enterprises, based on permanent hired labour mainly from Nigeria,
- cocoa based farm, called "intermediary system", consisting of a farm-enterprise unit with autonomous i.e. not related share-cropping system, and
- cocoa based farm with a share-cropping system.

Some food crops (e.g. plantain and cocoyam) are complementary to cocoa production mainly when cocoa plantations are created. During this process of creation of plantations, the labour productivity of food crop plots is high as a result of the initially high natural fertility of the forest land. Fully established cocoa plantations compete mainly with Robusta coffee, the other major export crop of the rain forest zone in Cameroon. Furthermore, it competes with the food crop production, mainly plantain, bananas, cassava, cocoyam, yam and maize. One part of the food crop production is determined by the dynamics of the extension of the cocoa plantations. The increase of food crop production within the cocoa plots initiated an extensification of the cocoa production leading to a reduction in the number of the homogenous plantations. This homogeneity is positively correlated with the sensibility of cocoa yields reacting to the use of chemical inputs (fungicides and insecticides).

The degree of commercialisation of food crop production is mainly a function of the distance to major markets, which determines the transportation costs to the major markets and of the farm resources. In the South-West province, the degree of commercialisation is relatively high. This has several reasons: the high demand of the Douala market, the relatively easy access to the South-West and the relatively abundant land, i.e. natural fertile resources.

Revenues from cocoa production are still the main cash income for the farm-households. The cash income ranges from 450,000 to more than one million FCFA per farm. This is the highest income level of smallholder farms in Cameroon. The share of cash income from the export crops range from 74 to 88%. As a result of structural problems such as, availability of inputs, especially pesticides, cocoa production was limited since the mid 80's. This caused a decline of cocoa production since 1985. The cocoa based farms searched to compensate the reduction of cocoa revenues. This search led to an augmentation of food crop production. The global increase of the food crop supply (cocoyam, plantain, cassava, and maize) partly explains the observed food crop price decline since 1985.

Main inputs for cocoa based farms are, fungicides and insecticides. Hired labour, occasional and permanent, is the other important variable cost for the farms. Purchase of inputs for food crop production are relatively unusual. The cocoa based farms have a high cost for drying cocoa in the South-West. While cocoa is dried without specific investments in the Centre/South province, it is dried in ovens in the South-West province because of the relatively high humidity. Cocoa based farms in this region show high investment cost for these ovens.

The comparison of cocoa based farms in the two main cocoa production areas shows the relatively higher productivity of the farm resources in the South-West area. This can be explained by the advantageous natural conditions of the South-West province, the relatively abundant labour and land resources.

### **3.4. Comparison between the farming systems**

Table 8 summarises the structure and economic performance of the different export crop based farming systems in Cameroon. In each system, the export crop is the main source of farm cash income. The land-man ratio is relatively small in the cotton and Arabica coffee systems as these are areas with high population density. It is relatively larger in the cocoa and Robusta coffee area, mostly less densely populated areas of tropical rain forest. The productivity of farm resources is higher in the southern Cameroon because of its higher

agriculture potential. The importance of off-farm income is relatively low, except in the Arabica coffee based system.

The best economic performance is shown by the cocoa based farming system in the South-West. This system has, on average, the highest net farm income and the highest labour productivity of all the export crop based systems. Highest land productivity can be found in the Arabica coffee based farms where natural conditions as well as the production technique are favourable to intensive agricultural production. The cotton based farms show the lowest farm income, labour and land productivity, mainly as a result of the extremely difficult production conditions.

Table 9 compares the situation of farm resources in the analysed farming systems. Each farming system consists of factors that are relatively scarce and others that are relatively abundant. Combined with the available innovations for export and food crop production, it describes the potential for agriculture of each of the respective systems.

