OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.

DISCLAIMER

FAIR USE POLICY

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

19922

Distr.
LIMITED

ID/WG.529/2(SPEC.)
29 October 1992

ENGLISH
ORIGINAL: FRENCH

United Nations Industrial Development Organization

Preparatory Meeting on Animal Feed
and Related Industries in Africa

Bamako, Mali, 15-17 December 1992

DOMESTIC ANIMAL FEED INDUSTRY: SENEGAL

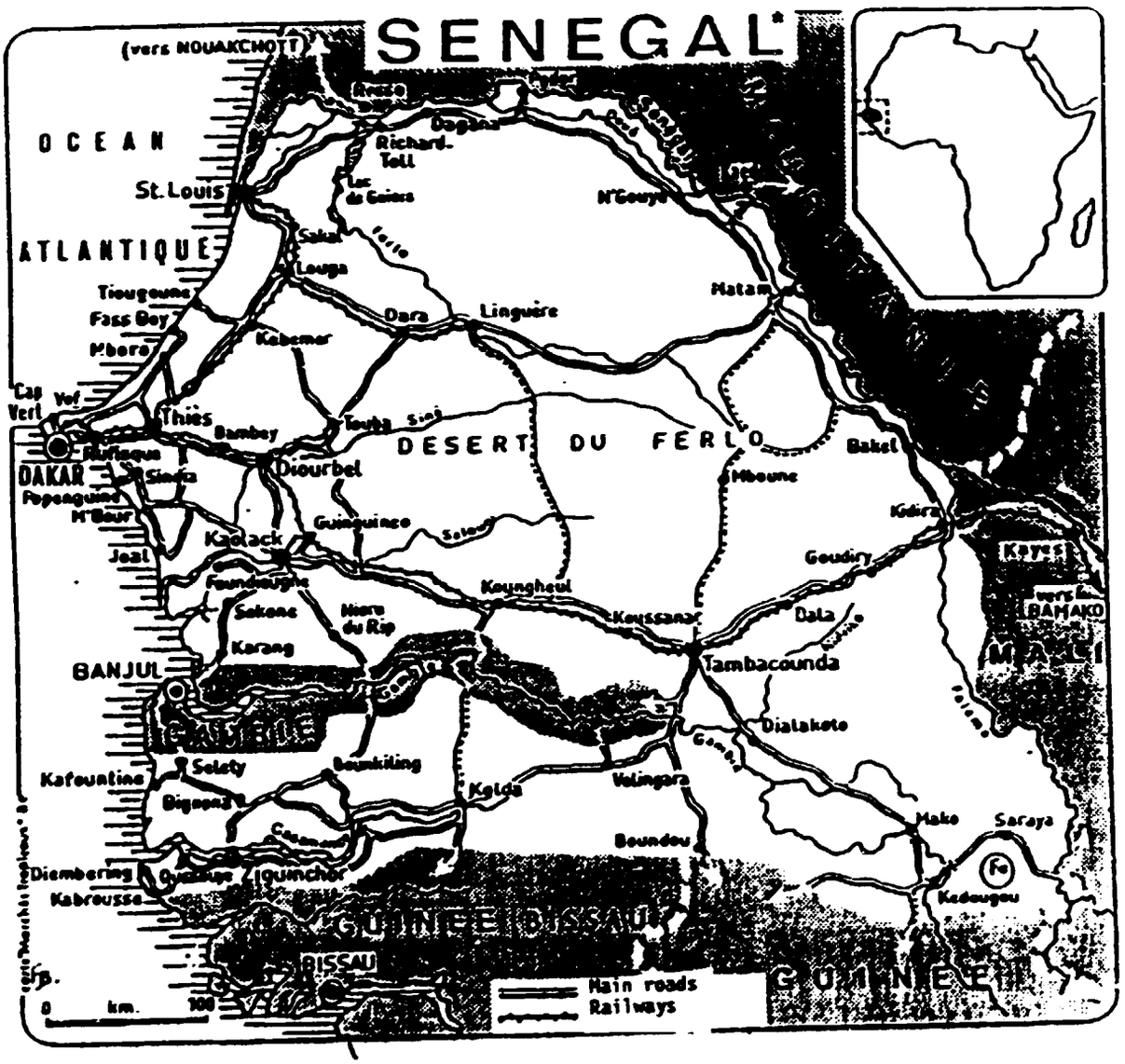
Background document*

Prepared by

Chérif Touré
UNIDO Consultant

* The views expressed in this paper are those of the author and do not necessarily reflect the views of the Secretariat of UNIDO. Mention of firm names and commercial products does not imply the endorsement of the United Nations Industrial Development Organization (UNIDO). This document is a translation of an unedited original.

V.92 57518 3894E



The boundaries shown on maps do not imply official endorsement or acceptance by the United Nations Industrial Development Organization (UNIDO).

CONTENTS

CONTENTS (continued)

CONTENTS (continued)

INTRODUCTION

The domestic animal feed industry in Senegal produces feedstuffs for poultry and livestock (cattle, sheep, goats, pigs and horses). Feeds for horses, pigs and goats are complex materials produced only in small quantities. Made-up feeds for dogs and cats are not produced in Senegal at all: demand is very slight because of the country's socio-economic circumstances.

The main areas of demand for domestic animal feed in Senegal are modern poultry farming (chickens, laying hens, breeding hens, ducks, turkeys, etc.) throughout the year and cattle and sheep in the dry season or while they are being fattened or kept indoors.

Poultry feed manufacture has developed since independence (1960), whereas the production of made-up ruminant feedstuffs did not expand until the 1970s drought. All these feeds depend on agro-industry by-products (cake, molasses and bran) from groundnut, sugar cane and wheat processing.

This study of the situation in Senegal focuses particularly on the made-up feed industry. It looks at fishmeal too, which is not a directly-consumed by-product. Simple feeds, the by-products of milling, oil-making, sugar-making, brewing and so on are considered more as inputs to the feed manufacturing process than as feedstuffs or finished products, in their own right.

We shall examine:

- The economics and structure of the domestic animal feed industry;
- The sectoral breakdown of raw material sources;
- The domestic animal feed production methods in current use.

Local constraints will be analysed and practical recommendations made regarding the development of the industry.

I. GENERAL DESCRIPTION OF THE ANIMAL FEED INDUSTRY

1.1. GENERAL CONTEXT

Senegal is located in the westernmost part of West Africa, in the Sahel region. It is bounded on the north by the Republic of Mauritania, on the south by Guinea Bissau and the Republic of Guinea, on the east by Mali and on the west by the Atlantic Ocean.

The country covers an area of 196,722 km^2. The population rose from 6,480,000 in 1985 (source: Ministry of Planning and Cooperation - seventh social and economic development plan) to 6,892,720 in 1988 (source: Office of the President of the Republic, Department of Planning and Economic Policy). It is now estimated at over 7,000,000, i.e. 35.5 people per square kilometre.

A priority sector in Senegal's social and economic development programme is self-reliance in food production. This implies self-reliance not only in agriculture, but also in livestock raising.

With an eye to achieving self-sufficiency in stock farming, the Government of Senegal has set a number of goals in its eighth social and economic development plan (1989-1995), including:

- Reasonable intensification of stock-breeding, involving in the first instance a stabilization of herds;
- An increase in productivity based on weight rather than numbers, with improved operating efficiency;
- An intensification of production utilizing agro-industry by-products and forage crops, through fattening, rebreeding and milk production;
- The development of small livestock enterprises, particularly poultry-keeping;
- Improved use of agricultural by-products grown with the help of irrigation (rice straw or straw from other cereals, flour- or rice-milling by-products, etc.).

