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Construction of Feed Mills in Senegal, Mali and Mauritania

FOOD & FEED GRAIN INSTITUTE
KANSAS STATE UNIVERSITY

MANHATTAN, KANSAS 66502

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SUMMARY STATEMENT

The author acted as consultant to AID/ADO/Dakar in evaluating plans for feed mills to be constructed in Senegal, Mali, and Mauritania. The mills are part of an AID-sponsored projected to increase poultry production in West Africa.

Background information on broiler production, egg-laying operations, hatcheries, and raw material (grain) availability were reviewed with AID personnel. Plans for feed production and some of the problems related to this area were also discussed.

Specific comments on the design, equipment, and construction were made for the mills at Nouakchott and Rosso, Mauritania; Bamako, Mali; and Dakar, Senegal.

Recommendations on the maintenance and operation of feed mills in general were also set forth.

OBSERVATIONS AND RECOMMENDATIONS FOR CONSTRUCTION OF FEED MILLS IN SENEGAL, MALI, AND MAURITANIA

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TABLE OF CONTENTS

REPORT OF ACTIVITIES IN WEST AFRICA

At the request of AID/Washington, the author traveled to Dakar in response to a request from the AID/ADO/Dakar to furnish consulting services regarding plans for feed mills to be constructed in Senegal, Mali, and Mauritania. These feed mills are part of a project sponsored by AID to increase the production of broilers (poultry) in the three countries.

I arrived in Dakar on Wednesday, August 18, 1971, and was requested to proceed on Thursday to Bamako, Mali, to meet with AID officials who had preceded me there. On arrival in Bamako, I met with Mr. Thomas, who has served as director of the OERS Regional Poultry Project for about four years, and with Mr. Osgutthorpe from AID/Dakar. Mr. Thomas reviewed the history of the broiler project and the progress to date on planning for the erection of feed mills and grain storage.

Briefly, the poultry project is a multinational project to produce broilers in the three countries. Breeder flocks would be maintained in Dakar and Bamako to produce approximately 1,000,000 broilers per year in Senegal and the same in Mali. Approximately 50,000 chicks would be shipped from the breeder location to Mauritania.

Construction of buildings for the laying flocks at Bamako was progressing well and the incubators were in operation. Dakar is progressing rapidly on physical facilities for egg production and hatching.

Mr. Thomas then reviewed the plans for feed production and some of the problems related to this area. Grain supplies in Senegal and Mali are barely sufficient to meet human food needs and in 1971 milo was being furnished under PL480 to both Senegal and Mali. Because of the shortage of grain, the breeding flock was being fed a ration containing a large amount of rice hulls, and egg production was below 10%.

Because of the limited grain and feed supplies, plans had been developed to build two feed mills, one at Dakar and one at Bamako. These mills had been planned to produce feed for the laying flocks plus the 1,000,000 broilers at each location. Much of the major feed processing equipment had been purchased and requests for bids had been made for other equipment. I was also advised by Mr. Thomas that plans to August 20 envisioned the purchase and storage of about an eight-month supply of grain which should last from one harvest season to the next.

Two small feed plants to supply feed in Mauritania were planned and major processing equipment had been ordered. A building had been constructed in Nouakchott, Mauritania, to house the feed mill there.

I was told on August 19 and 20 by Mr. Thomas and Mr. Osgutthorpe that plans and designs were needed for buildings and equipment installation for the feed processing area and for the grain storage.

On Friday, August 20, I spent part of the day visiting the poultry farm and hatchery and was shown the proposed location for the feed mill and grain storage where a building foundation was under construction. The remainder of the day was spent in getting prices on available construction materials in Bamako.

Since I had obtained all of the information which I felt was needed from Bamako, I decided to return to Dakar on Saturday in order to use the time getting information on construction costs and weather data in Dakar before proceeding to Mauritania on Wednesday.

The commercial attaché in Dakar arranged for me to visit with the Senegalese meterological office to obtain weather data, a building material supplier who furnished material availability and price information, and a general contractor who furnished information on local capabilities and costs of construction

in Senegal. These visits occupied most of the days of Monday and Tuesday. I also reviewed the equipment orders and specifications of equipment which had proceeded through the bidding stage.

At this point it was evident that considerable engineering time would be required to design the feed mills and structures which were planned and that these designs could not be done in the field.