Table 8. Comparison between different export crop based farming systems

	Cotton	Coffee			Cocoa	
		Arabica	Robusta	Robusta		
Province	Far-North	West	Littoral	East	South-West	Centre-South
Household Size	10.20	13.50	8.50	4.35	9.80	10.70
Avg. household labor force (ME)	4.75	4.50	3.10	2.12	4.10	2.50
Avg. cultivated farm size (ha)	3.90	2.3	3.70	3.91	7.7	4.90
Avg. export crop area (ha)	0.75	1.53	3.20	2.10	6.40	3.40
Share of export crop area (%)	20%	65%	86%	53%	83%	69%
Land-man ratio (hectare/man-equivalent)	0.82	0.51	1.20	1.84	1.88	1.09
Importance of export crop production for cash farm income (%)	57.2%	46.2%	81.2%	80.2%	83.1%	74.9%
Share of subsistence food crop production in gross farm revenue	68.2%	71.6%	38.9%	n.a.	25.0%	42.0%
Total variable cost (FCFA)	43250,00	93,441	81,922	n.a.	182,344	32,479
Net farm income (FCFA) <sup>1</sup>	102,211	317,036	230,574	n.a.	415,224	290,000
Estimated share of off-farm revenues for household income	22.0%	29.5%	10.5%	< 5.0%	0%	11.2%
Productivity of farm resources:						
- labour (FCFA/Man-day)	458	871	680	n.a.	1,021	591
- active household member (FCFA/ME)	21,518	82,291	74,140	n.a.	96,252	38,513
- cultivated land (FCFA/hectare)	38,343	136,186	61,982	n.a.	101,252	54,232
- capital (FCFA/working capital)	2.70	4.70	2.8	n.a.	4.28	8.10

Source: Survey Dschang, Hohenheim, Montpellier, 1991/92.

Table 9. Comparison of the farm resources in the different farming systems

	Cotton	Coffee	Coffee	Coffee	Cocoa	Cocoa
Factors		Arabica	Robusta Moungo	Robusta East	South-West	Centre-Sud
Land	abundant	scarce	abundant	abundant	abundant	scarce
Family labor	scarce	abundant	scarce	scarce	scarce	abundant
Hired labour	abundant	scarce	scarce	scarce	abundant	abundant
Capital	scarce, animal traction and hired labour	available, but off-farm invested	available, plantation, fertilizer and hired labour	scarce	available, plantation and cocoa ovens	available, but off-farm invested
Innovations for export crops	available: animal traction	none	limited: improved varieties	limited: improved varieties	limited: improved varieties	limited: improved varieties
Innovations for food crops	available: animal traction	limited: improved seeds	limited: improved seeds	limited: improved seeds	limited: improved seeds	limited: improved seeds

Source: Survey Dschang, Hohenheim, Montpellier, 1991/92.

## **4. METHODOLOGY OF THE STUDY**

The concept of Farming Systems (FS) emphasises the importance of understanding the whole farm household system, its constraints and potentials, and connects it with all other interlinked systems as well as the institutional and policy environment. The FS approach recognises that the system and the environment in which the small farmer operates is not only complex, but also, is influenced by many factors, both internal and external. Realistic and comprehensive improvements can only be identified by close examination of the farm households' overall situation including the interrelationships between resources, and ecological and socio-economic constraints.

### **4.1. Farm surveys**

Since no adequate secondary data sources were available to analyse agricultural production systems, farm level surveys were carried out to provide a sufficient data base. The surveys were conducted in two steps: 1), a one-time structural survey and 2), a continuous survey with a fortnightly recall period over one year. The samples were chosen from areas where the share of the specific export crop production in total export crop production was higher than 10%. The structural survey was carried out to establish farm typologies. It is based on a sample of 150 to 450 individual farm units per FS, in total 1,127 farms. It included, a onetime collection of such structural data as household composition and activities, type of land use, size and number of fields, number of plants, crops and trees, total export crop production, estimation of total food crop production, and principal characteristics of the use of inputs, husbandry activities, major family labour activities and hired labour use, commercialisation of food crops, and farmer's opinion on institutional issues. In the second phase, about 90 randomly selected farms for each respective system, totalling 279 farm-households in all regions were continuously surveyed during one year. In interviews held every two to three weeks, production related data such as, family and hired labour use, input use, harvested production, crops sold and their prices, and household related expenditures and revenues, were collected. Additional information was collected on farmer's opinion about product and input markets, their strategy concept for cropping patterns, mixed cropping, etc. Both genders were interviewed individually, as women often represent an independent decision unit. Farm plots were measured to assess land productivity. Furthermore, prices on local markets in the selected survey areas were collected monthly. The surveys were carried out between February 1991 and September 1992.