In 1990, there were 2,454,596 cattle, 5,951,365 sheep and goats, 103,517 pigs, 370,035 horses, 302,920 donkeys, 5,191 camels and 11,635,350 poultry in Senegal.

The annual per capita consumption of animal products was 9 kg at the start of the sixth plan (1979-1985). It had risen to 11 kg by the time of the seventh plan (1985-1989) as a result of the government campaign to achieve a level of 12 kg per inhabitant.

Under the eighth social and economic development plan, the aim is to maintain the per capita figure of 11 kg, in view of population growth.

This will not be possible without greater efforts to boost productivity by increasing weight while stabilizing numbers. In other words, it will be necessary to discourage dependence solely on "free-range" animals and to promote fattening. Fattened animals currently account for only 25 per cent of animals slaughtered in abattoirs (14 per cent of the total number).

One way of encouraging fattening is to promote the animal feed industry. In Senegal this should be done by making the best possible use of by-products from the agro-food industry and of other local agricultural products.

Such an industry does exist in Senegal, but some of the largest production units regard this activity as a secondary one. They see it as a means of utilizing a by-product generated in their main activity.

1.2. MAIN PRODUCERS

The domestic animal feed industry in Senegal is concentrated mainly in the Dakar region. The bulk of the market is supplied by some ten production units. There are also a few isolated producers, operating on a small scale or on a semi-industrial basis, who satisfy the needs of their own clients and, on occasion, a rather small circle of customers.

1.2.1. Poultry feed producers

1.2.1.1. Moulins Sentenac (Sentenac Mills)

This société anonyme (public limited company) was established before 1960 in the Dakar industrial zone. It was the first to produce poultry feed and therefore enjoyed a long-lasting monopoly in this field in Senegal, along with SSEPPC, which is now bankrupt.

Poultry feed production is not the main activity of Moulins Sentenac, which is to produce flour from wheat, millet, etc. The company uses 20 per cent of the wheat bran left over from its main activity to produce poultry feed. The remainder is used for livestock feed.

To operate their production unit, Moulins Sentenac employ three skilled workers and about ten unskilled workers, who are assisted by a veterinary surgeon. This team is divided into two shifts, each working eight (8) hours.

The poultry feed production averages 500 tons a month. However, output may fluctuate upwards or downwards because of the age of the unit and also because demand increases at certain times of the year.

Moulins Sentenac work in close collaboration with a large French producer, Guyomarch, which takes samples periodically for analysis.

1.2.1.2. SEDIMA

Sénégalaise de Distribution de Matériel Avicole (SEDIMA) (Senegalese Distributors of Poultry Farming Equipment) is a groupement d'intérêt économique (common economic interest group) which was established in 1986 at Malika. In view of the rapid expansion of its activities, it is now considering conversion to a limited liability company. It is currently working in close collaboration with ETNA, a French partner with a feed analysis laboratory.

Since its establishment, SEDIMA has taken over a large share of the poultry feed distribution market. Its present production capacity is two tons an hour, but this could be improved with automation and better equipment maintenance. For the last year, SEDIMA has been importing maize

(6,000 tons/year), for use in feed manufacture at a rate of 300-500 tons per month. The technical staff comprises a veterinary surgeon, two ITA experts and an economist.

Four projects started by SEDIMA, which have already been approved by the "single window", are at the funding stage:

- Hatchery construction;
- Plant extension: addition of a mineral/vitamin compound (MVC) unit and the building of a storage warehouse;
- Hatchery extension;
- Integrated project:
  * Abattoir capable of dealing with 600-700 birds/hour;
  * Breeding flock;
  * Battery breeding of 40,000 laying hens.

1.2.1.3. SENDIS Avicole

SENDIS emerged from the cooperative merger of four large-scale breeders. It subsequently became an economic interest group which has been operating since 1987. It is located at Malika, in the suburbs of Dakar.

SENDIS employs 15 permanent staff, including a veterinary surgeon, as well as 13 casual day labourers. The total production capacity is 20 tons per day from two production lines:

- A small-scale line: capacity 5 tons/day;
- A semi-industrial but still very rudimentary line: capacity 15 tons/day.

1.2.1.4. Aliment Pousse Vite

Aliment Pousse Vite is an example of a plant run by a breeder to cover his own needs, with some sales, depending on demand, to a small circle of customers. It is based at Rufisque. The production line is small, old and very rudimentary. The production capacity is 4 tons per day.

1.2.1.5. Complexe Avicole de Mbao (Mbao Poultry Farming Complex)

Complexe Avicole de Mbao (CAM), initially set up by the State as an integral part of the livestock directorate, was completely privatized in May 1990. It is now controlled and managed by Jourdan International, a European group.

CAM is active at several levels in the poultry-breeding sector:

- Import of eggs for hatching;

- Operation of a hatchery with a capacity of 168,000 eggs yielding from 47,000 to 50,000 birds per week;

- Sale of chicks;

- Raising of a breeding flock with a 17-week rotation period;

- Production of poultry feed and MVC.

The manufacturing unit has a weekly production capacity of 80-100 tons poultry feed and 100 tons MVC.

CAM employs six permanent staff to operate the factory. The manufacturing technology (cf. technology section) and installation type are among the most modern, probably because they are the most recent, of all of the plants visited.

The plant absorbs 100-125 tons per month of imported maize which is in fact bought from local suppliers. The amount of maize used could well rise in future in response to increased demand and in view of the regular upward trend in feed production at the plant since it came into operation.

Production of MVC (of which there are three types, depending on whether the bird is for eating, breeding or laying) is appreciably above the forecast levels. However, a considerable part of the raw materials (coccidia control agent, synthesized amino acids, etc.) used in its production comes from abroad.

The plant's output is distributed through a small network of feed depots located in the major poultry-breeding areas of Senegal.

* * *

The feedstuffs for use in poultry farming were initially packed in plastic sacks, which were often collected and reused. This practice has two unfortunate consequences:

- The plastic sacks impoverish the feed's vitamin content during transport and during storage;

- The reuse of the sacks can cause epidemics and spread contamination from one poultry farm to another.

CAM introduced an innovation in product packaging by bringing in single-use paper sacks with labels and relevant information about the composition and properties of the feedstuff involved. A few producers still use plastic sacks, but all others have followed CAM's packaging example.

1.2.2. Livestock feed producers

The feedstuffs described here are produced on an industrial or semi-industrial scale. In actual fact, they are only used to supplement the animals' basic food intake, which may be forage or other feeds that provide the animals with the bulk constituents they require.

1.2.2.1. Moulins Sentenac (Sentenac Mills)

Moulins Sentenac, to whom we referred earlier, also produce livestock feeds. As in the case of poultry feed, the average monthly livestock feed output is 800 tons, rising to 2,000 tons at the peak period. As in all Sahel countries, the peak period coincides with the start of overwintering.

Livestock feed absorbs 80 per cent of the plant's wheat bran production. This by-product of its main activity is thus directly incorporated in the animal feed production process.

Some of the output used to be exported to Gambia and Mauritania (before the Senegal/Mauritania crisis of 1989). The rest is sold locally - mainly in Dakar (where it is produced). This raises the question of transport, for which the consumers in the interior of the country have to pay. For some time, Moulins Sentenac have endeavoured to give their customers certain benefits, allowing them to buy on credit and even providing them with a veterinary follow-up service.

1.2.2.2. Grands Moulins

This is the largest and oldest flour producer, alone accounting for three quarters of flour sales in Senegal. In an effort to diversify their activities, Grands Moulins took over an old livestock feed production unit known as SENAL. The absorption of SENAL enabled them to expand production with a new livestock feed production line. Continuous processing of the wheat bran generated in flour production is now possible.