On Wednesday, August 25, a meeting was held in Mr. McAdams' office (AID/ADO/Dakar) where Mr. Osgutthorpe, Dr. C. Kasse (Co-Director, OERS, Regional Poultry Project), and I were present. At this meeting, Mr. McAdams and Mr. Osgutthorpe decided that the planned scope of the feed mills should be drastically reduced for Bamako and Dakar. The decision was made that feed was to be provided only for the laying flocks. I was also informed that I need not be concerned with the structural and building design since this could be handled faster and better by a local architect or engineer.

This decision, of course, drastically changed the objectives of my work since the production capacity of the two large mills was reduced by about an order of magnitude, i.e. from about 20 to 4 tons per day.

On Thursday, Mr. Thomas and I were sent by car to Mauritania. We were instructed that a representative of the Ministry of Agriculture would meet us in Rosso, Mauritania, to examine a building which the GOM had offered for a feed mill. Upon arrival in Rosso, we went to the governor's office hoping to meet the representative from Nouakchott. The governor knew of no buildings which were available or of no discussion of the matter. We proceeded to Nouakchott.

At Nouakchott, we visited the new building which had been completed a few weeks previously for the feed mill. This concrete block building was obviously adequate for the intended purpose.

We met with Dr. Kasse, representatives of the Ministry of Agriculture (headed by Mr. Ahined Soeud, Director of Livestock Services), and U. S. Embassy staff on Friday and Saturday morning and returned to Dakar on Saturday.

On Sunday, Mr. Thomas and I visited with Dr. Kasse at the poultry farm near Dakar. We saw the existing feed mill facilities which would be replaced by the larger mill when the flocks were expanded.

On Monday a meeting was held with Messrs. McAdams, Osgutthorpe, Thomas, Dr. Kasse and me present. The whole matter of size of facilities was again reviewed and the decision was made to allow for 500 M.T. of broiler feed at Bamako.

On Tuesday I recalculated grain storage space requirements and wrote the recommendations for the feed mills.

On Wednesday I reviewed the recommendations with Messrs. McAdams and Thomas and Dr. Kasse, and left in the late afternoon to return to the U. S.

Since I have received no further information regarding a change in the size of the planned facilities, the recommendations made before leaving Dakar should be adequate and applicable. Most of the major equipment has been ordered and should present no difficulty in installation by local personnel with some limited supervision by an experienced millwright. Equipment which has been ordered and is not needed probably should be stored in case of a later decision to expand the facilities to produce at the original planned capacity.

As soon as the mill buildings are completed and all major equipment is on hand, it would probably be desirable to employ a millwright to supervise local labor and craftsmen in the installation of machinery. If all machines are on hand, this installation should not require more than one month total for Dakar and Bamako. If desired, it should be possible to furnish millwright services through the Kansas State University contract.

RECOMMENDATIONS REGARDING THE WEST AFRICAN FEED MILLS

The following recommendations are based upon these assumptions:

1. Feed mills are to be built to supply the following:
   - 10,000 layers plus replacements at Dakar
   - 8,000 layers plus replacements at Bamako plus 1 Kg. feed each for 500,000 broilers
   - 25,000 broilers at Rosso
   - 25,000 broilers at Nouakchott
2. Grain storage is to be built to store the grain required for 8 months of production.
3. The detailed structural design is to be handled locally by an architect or structural engineer.

MAURITANIA

Feed Mill at Nouakchott

The building which has been constructed to house the feed mill is entirely adequate if the main grain storage for Mauritania is located in Rosso.

The hammermill and mixer which Dr. Kasse is ordering should be adequate to supply the broiler feed to be used.

A platform scale of about 400 kg capacity will be needed. (This should be specified as a portable platform scale, 400 kg capacity, double beam, 40 x, ½ kg, meeting Handbook H 44 requirements.)

Feed Mill at Rosso

Rosso is located in a river valley which appears to be subject to flooding. The town is protected from the river by a dike. In periods of heavy rainfall it is likely that some surface flooding will occur in most of the area. This may not be too severe since the floor of the mosque is no more than one foot above the street level; on the other hand, the floor of the governor's office is about three feet above grade. Someone should interview responsible persons

who have lived for a few years in the community to ascertain the probable level of flood waters which may be expected. If it is necessary to provide considerable flood protection, it would be best to locate the floor of the mill at truck-bed height to make the truck loading and unloading easier.