Table 10. Sample Size for the Agricultural Price Policy Analysis in Cameroon

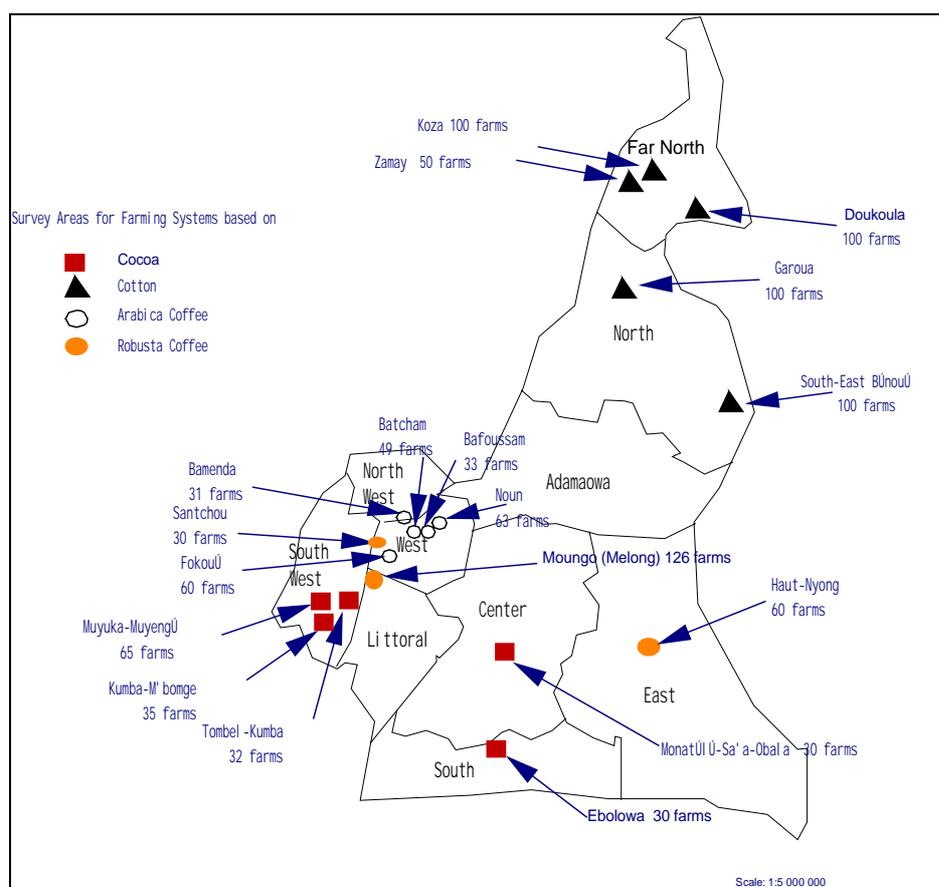
<b>COTTON based Farming System</b>	Province	Division	Survey sample		
			Structur al	Continuo us	Addition al
SOUTH-EAST-BENOUE (Touboro-Sorombéo- Madingrin)	North	Mayo Rey	100	--	30
GAROUA (Ngong-Djalengo- Hamakoussou)	North	Benoué	100	--	30
DOUKOULA (Karhay- Tchatibali- Taala)	Far- North	Mayo Danay	100	42	--
KOZA (Koza-Kolofata)	Far- North	Mayo Sava	100	41	--
ZAMAY (Mokong-Zamay-Mokolo)	Far- North	Mayo Tsanaga	50	13	--
<b>TOTAL</b>			<b>450</b>	<b>96</b>	<b>60</b>