Livestock feed production is therefore now dependent on the bran generated by the flour production unit. Notwithstanding this, the current capacity of the livestock feed plant is 160 tons per day. Since local demand far outstrips supply, there are plans to increase the production capacity to 300-350 tons per day by importing wheat bran.

The production unit is almost completely automated, but would benefit from renovation.

Grands Moulins employ 15 people to operate the feed plant.

The product is packed in plastic sacks with labels indicating the composition and instructions for use.

1.2.2.3. SONACOS - SETUNA

SETUNA (Sénégalo-Tunisienne de Nutrition Animale) is a newcomer to livestock feed production. It was established in 1984 by joint agreement between the Governments of Senegal and Tunisia. The plant, which is located at Diourbel, was given official approval in 1988 and started up in 1990.

SETUNA is part of the SONACOS (Société Nationale de Commercialisation des Oléagineux du Sénégal) group, which manages it through SEIB, the group's subsidiary at Diourbel.

The plant has a nominal production capacity of 15 tons an hour, which is far beyond the needs of the Senegal market. It was therefore designed to serve the broader subregional market.

The plant is currently finding it hard to achieve its normal operating level. The main reason is that the Tunisian specialists who built the plant have left Senegal and taken a large number of important documents with them. The technicians on the spot, who have received no training, are having problems in mastering the equipment.

The livestock feed production unit has a nominal capacity of 82-84 tons per day. It has just started up and it is using a formula developed by ISRA (Institut Sénégalais de Recherche Agricole).

SETUNA also has a large poultry feed production line with a capacity of 90 tons per day which just started production in the second half of July 1992.

SETUNA products are packed in sacks with labels indicating the product composition.

SETUNA uses the SONACOS distribution network to dispatch its product, both locally and for export.

The principal local customer is the State, above all in respect of its livestock protection programme, which took 3,000 tons in 1991.

1.2.2.4. ISRA's Sangalkam Farm

This farm, 20 km from Dakar, went through a period of expansion some time ago, but is now in crisis and decline owing to inadequate funding and creeping drought in the region.

The livestock feed production installations are obsolete and production is now carried out on a small scale, mainly for feed formula trials. This is how the feed ration for dairy cattle (Raval) was developed.

1.2.2.5. Cap Vert Agri

This is also a farm with its own unit to manufacture feed for use on the farm and for a fairly small number of customers around Keur Massar village.

Cap Vert Agri uses the formula proposed by the Sangalkam Farm. Raval is produced here on a semi-industrial basis. Cap Vert Agri employs three permanent staff to operate the unit and satisfy the needs indicated.

1.3. INPUTS AND MAIN SUPPLIERS

1.3.1. Fishmeal

Fishmeal is produced in Senegal by two different processes, one small-scale and the other industrial.

Small-scale production is frequently the task of the women. They collect the leftovers from small-scale or semi-industrial fishing and dry them in the sun after initially cooking them. The product obtained is then pounded or crushed to yield the meal. This type of meal is problematic in that it rots quickly and may also have constituents that are unsuitable, or even harmful, for animal consumption.

Industrial production also uses leftover and surplus fish collected from local fishermen or canneries. The agreed price is 8 F/kg for whole fish and 4-7 F/kg for scraps. There are two plants: Afric Azote and Sénégal Protéine.

1.3.1.1. Afric Azote

This company has been established at Dakar since 1961. It rents a site from the Dakar Autonomous Port Authority. The first production unit was designed and constructed by the manager, who is a trained metallurgist.

The plant's present production capacity is 400 tons a day. It employs 50 people and some day labourers. However, 90 per cent of production is exported.

1.3.1.2. Sénégal Protéine

This unit has an average capacity of 40 tons a day. Fishmeal production rises from February to July and falls from July to January because it is dependent on the catches made in the subregion.

1.3.2. Maize

Imported maize is most widely used in livestock feed production, primarily because it is cheaper than locally-grown maize. The main importers are Bocar Samb, STIMEX and SEDIMA.

1.3.2.1. Bocar Samb

Bocar Samb is a private person who enjoyed a monopoly for a long while and used to charge rather high prices. His maize stock amounted to 15,000 tons in 1991 when he faced competition for the first time, with the appearance of new importers on the market.

1.3.2.2. STIMEX

STIMEX is an import/export enterprise that has been attracted to cereals marketing. It began to import and market maize in October 1991. The first import consignment was 2,300 tons, worth 125 million CFA francs. The second consignment, in 1992, was 2,000 tons.

1.3.2.3. SEDIMA

This livestock feed producer has recently started to import maize. In 1991 SEDIMA imported 6,000 tons. Since the firm needs only about 1,000 tons a year, the remaining 5,000 tons were resold locally. SEDIMA currently possesses storage capacity for 5,000 tons of cereals.

Maize importers are now concerned that all producers will follow SEDIMA's lead and start importing.

However, imported maize is not used exclusively to produce livestock feed; some of it is for human consumption.

1.3.3. Groundnut cake

The main producer is SONACOS, with plants at Dakar, Diourbel, Kaolack and Ziguinchor. Annual production is between 150,000 and 200,000 tons (of which 87 per cent is exported). Stock-raising accounts for 15-25,000 tons, including 3,000 tons for the livestock protection programme.

1.3.4. Cotton seed

This is produced and marketed by SODEFITEX, which collects and processes cotton grown in Senegal. Annual cotton seed production is 25-30,000 tons. It is mainly used to feed livestock. A fair amount is exported and the rest is sold to SONACOS (10 CFA F/kg) and to feed producers (31 CFA francs/kg).

1.3.5. Molasses and bagasse

These sugar-industry by-products are produced in Senegal mainly by the Compagnie Sucrière Sénégalaise (CSS) at Richard Toll in the north of the country.

CSS is planning to set up an animal feed production unit which would enable it to reuse its two by-products, bagasse and molasses. At present, molasses production is 38,000 tons a year and bagasse production is 300,000 tons a year.

1.3.6. Draff

Draff is a by-product of brewing and tomato product manufacturing. Brewery draff is produced mainly by SOBOA at Dakar. Tomato draff is produced by SOCAS and SNTI, which are both in the north of Senegal. Draff production is currently estimated at 1,000 tons a year.

1.3.7. Wheat bran

This is a by-product of flour production generated by the two large milling enterprises: Moulins Sentenac and Grands Moulins at Dakar. They recycle it in their livestock feed production, apart from the quantity sold to SETUNA - SONACOS (about 10 tons a year). Total wheat bran production is of the order of 35-40 tons a year.

1.3.8. Rice bran

This is produced by small isolated rice dehusking units, mostly situated in the north and south of the country. Total production is estimated at 10,000 tons a year, but in fact rice bran is used very little in the manufacture of livestock or poultry feeds.