We were shown a sample of a broken grain rice product which the authorities in Nouakchott said was available in adequate quantity from the rice mill in Rosso. If further investigation discloses that this rice product is available in sufficient quantity throughout the year, less grain storage will be needed and a building similar to the one at Nouakchott will be adequate.

If grain storage is required, the amount of grain needed to feed the 50,000 broilers in Mauritania will be approximately:

$$\frac{50{,}000 \times 5 \times .7}{1000} = 175 \text{ M.T.}$$

where: 5 kg is the amount of feed to produce 1 broiler,
70% of the ration will be grain.

If grain is stored for only 8 months, 125 M.T. storage will be adequate. This will require about 180 cu. m. of actual storage space. If the building is similar to the one existing in Nouakchott, the grain can be piled to a height of about 3 m. Hence, 60 square meters of effective floor space of a bag warehouse is only about 2/3 of the total floor area, so about 90 square meters of floor space will be needed. This would be provided in a 10 x 20 m. building similar to the one in Nouakchott with half the building used for storage and the other half for processing.

This, then, would indicate a total building size of 10 x 20 m. The grain storage should be separated from the milling area by a fire-resistant wall for additional fire protection. The cost will be approximately $12,000, if contracted.

The hammermill and mixer which has been ordered will be adequate. Two platform scales of about 400 kg. capacity will be needed plus a hand truck.

MALI

Feed Mill at Bamako

The proposed site of the feedmill appears to be subject to some shallow surface flooding. It is recommended that a sand fill about one foot thick be provided under the floor.

The existing foundation can probably be used by the architect if he finds that a building 12 m. wide is not too expensive compared to a wider building.

The feed requirements per year will be:

$$\frac{8000}{1000} \times 50 \text{ T} = 400 \text{ T for layers}$$

$$\frac{8000}{1000} \times 10 \text{ T} = 80 \text{ T for replacements}$$

$$\frac{500{,}000}{1000} \times 1 \text{ Kg.} = 500 \text{ T for rearing broilers}$$

Total 980 T/year

The grain storage requirements will be about 980 x .7 x .67 = 460 tons, and the daily production will be about 4 T/day.

Since about 730 kg of grain can be stored in one cubic meter, the effective storage space will be 630 cu. m.

The structural engineer will probably elect to make one of two designs to best utilize one/half of a 12-meter long beam for the sidewall post. He may imbed the post in a concrete pier which would leave a sidewall height of about 5 m. He may set the post on a concrete pier which will provide a sidewall height of about 6 m.

If a 5 m. sidewall height is available, a storage depth of about 4 m. will be available under the roof. The floor space required will then be:

$$\frac{630}{4 \times .67} = 235 \text{ sq. m.}$$

A storage building about 12 m. x 30 m. will provide storage for the grain and other ingredients and finished feed. This would also allow a 25% increase in capacity without further addition. A 12 m. x 10 m. addition will provide adequate space for the milling equipment. This would then require a total floor space of 12 x 40 m. which will cost about $30,000, if contracted.

Since PO's and POI/C's have been issued for the mill at Bamako, the following equipment should provide adequate processing facilities:

1. The inclined auger conveyor should be used to feed the grain cleaner which will be mounted above the floor to provide gravity flow to the hammermill.

2. The hammermill should be mounted above the floor to provide gravity flow to the mixers. The gravity slide should be of an angle of at least 60° with the horizontal.

3. The two mixers should be installed as planned to provide standby capacity in case of breakdown.

4 The gross weight bagger can be installed on one of the mixer discharges, or the bucket elevator can be installed to elevate to a small bin on which the gross weight bagger would be installed.

5. The warehouse scales for weighing ingredients into the hammermill or mixer are adequate as are the hand trucks and sewing machine, which have been ordered.

SENEGAL

Feedmill at Dakar

The feed requirements for 10,000 breeders plus replacements will be:

$$\frac{10,000}{1000} \times 50 = 500 \text{ T/yr for layers}$$

$$\frac{10,000}{1000} \times 10 = 100 \text{ T/yr for replacements}$$

The grain storage required will be 600 x .7 x .67 = 285 T. requiring 400 cu. m. of effective storage space.

Dr. Kasse has preliminary plans for a building of 10 m. width. If this is constructed in 10 m. modules with a working height of 4 m. (5 m. sidewall

height), the floor space required will be:

$$\frac{400}{4 \times .67} = 150 \text{ sq. m.}$$

A storage area of 10 m. x 20 m. will provide adequate storage for the grain plus other ingredients and finished feed. A 10 m. x 10 m. addition will provide sufficient area for the grinder and mixers.