<b>COFFEE based Farming System</b>	Province	Division	Survey sample	
			Structu ral	Continu ous
Batcham	West	Bamboutos	49	30
Fokoué. Fondonera	West	Ménoua	92	30
Santa	North-West	Mezam	31	
Bafoussam	West	Mifi	33	
Foumbot. Koutaba	West	Noun	64	
Nguelemendouka. Dimako	East	Haut-Nyong	60	
Melong	Littoral	Moungo	126	33
<b>TOTAL</b>			<b>455</b>	<b>93</b>

<b>COCOA based Farming System</b>	Province	Division	Survey sample	
			Structu ral	Continu ous
Muyuka-Muyengé	South-West	Fako	65	45
Kumba-M'bomge	South-West	Meme	35	24
Tombel-Kumba	South-West	Meme	32	21
Monatéle-Sa'a-Obala	Centre	Lékié	30	
Bafia-Mbangassina	Centre	M'bam	30	
Ebolowa-Ambam	South	Mvila. Ntem	30	
<b>TOTAL</b>			<b>222</b>	<b>90</b>

			Survey sample	
			Structur al	Continu ous
<b>TOTAL</b>			<b>1.127</b>	<b>279</b>

Figure 6. Location of survey areas



Source: compiled by Andrea Fadani 1995.

## 4.2. Data preparation and analysis

Within each of the surveyed farming systems, the analysis of the collected farm data started with a formulation and characterisation of farm types. Farm types were formed on the basis of different criteria in the three farming systems. Types of cotton based farms were differentiated according to the use of animal traction, types of cocoa and Robusta coffee based farms, by farm size and labour organisation and Arabica coffee based farms, according to the diversification of farm activities. The aim of categorising farms is to form homogeneous groups of farms that show similar reactions to changes in prices, technical parameters and the socio-economic environment. For each FS, the gross margin for individual cropping and livestock activities, whether for subsistence or for sale, were calculated. On this basis, farm activities within a farm and between different farms were compared. Farm and household income, including off-farm income was calculated and grouped by source into income from export and food crops, livestock, and off-farm activities. On this basis, the productivity of farm resources was established (net farm income per hectare, per man-equivalent, per man-day, and per unit of working capital).

## 4.3. Farm-Modelling

The analysis of the farm survey data provides the information for modelling typical export crop based FS that are used to derive the effects of price policy measures on production and income at the farm level, and especially to study the interdependencies between traditional export and food crops. The modelling of each FS is based on linear programming (LP). The

objective of the model is to maximise net farm income under the constraints of farm resources and the provision of minimum requirements of adequate food for household subsistence. Being based on a year survey and lacking time series data, risk factors, other than the minimum requirements for the household food consumption have not been considered. Off-farm activities were not integrated in the farm-household models, but its economic profitability was compared with the shadow price of labour resulting from the model.

The main source of the data base is the structural and continuous survey with secondary data completing the data sets. Data analysis is mainly concentrated on the identification of typical farms and farm enterprises, the calculation of technical and economic coefficients, factor endowment, identification of technical improvements and innovations, product and input prices, and socio-economic constraints within the respective FS. Mainly static comparative analysis with parametric variation, i.e. the systematic stepwise change of the model's coefficients to obtain a sequence of optimal solutions, is used to show the impact of export crop, food, and input price changes on farm organisation, labour economy, production and income. To test the impact of changes in the traditional gender specific division of labour, different labour allocations were analysed within the model. Also, policy changes under the Cameroonian structural adjustment programme, such as reduction of fertiliser and other input subsidies, devaluation and privatisation measures were analysed in different policy scenarios.