1.4. DISTRIBUTION

The distribution system is more or less complex, combining both a short circuit and a long circuit. These include:

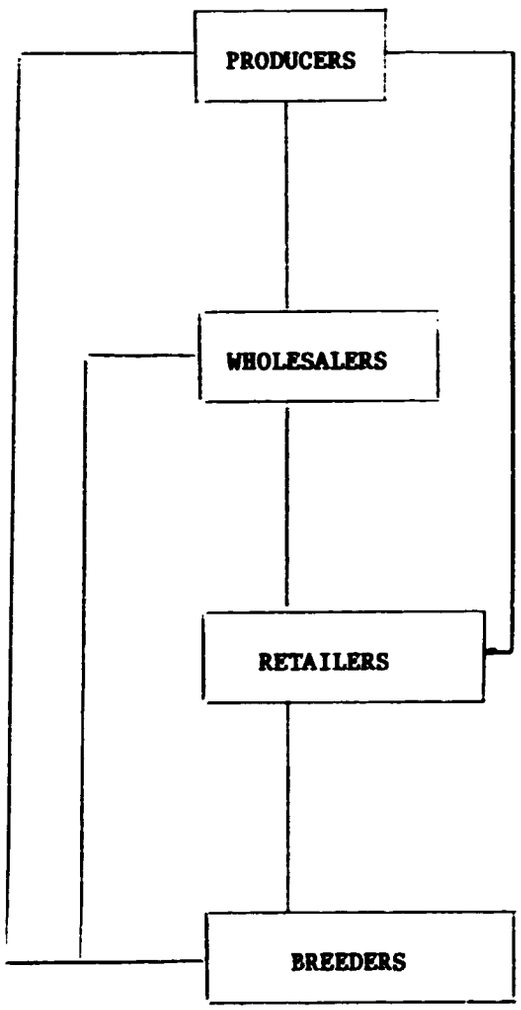
1.4.1. Producers. Some producers are breeders and thus consume their own products. The remaining production is sold, either direct to breeders (end use) or to wholesalers or retailers.

Some producers, such as SEDIMA and the Complexe Avicole de Mbao, possess their own distribution network. This means that they are present at all stages in the cycle and maintain direct contact with the end user. In some instances, they even deliver to the customer at home.

1.4.2. Wholesalers and small wholesalers are found mainly outside the Dakar region, where most production units are located. Most of them are breeders. They obtain supplies from Dakar to cover their own requirements and sell the rest locally to retailers or direct to other breeders.

1.4.3. Retailers are also found mainly outside the Dakar region. Their principal customers are small-scale breeders (less than 100 animals). They have the option of obtaining supplies either from the wholesalers or small wholesalers or from the producers. Their margin is therefore highly variable, depending on the prices paid to producers, the wholesale prices, the cost of transport and the quantity purchased.

THE DOMESTIC ANIMAL FEED DISTRIBUTION SYSTEM



II. SECTORAL ANALYSIS OF RAW MATERIAL SOURCES FOR FEED MANUFACTURE

The raw materials for domestic animal feed manufacture are cereals and agro-industry by-products.

2.1. CEREALS

There is great pressure on cereal use in domestic animal feed in Senegal because of the need to use cereals to feed the population. Senegal imports wheat (100 per cent of consumption), rice (two thirds) and maize (over a third).

As a consequence of the national cereals deficit and the cereal price structure, imported maize costs less than locally grown maize. Maize is virtually the only cereal used in feedstuffs for animals (monogastric). Millet and sorghum are occasionally used by domestic animal feed manufacturers.

Imported maize is the main cereal fed to domestic poultry because it has a very high energy value. However, maize is protein-poor, with 5.1 grams of nitrogenated matter per kilogram gross. Moreover, the proteins found in maize have a very unbalanced amino acid profile, with lysine and tryptophane deficiency and leucine surplus. The phosphorus content of maize can scarcely be tapped since there are no endogenous phytases. Maize is rich in easily accessible xanthophylls which are useful in colouring the egg yolk.

Maize is imported by Mr. Bocar Samb (a large-scale trader in Dakar) and also by STIMEX and SEDIMA, who started importing in 1991.

SEDIMA apparently imports 6,000 tons a year, while STIMEX markets 4,500 tons a year. The largest importer, Mr. Bocar Samb, was said to have a stock of 15,000 tons of maize at the beginning of last year. Senegal thus has about 25,000 tons of imported maize to feed the population and to feed animals.

The locally-grown maize sells at 80-85 F/kg and is more expensive than imported maize selling at 70-75 F/kg. Local maize production is very variable from one year to the next and from one season to the next.

The imports of SEDIMA and STIMEX have caused the price of imported maize to fall appreciably (15 F/kg). In general terms, feed manufacturers and breeders find the maize supply situation satisfactory.

Other cereals, such as millet or sorghum, are sometimes used, but in far smaller amounts because of their purchase price, compared with that of imported maize. The nutritional value of millet and sorghum is similar to that of maize (rich in metabolizable energy, but protein imbalance and low level of available phosphorus).

2.2. CEREAL BY-PRODUCTS

The cereals that produce by-products for use in domestic animal feed manufacture are rice and wheat.

2.2.1. Wheat bran

The milling industry in Senegal produces only wheat bran (fine or coarse) for use in the domestic diet. The wheat bran from the pericarp of the grain is low in starch (19 per cent of the dry matter) and rich in protein (17 per cent of the dry matter) and in available phosphorus. The annual wheat bran availability in Senegal is 20-25,000 tons. It is produced by Moulins Sentenac and Grands Moulins in Dakar. Both plants utilize this by-product directly in their livestock feed units. A very small quantity is currently consumed directly by domestic livestock in Senegal.

2.2.2. Rice by-products

The by-products of rice are bran and flour. The bran is obtained in the dehusking process, and is mixed to a greater or lesser degree in rice balls. This mixture is distributed direct to livestock in the rice-growing areas (Senegal River valley and Casamance).

The rice flours are obtained in the bleaching and polishing processes. They therefore contain less fibre than bran and are also less rich in protein. The proteins in rice flour are not too unbalanced and minerals are abundant.

The dehusking and bleaching processes are carried out in small industrial or semi-industrial units in the Senegal River valley and in the Ziguinchor region. Rice by-products are produced in very small quantities and in a highly decentralized fashion. They are in fact used very little by industrial domestic animal feed manufacturers in Senegal. It should be noted, however, that they pose no incorporation problems (no limit on the uptake factor).

2.3. SUGAR CANE BY-PRODUCTS

In the extraction process, sugar cane is crushed and the juice and bagasse (fibrous cane residue) are collected. Molasses is a by-product of sugar refining.

The bagasse accounts for about 30 per cent of the sugar cane. Bagasse is 50 per cent water, 48 per cent fibre and 2 per cent dissolved matter (sugar). Bagasse production by the Compagnie Sucrière Sénégalaise at Richard Toll is estimated at around 250,000 tons a year. Two thirds of this bagasse is reused by the company as fuel. One third (83,000 tons) would be available for animal feed.

Annual molasses production by the Compagnie Sucrière Sénégalaise is estimated at 33,000 tons. Molasses is essentially made up of saccharose and reducing sugars. The ash contains a remarkable percentage of potassium, in particular. The permissible rate of molasses incorporation is limited by the risks inherent in its high hygroscopic capacity and granulation problems. Whereas molasses is sold in the River region and in the northern half of Senegal, bagasse is consumed exclusively where it is produced (River region). Molasses is sold at 30,000 CFA francs/ton in Senegal and US $ 60 dollars/ton for export.

2.4. CATTLE CAKE

This is a by-product of the edible oils industry. It is often low in fat (particularly after solvent extraction) and rich in protein, which makes it attractive as an animal feed option. Groundnut cake is the most widely used in Senegal. Cotton seed and palmetto cakes are used in small amounts.

Groundnut cakes are among the richest in proteins with a very high bio-availability level. However, the amino acid content is rather mediocre, with deficient lysine, sulphurated amino acids and tryptophane.

The Société Nationale de Commercialisation des Oléagineux du Sénégal (National Society of Senegal for the Marketing of Oil-yielding Products) (SONACOS) manufactures deoiled (standard) groundnut cake and deoiled and detoxified groundnut cake.

The oil is extracted industrially by SONACOS using hexane as solvent. Small-scale manufacturers produce expeller groundnut cake (under pressure) which contains more fat than the deoiled cake.