The building cost will be about 10 x 30 x $60/sq. m. = $18,000, if contracted.

The equipment ordered, one hammermill and one mixer, will be satisfactory and additional equipment should be ordered to provide about the same capabilities as those at Bamako. This includes:

One 20-ft. inclined screw conveyor (as specified for Bamako)
One grain scalper (as specified for Bamako)
Four hand trucks (as specified for Bamako)
One sewing machine (as specified for Bamako)
Two platform scales of 400 kg. capacity

Since the proposed building site at Dakar is well drained, a one-foot sand fill under the floor should be adequate.

GENERAL COMMENTS

Since the availability of repair parts is poor, an adequate set of spare parts should be ordered as soon as machine instruction books are available. Spare parts which should be on hand include:

1. All bearings and dust seals
2. All chains and sprockets
3. All V-belts
4. At least two spare screens and sets of hammers for all hammermills
5. Any other parts subject to frictional wear except shafts which can be machined locally in Dakar or Bamako if needed.

After all equipment is received, it should be determined what class of motors were furnished. All open, drip-proof motors should be replaced as soon as possible because of the fire hazard they present. TEFC, Class II, Group G motors are preferred over TEFC motors because of their greater safety in grain milling operations and should be specified at 220 v. Fifteen H. P. hammermill motors will be adequate for the planned capacity, but new couplings will be required for the smaller shafts.

All electrical controls should be located in an area where they will not be subject to grain dust. This may be a small room not directly opening to the processing area.

All motors should be equipped with thermal overload protection devices. These are available in Dakar.

Since the production capacity required is quite small compared to the capacity of each individual machine, low voltages should not be a great problem. It is doubtful that standby generators are necessary.

Ammeters rates at at least three times the hammermill motor current should be provided in the line to each hammermill motor. This should be visible to the operator to enable him to feed the hammermill at its rated capacity without overloading the motor.

Good ventilation of the processing area at Bamako and Dakar will be desirable to reduce dustiness in the mill and provide cooler working conditions. I recommend that sliding doors about 3 m. high be installed on both sides of the processing area.

The limited amounts of oyster shell should not cause excessive hammermill wear. The large chunks of sun-dried salt should be reduced to no larger than one-inch diameter before being fed into the hammermill; this may be done by hand with a hammer.

In the U. S., feedmills of this capacity would purchase a vitamin drug premix from suppliers such as Saunders (French), Pfizer, or Lohman (German). The trace mineral premix should not be incorporated with the vitamin premix because of the possible catalytic reaction.

If a decision is made at a later date to feed commercial flocks at Dakar and Bamako, the storage facilities may be extended very easily as required. The processing areas recommended above should be adequate and all of the suggested equipment can be utilized. Some additional equipment will be required, such as ingredient storage bins, elevating equipment, etc.

If the facilities should be so extended, a competent engineering firm familiar with feed mill design should be employed to design the equipment layout.

Grain fumigation will be required. If the sacked grain is stored in piles of, say, 10 m. x 10 m. x 5 m., it may be covered with plastic sheets. The sheets would be sealed along the edges with tape or by folding and at the floor by placing weights on the plastic to hold it against the floor. We recommend the use of Phostoxin as the fumigant because of the ease of handling and application.

The structures which are prescribed above provide 12 m. x 10 m. bays (Bamako) and 10 m. x 10 m. bays (Dakar). Within these bays, the sacked grain should be stacked leaving about 1 meter clearance between the stacks and the walls or other stacks. This space is necessary to inspect and treat the grain for insects. Bays longer than 12 m. would probably not be practical since this is the standard length of steel for hoists. The roof covering may be of either galvanized sheet metal or cement asbestos. The sidewall may be covered with sheet material or be built of concrete block. The structural design engineer will have to determine if it is cheaper overall to use the

load-bearing properties of the concrete block construction. Since no grain will be piled under the truss, the designer will have the option of providing knee bracing at the corner of the side post and roof truss. It is probably not desirable to install internal posts because a clear span will enable trucks to back into the warehouse for unloading.

Copies of the book "Feed Manufacturing Technology", American Feed Manufacturers Association, 63 W. Jackson Blvd., Chicago, Illinois, will provide a good reference source for personnel concerned with the operation of these mills.