It should be emphasised that the micro based policy analysis approach has to face the aggregation problem. It implies that it is difficult to formulate policy conclusions on the basis of micro policy analysis. Generalisation at the macro level requires certain severe homogeneity conditions, endogenizing prices and resource and environmental constraints<sup>8</sup>. In reality these conditions are not fulfilled. Therefore, the results derived from FS based analysis cannot be used to derive quantitative assessments of impacts on macro aggregates, such as income, production, employment or exports. Nevertheless, the micro based approach is useful for indicating directions of change at the macro level and for analysing the impact of policy at farm/household level.

#### **4.4. Development of different scenarios**

Several scenarios have been developed to analyse possible and realistic agricultural policy changes and institutional requirements in Cameroon. In the scenario approach, various factors are simultaneously changed and their impacts on the farm production, the productivity of farm resources, farm income, etc. are analysed. The results from the scenarios were compared to a reference system, that is, the observed economic situation during the farm surveys in the agricultural year 1991/92. The following basic scenarios had been used for the analysis of the impact of agricultural price policy in the respective farming systems:

- 1) Actual economic situation: export prices decline with declining food prices, fertiliser and pesticides market are liberalised resulting in increasing input prices.
- 2) Adjustment related to international market prices: export prices are heavily reduced, food crop prices remain constant and input prices increase to world market level.
- 3) Medium term adjustment on the world markets: export prices increase and food crop prices remain constant and input prices increase to world market level.
- 4) Devaluation of the FCFA: export prices increase with constant food prices fertiliser and pesticides markets are liberalised and input prices increase to world market level.

## **5. IMPACT OF AGRICULTURAL PRICE POLICY**

The major implications derived from the three case-studies can be summarised under two headings: first, the impact of prices on production and second, the long-term development perspectives. In all three study areas, prices do show a significant but different impact on production of export and food crops. We will first look at the short-term impact (without taking into account the effect on investment) and then the long-term dynamic changes, particularly in the form of new investments in new plantations.

## 5.1. Short-term Price Impact on Production

### 5.1.1. Cotton

In the cotton areas, price reactions depend much on the system under which cotton is produced. Three production systems were analysed:

Cotton manual (C-M)

Cotton with draught animals (C-A)

Cotton with irrigated onion production (C-O)

*If cotton prices increase, we observe the following reactions:*

<i>in(C-M)</i>	<i>in(C-A)</i>	<i>in(C-O)</i>
<i>Cotton output only slightly increases. Food production, which is largely for subsistence, remains constant.</i>	<i>Output increases significantly more, mainly by area expansion, feasible because of draught animal power,</i>	<i>Increasing prices up to 200 FCFA/kg, cotton remains constant; above 200 FCFA/kg, cotton is becoming more competitive than onions and its production increases.</i>

Additional income is invested in animals husbandry.

*If cotton prices decrease or food prices increase:*

in(C-M)	in(C-A)	in (C-O)
Cotton output decreases slightly; food production increases.	Cotton remains stable or may even increase; food production increases. Explanation: (i) high fixed capital in form of animals, (ii) fixed income hypothesis	Cotton may drop out entirely; onion production expands.

### **Policy Conclusions**

The policy conclusions derived are as follows:

- (i) Labour availability is a key constraint. Development of labour saving innovations is an important area of research and innovation policy,
- (ii) Institutional and marketing constraints are important in limiting additional food production, particularly in input supply, infrastructure, marketing and credit. Rural policies need to focus on these areas,
- (iii) There is a high preference for investing additional income in animals. This leads to overstocking causing environmental problems and calls for research in environmental protection, alternative investment possibilities, e.g. attractive savings facilities and innovative savings/investment programmes.

#### 5.1.2. Coffee

The study analysed the two coffee sub-systems, Arabica (A) and Robusta (R). (A) areas are characterised by high population density with little or no additional land available for crop area expansion, (R) areas are generally less densely populated with area expansion feasible. Within both (A) and (R) areas, we observe the expected reaction to relative price changes, although with some differences. Rising coffee prices lead to rising coffee output and vice versa. There is, however, a difference in the source of production increase:

In (A) areas, production increases are due mostly to higher productivity, i.e. higher fertiliser application and more labour input.