The expeller groundnut cakes (small-scale production) are fed direct to the animals belonging to rural breeders. Domestic animal feed manufacturers obtain their supplies straight from SONACOS. On average, SONACOS sells 1,000 tons of standard groundnut cake at 45,000 F/ton in bulk and 50,000 F/ton bagged. SONACOS also supplies the Government with 3,000 to 5,000 tons for the Senegal livestock protection programme. Since there are few buyers in Senegal for ammonia detoxified groundnut cake at 65,000 F/ton, it is mainly exported. SONACOS produces about 160,000 tons of groundnut cake each year.

Cottonseed cake is produced exclusively by SONACOS Lyndiane (Kaolack). The quality is moderate: it contains 42 per cent crude protein, but is deficient in lysine and sulphurated amino acids. The presence of gossypol in cottonseed cake is detrimental to the growth and viability of poultry, and the amounts incorporated in feed formulas are accordingly limited.

The Lyndiane industrial plant produces an average of 8,000 tons of cottonseed cake annually. The average selling price is 30,000 F/ton. Since virtually none is consumed in Senegal, the cottonseed cake is exported.

Expeller groundnut and palmetto cakes are produced on a small scale and are not marketed by the feed manufacturers.

2.5. FISHMEAL

Fishmeal is manufactured industrially (by Sénégal Protéine and Afric Azote) and on a small scale (by Kéthiakh). The quality and quantity of the small-scale production tend to fluctuate greatly. There is less variation in the industrial production, although the protein content of the meal is largely dependent on the raw material (the proportions of unsold whole fish and cannery fish waste used).

The fishmeals are used because of their nutritional value, combined with their high amino acid and mineral content. The industrial fishmeals contain between 60 and 65 per cent protein material. Senegal produces about 5,000 tons a year of fishmeal, 10 per cent of which is sold in Senegal.

Following the bankruptcy of SOPESINE at Djifer and SOSETRAPROMER at Dakar Port, Afrique Azote accounts for over four fifths of national output. Fishmeal sells at 115,000 F/ton, including 7 per cent value added tax. Small-scale production for animal feed use is insignificant compared with industrial fishmeal production. Scarcely 50 per cent of the installed capacity is utilized.

2.6. OTHER RAW MATERIALS

The other raw materials used in animal feeds are brewery and tomato product draff, mineral/vitamin compounds, rice bran, cottonseeds and groundnut shells. With the exception of the mineral/vitamin compounds, which are included in both poultry and livestock feeds, these raw materials are used only in livestock feed.

Tomato draff is produced by the Société Nationale des Tomates Industrielles (Industrial Tomato Products Company) at Dagana and the SOCAS plant at Savoigne (near Saint-Louis). Brewery draff comes from SOBOA at Dakar, which delivers its production to Société d'Elevage SOCA. The draff contains about 20 per cent cellulose and a somewhat higher concentration of protein. Annual availability in Senegal is estimated at 1,000 tons.

The draff is used principally by private breeders and not by the major livestock feed manufacturers. The same applies to rice bran and cottonseeds.

Cottonseed contains about 23 per cent cellulose material, 22 per cent protein and 23 per cent fats. Average annual production is around 22,000 tons, of which a fifth would be available for use in animal feed at improved breeding establishments.

Rice bran contains about 10 per cent protein and 16 per cent cellulose. Bran is produced by the tiny rice-processing plants scattered in the Senegal River valley and the south of the country for the most part. In view of the small quantities involved, rice bran is hardly used in the feed manufacturing industry.

Among the MVC components, salt, tricalcium phosphate and calcium (shells or Bargny stone) are found locally. The other components (bicalcium phosphate, synthetic amino acids, vitamins, coccidia control agents, etc.) are imported.

III. EXISTING DOMESTIC ANIMAL FEED PRODUCTION TECHNOLOGY

3.1. MANUFACTURING OF MADE-UP FEEDS

Depending on the nutritional specification, the manufacture of made-up feeds involves a series of cleaning, weighing, crushing, mixing, pressing, screening and packaging operations of varying complexity. The aim is to combine the raw materials (cereals, middlings, cakes and animal and plant meals), with minerals, vitamins and different additives (synthesized amino acids, antibiotics, coccidia control agents, etc.) in predetermined proportions.

The technology available in Senegal for made-up feed manufacture more or less follows this pattern. Below we describe the operations which are carried out; the emphasis will vary depending on whether the production unit is industrial or semi-industrial.

3.1.1. Cleaning and dust removal

Cleaning and dust removal, particularly in the case of cereals, are the first steps in preparing a clean, homogeneous raw material with no impurities or foreign bodies.

This preliminary operation is not carried out in all the manufacturing units visited.

3.1.2. Weighing and proportioning

The proportioning of the ingredients ensures that they are incorporated in specific quantities. This initial operation in the manufacture of made-up feeds requires scales that can weigh quantities ranging from quintals (100 kg) to kilograms or milligrams. Weighing takes place again when the feeds are packed. Too little of one or more ingredients can mean inadequate nutritional value; too much always means negative economic repercussions.

The scales used are simple mechanical models (beam scales, equal-arm scales), or electronic and mechanical scales with numerical readout, such as those used by Complexe Avicole de Mbao.

3.1.3. Crushing

The raw materials are crushed in order to obtain a smaller grain size permitting better homogenization of the mixtures. Crushing is most frequently done by hammer mills, which may be imported or manufactured locally.

The hammers, which are attached to a rotor, squash the grains until they pass through the holes in a mesh under the combined effect of the centrifugal force generated by the rotor and exhaust suction. The desired grain size is obtained with meshes ranging from 1 mm to 5 mm.

Roller mills and crushing rolls are used very little for the manufacture of made-up feeds in Senegal.

3.1.4. Homogenization

The weighed and crushed ingredients are homogenized in vertical or horizontal mixers to give the proper distribution in the mass of the mixture.

Some manufacturing units (SENDIS, AGRICAP, Aliment Pousse Vite) use vertical mixers, while the largest units (Complexe Avicole de Mbao, SEDIMA, Moulins Sentenac) have horizontal mixers. Moulins Sentenac also use a premixer to boost mixing effectiveness.

Mixing is influenced by the particle size distribution, density, shape and friction coefficient of the ingredients, as well as by possible chemical interactions and the static electricity potential.

The faster the rate at which a raw material is incorporated in a feed, the greater the diameter of the particles is likely to be, and vice versa.

Low specific weight constituents should be put into the mixer before heavier products to prevent them from rising to the surface. An unduly long mixing time can also cause the mixture to break down.

In most of the facilities visited, certain essential fine particles that escape from the mixer are recovered in filters but not returned to the mixer. The Mbao Poultry Complex is an exception here, because it uses a timed shaker which returns these fine particles to the mixture in the course of the process.

Techniques such as monitoring of homogenization using metal ions (potassium ferrocyanates) and fluorescent feed labelling are virtually unknown.

3.1.5. Liquid incorporation

The liquids most often incorporated in made-up feeds are choline, certain synthesized amino acids, fats and molasses. The latter are inserted at ambient temperature, in viscous or solid form.

Better nutritional quality can be obtained, and local deterioration and overheating avoided, if molasses and fats are heated in a water bath to 60°C and 70°C, respectively. However, only small quantities can be incorporated in this way owing to mixture flow problems.

Choline and certain synthesized amino acids are incorporated in the feed in liquid form for the sake of convenience.

3.1.6. Granulation

Granulation is achieved by passing the feed through the perforations in a flat or annular die. The granules (small cylinders, a few millimetres long, cut by a revolving knife) are produced by water vapour injection (wet process) or without vapour injection (dry process).