In (R) areas, production increases because of higher input use, as in (A), as well as reactivation of existing but neglected coffee fields and (in the longer term), an expansion of plantations.

The reaction of food crop production is determined, to a significant extent, by the division of labour between men and women (men are responsible mainly for export crops while women focus predominantly on food crops). Food production is home consumed to 90 % and only the remaining 10 % of the food produced is marketed. If food prices decrease, subsistence, i.e. 90 % of production, is maintained and only the marketed share decreases, but relatively little.

If food prices increase, production expansion is soon constrained by availability of inputs such as improved seeds, fertiliser, labour and credit. Women receive higher income with rising food prices, but they are limited in increasing production because of the input constraints.

### **Policy Conclusions**

The policy conclusions from the results synthesised above are the following:

- (i) Prices do have an effect on production in the expected direction, but the reactions are relatively modest because of institutional constraints, particularly for food crops where women carry the main responsibility.
- (ii) Productivity enhancing innovations, particularly in food crops, extension and agricultural credit are high priority areas for supporting production increase. These must be specifically oriented towards women.
- (iii) On-farm labour availability, particularly of women, is a dominant constraint. How the labour constraint can be mitigated, is an important research question.

### 5.1.3. Cocoa

*If cocoa prices increase relative to food crops, one observes:*

- (i) in the South West, a region with young plantations and high yield potential (800 kg/ha max.):

cocoa production increases

plantain production drops, root crops decrease slightly

- (ii) in the Centre and South provinces, a region with partly over-aged plantations and a lower yield potential (400 kg/ha max.):

cocoa production increases

food crops remain relatively constant.

Relative price increases for cocoa lead to a shift of resources into cocoa, resulting in higher production in both areas. However, productivity increasing innovations are important and may explain differences in price reactions.

*If food prices increase relative to cocoa one observes*

in the South West, food production increases but also cocoa production increases.

in the Centre and South, in principle the same reaction although weaker.

In other words, with increasing relative food prices we see a complementary, rather than a competitive relation between export and food crops. The explanation is as follows: with rising food prices, more fertiliser and pesticides are used for food crops, thus increasing their production and productivity. This has two effects: first, the subsistence of the household can be satisfied with less resources; second, the additional food produced will soon be hitting the constraints in infrastructure, markets and marketing. Thus, it does not make sense to produce more food crops than the marketing system can absorb. As a consequence, the free resources are devoted to cocoa production.

In addition, the relative weak reaction of food crops to rising (relative) food prices is also due to the gender distribution of responsibility as indicated earlier. Hence, although food crop prices rise, women cannot expand production as much as they would wish because of limited access to fertilisers and credit.

### **Policy Conclusions**

The policy conclusions are essentially the same as shown for coffee:

- (i) Productivity increasing innovations in food crops have an important and significant positive effect on food crop and export production at the same time (complementary relation). This points to a high priority in food crop research.
- (ii) Agricultural marketing and infrastructure deserve high priority in expanding food production.
- (iii) Agricultural services like input supply, agricultural credit and other extension services have to be oriented also specifically to those producing food, i.e. to women.

## **5.2. Longer-Term Development Perspectives**

### 5.2.1. Cotton Area

Of the three cotton growing regions in the north, the densely populated area of Mandara Mountains can expand food crop production mainly for its own consumption. The region bordering Nigeria "Plaine de Diamaré" has significant potential for exporting food to Nigeria. The less populated area of the Benoué Valley provides the largest potential for increased cotton production. In all three areas, labour availability at the farm level as well as infrastructure, input supply, marketing and credit are key constraints.

### 5.2.2. Arabica Coffee - (A)

Production expansion will require higher yields, as area is limited. Research in high yielding, cost-reducing and quality-improving varieties is a priority.