The moisture in the granulating machine ranges from 15 to 18 per cent. The granules emerge from the process at 70°C and 80 per cent, and are cooled, dried and screened before being weighed, packed and stored.

In Senegal, liquid incorporation and granulation are operations confined largely to to livestock feeds. Poultry feeds are weighed, packed and stored as they leave the mixer in powder form.

3.2. MANUFACTURING OF SIMPLE DOMESTIC ANIMAL FEEDS IN SENEGAL

3.2.1. General remarks

The simple feedstuffs for domestic animals in Senegal include cottonseeds, groundnut cakes, cottonseed cakes, molasses, bagasse, cereals and their products, draff from barley used in brewing and from tomatoes, fishmeal, mineral elements and additives, such as synthesized amino acids, vitamins, coccidia control agents and so on.

The requisite cereals, additives and some MVC components are to a large extent imported.

The technology used in manufacturing simple feeds in Senegal relies heavily on the by-products of other industries: milling (brans), oil production (cakes), brewing (draff) and sugar production (molasses and bagasse). Only fishmeal is manufactured specifically for the purpose of producing simple feeds for domestic animals in Senegal; it will therefore be dealt with in some detail here, while industries such as milling, oil production, brewing and tomato concentrate and sugar production are merely mentioned because they are more traditional, more widespread and less specific to the domestic animal feed sector.

Cellulose materials (straw and groundnut shells from small-scale production, forage) are not included here. They form the basic food intake of ruminants and have nothing to do with the domestic animal feed industry.

We shall now describe the manufacturing process by which fishmeal is produced in Senegal and then the technological processes aimed at enhancing nutritional quality.

3.2.2. Fishmeal manufacture in Senegal

Sénégal Protéines and Afric Azote are the principal industrial fishmeal manufacturers.

Small-scale fishmeal technology (Kéthiakh' is of dubious quality and very variable composition. It is used very little on semi-traditional farms. Afric Azote is the oldest producer, established since 1961/1962, and the largest, with a daily capacity of 400 tons of fish waste. Only 10 per cent of Afric Azote's production is sold in Senegal - the rest is exported to Europe. The protein content varies from 60 to 65 per cent. The different manufacturing stages are described below.

3.2.2.1. Crushing

Only the hard parts of the fish waste (sole fillet waste, tuna, anchovies and other unsold fish scraps) are crushed. The crushed product and the soft waste are carried into the cooker by a helicoidal screw.

3.2.2.2. Cooking

The soft waste is cooked for 7-8 minutes after steam has been injected at 120°C. The double-shell tunnel cooker has a screen to separate the fish liquor from the solid material.

3.2.2.3. Mechanical pressing and drying

The solid material from the cooker passes into a mechanical press with a vibrating screen. This completes the extraction of the fish liquor and produces cakes that need to be dried. The collected fish liquor is heated to 90°C and then passed into a centrifuge which separates the fish oils from the water. This operation is further refined by a system of settling tanks.

The fish oil used to be discharged into the sea and polluted Bel-Air beach. It is now collected and mixed (to the extent of 30 per cent) with fuel oil for use as a fuel with a calorific value only slightly below that of 100 per cent fuel oil.

3.2.2.4. Recooking

The dried cakes are inserted in a tunnel where the temperature rises from 85°C on entry to 250°C, returning to 85°C on exit. Monitoring the time the cakes spend in the tunnel ensures proper cooking.

The cooked product and the gases go into an expansion chamber with four chicanes or into a pressure-relief cyclone. The deposits are collected on a vibrating screen which separates the fishmeal from the coarse elements - vertebrae and bones - which are crushed before being mixed with the meal.

3.2.2.5. Separation, mixing and bagging

It is necessary to remove any ferrous elements and other foreign bodies from the fishmeal in order to obtain a purer product. The meal is passed over a magnet which collects the ferrous bodies.

The meal then passes through a pneumatic system powerful enough to suck up the light fishmeal components and leave behind any heavier elements, such as small stones.

The product is then homogenized in a screw mixer before being bagged. The full sacks are held for 24 hours before being sewn up and stored. This makes it possible to obtain a natural product without adding ascorbic acid (preventing product fermentation).

3.2.3. Technological treatment and nutritional quality

The technological treatment of the raw materials for simple domestic animal feedstuffs mainly concerns cakes (groundnut, cottonseed and palmetto). The cakes are what remains after extraction of the oil from the oleoproteinaceous seeds or fruits. They usually have a high nitrogen value, and their trade names evoke particular features of the technological treatment. Below we give a general outline of the technology used to produce such cakes.

* Extraction under pressure is used to produce industrial expeller cakes with 5-10 per cent fat. Cakes manufactured by small-scale producers contain more fat. This applies to expeller groundnut cakes. Expeller palmetto oil cakes are produced industrially only by SONACOS at Ziguinchor.

* Solvent extraction with hexane yields an ordinary deoiled cake with a fat concentration of less than 4 per cent. This type of groundnut cake is a staple item for domestic consumption and is sold in Senegal at 50 F/kg in bags or 45 F/kg in bulk.

* Physico-chemical detoxification of deoiled groundnut cakes (by the addition of ammonia and Formol) is designed to reduce or inactivate aflatoxin and to enhance the resistance of protein to microbial digestion in the rumen. This increases the level of intestinal digestive proteins of food origin. Very little detoxified groundnut cake is consumed in Senegal because of the slightly higher cost (65 F/kg for local sale).

* The tanning of cake protein by chemical means (addition of Formol) or autoclaving makes the protein more resistant to microbial degradation in the rumen. This process is not yet used in Senegal.

Some treatments require heating to different temperatures during the production process. The application of heat to the raw materials, pulses in particular, reduces thermolabile antinutritional factors, anti-trypsin factors and antivitamins (D, B12 and E) and destroys certain pathogenic agents (salmonella).

IV. CONSTRAINTS AND RECOMMENDATIONS

The constraints affecting the development of the domestic animal feed industry in Senegal and the recommendations to be made on the subject fall into two categories, macroeconomic and micro-economic.

4.1. MACROECONOMIC CONSTRAINTS AND RECOMMENDATIONS

The constraints on the development of the domestic animal feed industry in Senegal give rise to recommendations in the following areas:

- Raw material availability and diversification;
- Socio-professional reorganization of the poultry and meat/milk branches, of which feed manufacturers are an important component;
- Training and innovation in research and development policy.

4.1.1. Raw material availability and diversification in the domestic animal feed industry

Virtually all industrial plants producing domestic animal feedstuffs in Senegal are located in the Dakar region (apart from SETUNA at Diourbel). The main reason for this is the proximity of agro-industry by-products and of the large-scale feed consumers (particularly poultry breeders).

The constraint relating to raw material availability and diversification does not apply to the noble materials (proteins) of which Senegal is a major exporter, with over 4,500 tons of fishmeal and more than 145,000 tons of cake annually. Rather, it applies to energy-giving substances, above all cereals and cellulose. It should be noted that, unlike some developed countries, Senegal has a molasses surplus.

The raw materials used by the domestic animal feed producers are concentrated in the Dakar region, which is at the forefront of modern poultry breeding in Senegal.

The development of the domestic animal feed industry in Senegal requires:

- Diversification of supply for both feed manufacturers and breeders, larger amounts of certain agricultural products or by-products (other cereals, maize cobs, niébé forage, fatty groundnut bran, rice bran, etc.) being made available;
- Increased availability, coupled with an acceptable pricing policy, of all raw materials (the greater availability of cereals during the year due to the liberalization of maize imports has had a beneficial impact on feed industry development);
- Decentralization of feed production units, bringing them closer to the breeding and raw materials production areas. Transport costs are a relatively important factor in deciding what feed to buy. Decentralization of the industrial production units could be combined with the development of new MVCs that would not be incorporated in the made-up feed at a rate of only 1-5 per cent, but at 10-30 per cent, depending on the basic types of feed available in the various regions.

4.1.2. Socio-professional reorganization of the poultry and meat branches

As part of its policy of collaboration with socio-professional groups, the Ministry of Rural Development and Water Supply is establishing an agricultural branch policy to remove certain obstacles to development.

This new approach is prompted by, for example, the absence of collaboration and harmonization in the poultry-breeding branch, particularly as regards commercial margins and pricing. As a result, the reduction in domestic animal feed prices over the last four years and the improvement in nutritional quality which have cut the production cycle for broilers - chickens raised for their flesh - to 45 days as compared with 55 or even 60 days earlier, have benefitted traders more than feed manufacturers and breeders.

The interprofessional committees in each branch could suggest and apply suitable solutions. The committee in the poultry branch could promote the harmonization of certain taxes on farming sector inputs, and the 7 per cent value added tax on chicks would probably then be revised.

In this framework of collaboration and harmonization of development policy for the poultry, meat and milk branches, the Government and the economic protagonists will be able to work out a code governing production standards in the domestic animal feed industry (standards for feed composition, declared feed content, analytical tolerances, etc.). The standards relating to packaging (type and quality), storage and, in general, the distribution circuit should be reviewed to bring about a much-needed improvement.

The socio-professional reorganization of the poultry and meat branches, which is well under way, ought to be particularly encouraged with the emergence of new possibilities for credits to breeders and appropriate training resources.

4.1.3. Training and innovation in research and development policy

Training and innovation in research and development policy are matters that concern not just the breeders, but also the feed manufacturers, those with the technical and commercial responsibility for feeds and animal products.

The dynamism in the domestic animal feed industry comes mainly from the advent of new and innovative protagonists in the supply (SEDIMA and STIMEX) and manufacturing (SEDIMA, SENDIS and Complexe Avicole de Mbao) sectors.

The large production units are supported by foreign enterprises (Guyomarch, Etna and Jourdan International), particularly with regard to breed selection, raw materials analysis and feed formulations. Some of the fruits of their research have yet to be applied in this industrial sector in Senegal.

The judicious adoption of new ways of expressing energy requirements and inputs (meat forage units and milk forage units) as well as nitrogen requirements and inputs (the PDI system: true proteins that can be digested in the small intestine) could lead to greater natural resource optimization. This new scientific knowledge can be applied to the technological treatment of domestic animal feeds (feed balance in relation to specific needs, adaptation

of concentrate composition to forage quality, balance of nitrogenous material, protection of proteins and fats, and so on).

Training and further training could be organized for hatchery operators, manufacturers, breeders and distributors of feeds and breeding products under the aegis of the interprofessional committees which are currently being set up. These committees could assess the need for new infrastructures (modern abattoirs and analysis, control and pathology laboratories) or a pricing system or any other arrangement to promote effective integration in the economy of the country and the subregion (the ECOWAS economic area).

4.2. MICRO-ECONOMIC CONSTRAINTS AND RECOMMENDATIONS

Obstacles to the development of the domestic animal feed industry are examined here in the light of the raw material purchasing, production and marketing functions of the enterprises involved.

4.2.1. Raw material purchasing constraints and recommendations

In general terms, the industrial units are supplied with raw materials on the basis of availability that is often limited. Raw material prices depend more on supply than on a balance between supply and demand, on the one hand, and on the price quality relationship, on the other hand. Prices are not directly indexed to nutritional quality, which is rarely determined in an objective manner.

Regular analysis of the nutritional quality of the raw materials could have helped feed manufacturers in taking purchasing decisions.

The analyses of raw materials and domestic animal feeds requested by the manufacturers and conducted in Senegal have been very unsatisfactory with regard to quality, time lag and prices.

The establishment of a private analysis control laboratory specializing in this area could help to even out prices to the benefit of the parties represented on the interprofessional committees in the meat, milk and poultry branches.

The dismantling of the old maize supply monopoly should be encouraged as a model to be followed in shaping Senegal's economic liberalization policy.

4.2.2. Production constraints and recommendations

More astute purchasing of raw materials, emphasizing nutritional quality, makes it easier to optimize production by minimizing costs while maintaining a well-defined nutritional value. A local computer system incorporating details of the new purchase prices and the corresponding nutritional value of the raw materials would make it possible to adjust the feed formulas quickly. This rapid adjustment would generate better-balanced feeds at lower cost than long-established standard formulations.

Another innovation which would help to reduce production costs and improve nutritional quality would be automation of the production line with a suction system for collecting some of the fine particles that tend to escape, particularly during mixing; this could cut materials losses and contain possible quality loss at the product handling and mixing stages.

The policy of defining new products on a sort of market-following basis - that is, in line with the segmentation of the Senegalese market - must be pushed harder by the most innovative feed manufacturers. To reduce transport costs, for example, more consideration should be given to the idea of launching a new mineral/vitamin compound, to be used as a supplement to certain specific basic feed types in the regions away from Dakar; such a supplement could well have attractive nutritional potential for both livestock and poultry.

The innovation could also extend to the manufacture of granulated feed for poultry, something which has yet to be used in Senegal. The granulation of poultry feeds would of course raise production costs and require increased water consumption, which results in damper litter in free-range systems and hence encourages the proliferation of microbes and parasites. However, the benefits of granulated poultry feed might well prevail over these disadvantages. This is because the granules have economic, physiological and nutritional advantages. Granule losses are less serious than meal losses, particularly when a feeding line is used to distribute the feed. Furthermore, the chickens, especially the growing young ones, consume more food in granule than in meal form, thus enhancing feeding effectiveness.

From a physiological standpoint, the ambient air is less contaminated if granulated feeds are used. Nutritionally speaking, the granules are more homogeneous and there is no risk of the mixture breaking down. The heat of the granulation process (70-80°C) reduces anti-trypsin factors and possible contamination. And finally, feeding effectiveness is apparently better when the animals are raised in a hot environment. Other new techniques (such as protein tanning and protection of amino acids and fats, etc.) should also be tested.

4.2.3. Product marketing constraints and recommendations

Greater attention is now being paid to marketing as a result of the increase in competition over the last four years. However, the progress achieved in this field should benefit all producers. Senegal thus needs:

- Better raw material and finished product packaging through the general use of once-only sacks, limiting the risk of carrying contamination from one farm to another, above all poultry farms;

- Better identification of finished products by indicating the composition and properties of the feeds, the date of production and the production batch number;

- More specialized salesmen who could give users and producers better advice about each other's problems (better product definition, sales terms and rates, conditions of storage and use, etc.).