### 5.2.3. Robusta Coffee - (R) and Cocoa

Labour, infrastructure and institutional constraints are the major limiting factors. In the future, the major potential for expansion is in the Eastern Region. However, with liberalisation the risk of price fluctuations at the farm level will likely increase, and may hamper development. Labour is a key constraint in coffee as well as in cocoa expansion. So, migrating labour (from Nigeria) as well as labour saving technologies are likely to play an important role in future coffee and cocoa expansion. There exists a mobility of resources between export and food crop production. Therefore, with rising export crop prices resources will shift to export crop production (although some restrictions will remain because of gender division of labour). As a result, food crop prices will tend to rise, creating a balance at a higher general price level, unless productivity in food crop production increases. A key factor in the success of relative price increases for export crops will, therefore, be the capacity to generate productivity increasing innovations in food crops. Thus, one can conclude that high priority needs to be given to the research in food crop improvement, improvement in extension, input supply, credit and marketing for food crop production.

## **6. AGRICULTURAL PRICE POLICY, LINKAGES TO OTHER POLICY INSTRUMENTS AND FURTHER RESEARCH NEEDS**

### **6.1. Priority Setting in Agricultural Research Policy**

The present analysis shows that, without productivity increasing innovations in food crop production, neither food crops nor export crops can expect a sustained expansion in the long run. Improvements in food crops, therefore, have the highest priority in research and innovation development.

The study also shows that, at the farm level labour constitutes often an overriding constraint. It is vital for crop research to be aware of this constraint from the beginning. Innovations with significant additional labour demand, particularly during the peak labour demand season, will have little chance of acceptance by farmers. Agronomists and engineers tend to overlook socio-economic constraints. They need to understand that economic constraints can be as restrictive as technical ones, such as lack of water is for irrigation.

## **6.2. Agricultural Finance**

The three sub-studies show consistently that liquidity is a serious constraint (together with other factors, see section 3 below) in most production activities. The finance constraint is particularly apparent in food production activities. As women play a predominant role in food production, the following two factors reinforcing each other in constraining finance for food production:

- lack of credit for food crops per se, and
- lack of credit for women.

Therefore, it is of high priority to strengthen research in designing and testing innovative agricultural finance programmes for food crop production with access for women.

## **6.3. Agricultural Inputs and Services for Women**

The study found that - apart from credit - women face particular problems in access to extension, fertiliser, seeds, and other agricultural inputs and services. In view of the important role that women play, there is an urgent need for research and experimentation with innovative concepts in institutional design opening access to women in the areas listed.

## **6.4. Environmental Issues**

There is an increasing pressure on resources, particularly in the more densely populated areas, thus underlining the need for strengthening research in soil conservation and anti-erosion measures and their integration into sustainable production systems. This will require interdisciplinary research, bringing together soil scientists, agronomists, livestock researchers and economists.

A particular issue appeared in the northern area, where we observe a high preference for investing additional income from cotton or food crop production into the expansion of the animal herd resulting in some areas in serious overgrazing and environmental degradation. Research for those areas should be directed towards creating attractive alternative investment opportunities, i.e. attractive financial savings and investment schemes.

## **6.5. Rural Development Activities**

In all study areas, off-farm work plays an important role in securing employment and income for the household. Off-farm work promotes the use of modern inputs, stabilises income and food consumption. In addition, infrastructure is shown as important for input use and marketing in all areas studied. Thus, rural development activities are of vital importance to agricultural development, and research into the proper formulation of such programmes deserves priority.

## **6.6. Liberalisation and Agricultural Services**

With liberalisation and the reduction of government and parastatal enterprises in agricultural production and marketing, there are emerging gaps in agricultural services which are likely to hamper agricultural development. These include, particularly, the role of former parastatals in agricultural input and harvest financing. It is urgent for agricultural financing institutions to design schemes that can take on these functions on a broad scale.

There is also a need to define more clearly the role of the government vis-à-vis the private sector, particularly in setting a legal framework that is fair and enforceable and that guarantees free market access and effective competition.

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