Annex 1

ESTIMATE OF POULTRY FEED CONSUMPTION IN SENEGAL
IN 1991 AND IN THE FIRST HALF OF 1992

	Broiler chicken - imports								Broiler chicken - local production							
Distributor	1991 (year)	January 1992	February	March	April	May	June	Total for first half of 1992	1991 (year)	January 1992	February	March	April	May	June	Total for first half of 1992
SEDIMA	1,221,360	73,000	150,990	12,365	5,071	66,930		308,356			49,880	72,707	84,522	114,075	76,915	398,099
SENDIS	361,896	49,956	74,106	32,154	31,004	29,335	19,706	236,261								0
COUVOIR SANGALKAM	147,600		143,500	44,500		53,100		241,100	781,615	95,580	64,699	86,107	84,050	82,501	64,128	476,065
SOSEDEL	64,000	4,000	19,000	5,000	5,000	10,000	5,000	48,000								0
ALISEN								0								0
COMPLEXE AVICOLE	40,500							0	891,102	70,149	158,799	62,030	93,366	116,391	75,291	576,025
TOTAL	1,835,356	126,956	387,596	94,019	41,075	159,365	24,706	833,717	1,672,717	165,729	273,378	219,844	261,937	312,967	216,334	1,450,189
Feed consumption in kg	6,974,353	482,433	1,472,866	357,272	156,085	605,587	93,883	3,168,125	6,356,325	629,770	1,038,836	835,407	995,361	1,189,275	822,069	5,510,718

Annex I (continued)

Distributor	Laying hens - imports							Total for first half of 1992	Laying hens - local production							Total for first half of 1992
	1991 (year)	January 1992	February	March	April	May	June		1991 (year)	January 1992	February	March	April	May	June	
SEDIMA	151,890	8,000	15,350		13,100	7,191	32,946	76,587								0
SENDIS	67,377	520	11,638		1,012	33,896		47,066								0
COUVOIR SANGALKAM	124,540	12,300				21,300	20,400	54,000								0
SOSEDEL	250,000	1,500						1,500								0
ALISEN	27,600							0								0
COMPLEXE AVICOLE	5,100							0	166,505	19,711	27,140	37,504	52,017	29,637	59,516	225,525
Total	626,507	22,320	26,988	0	14,112	62,387	53,346	179,153	166,505	19,711	27,140	37,504	52,017	29,637	59,516	225,525
Chicks/chickens	5,951,817	212,040	256,386	0	134,064	592,677	506,787	1,701,954	1,581,798	187,255	257,830	356,288	494,162	281,552	565,402	2,142,488
Laying hens	24,422,496	870,078	1,052,046	0	550,114	2,431,970	2,079,534	6,983,742	6,490,698	768,374	1,057,971	1,461,981	2,027,727	1,155,310	2,320,053	8,791,416
Total	30,374,312	1,082,118	1,308,432	0	684,178	3,024,647	2,586,321	8,685,696	8,072,495	955,629	1,315,801	1,818,269	2,521,888	1,436,861	2,885,455	10,933,903
Total consumption	37,348,665	1,564,551	2,781,297	357,272	840,263	3,630,234	2,680,204	11,853,820	14,428,820	1,585,399	2,354,638	2,663,676	3,517,249	2,626,136	3,707,524	16,444,621

Annex II

FEED CHARGES OF THE MAIN MANUFACTURERS IN SENEGAL

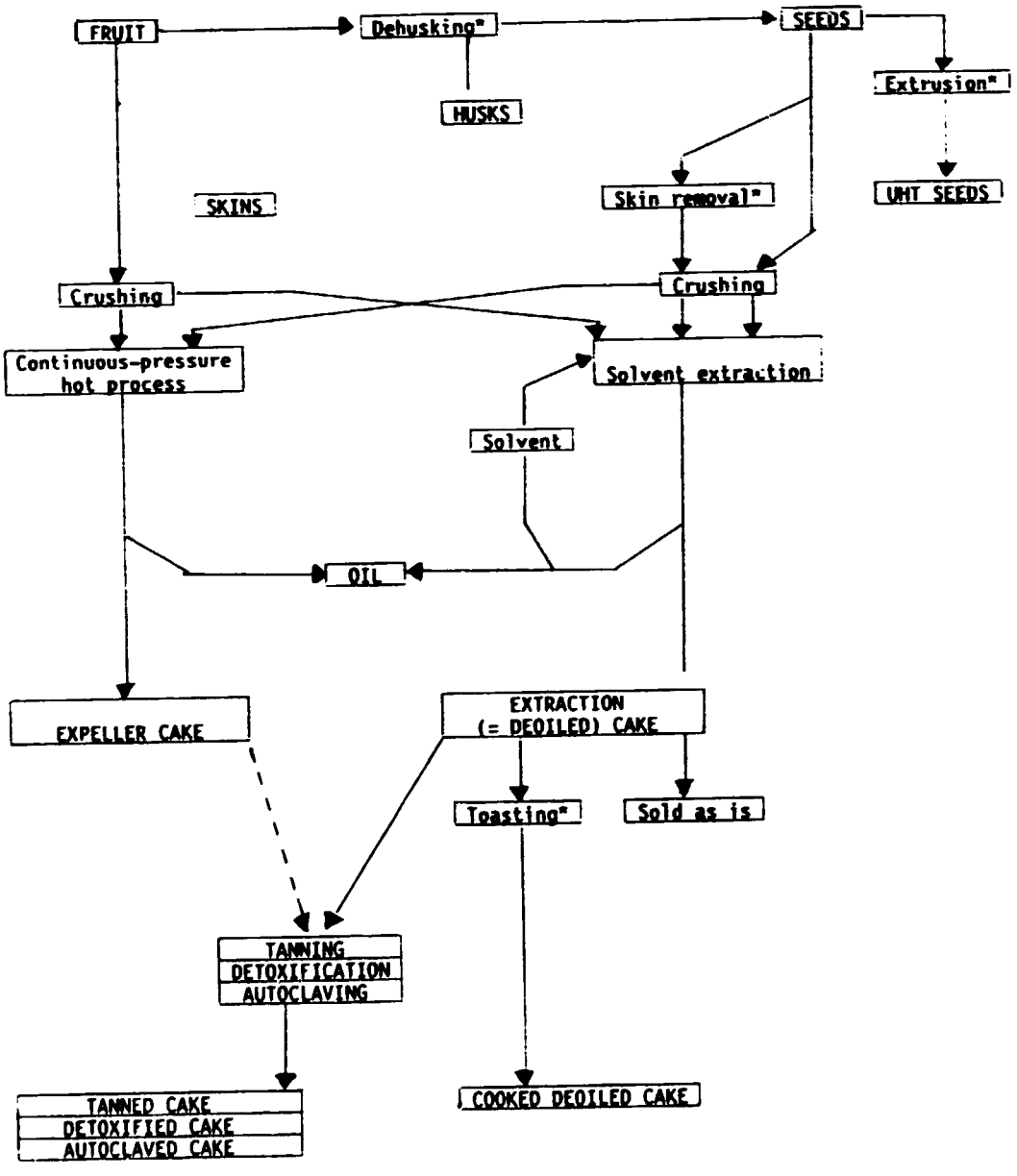
Manufacturers	Feed for broiler chickens						Feed for laying hens								
	Starting			Finishing			Chick			Chicken			Hen		
	50 to 500 kg	500 kg to 1 ton	> 1 ton	50 to 500 kg	500 kg to 1 ton	> 1 ton	50 to 500 kg	500 kg to 1 ton	> 1 ton	50 to 500 kg	500 kg to 1 ton	> 1 ton	50 to 500 kg	500 kg to 1 ton	> 1 ton
SEDIMA	5,050			4,950			4,800			4,400			4,500		
SENDIS	5,100			5,000			5,100			4,250			4,650		
COMPLEXE AVICOLE	6,000	5,900	5,800	5,800	5,700	5,600	6,000	5,900	5,800	5,750	5,650	5,550	5,250	5,150	5,050
SETUMA-SONACOS	5,200			5,100			5,200			5,100			4,800		

Livestock feed in 40-kg sacks		
SETUMA-SONACOS	YAFAL	2,860 F
GRANDS MOULINS		2,200 F
ISRA SANGALKAM FARM	RAVAL	2,200 F

sold at 35 F/kg to the State for the livestock protection programme

Annex III

GENERAL OUTLINE OF TECHNOLOGY USE IN CAKE PRODUCTION



* These operations are only performed for some products.