



**UNITED NATIONS DEVELOPMENT PROGRAMME**  
**REGIONAL BUREAU FOR THE ARAB STATES AND EUROPE**

**UTILIZATION OF COTTON CROP RESIDUES  
IN THE PRODUCTION OF ANIMAL FEEDS**  
RAB/89/018

**PROJECT DOCUMENT**

**ARAB ORGANIZATION FOR  
AGRICULTURAL DEVELOPMENT  
(AOAD)**

**ARAB FUND FOR ECONOMIC  
AND SOCIAL DEVELOPMENT  
(AFESD)**

**KHARTOUM, MAY 1991**

UNITED NATIONS DEVELOPMENT PROGRAMME

PROJECT FOR THE GOVERNMENTS OF

EGYPT, SUDAN AND SYRIA

Project Number	:	RAB/89/018		
Project Title	:	Utilization of Cotton Crop Residues in the Production of Animal Feeds.		
Duration	:	Five Years.		
Project Site	:	Regional with Coordination Office in Egypt.		
ACC/UNDP Sector and Subsector	:	Agriculture, Forestry and Fisheries (0430)	UNDP/IPF	\$2,963,000
			Other	\$0.00
Government Implementing Agency	:	Ministries of Agricultures and Animal Resources in participating Countries	Govt. or third party cost sharing	\$0.00
			UNDP Total	\$2,963,000
Government Sector and Subsector	:	Agriculture, Animal Resources.		
Executing Agency	:	?		
Associated Agency	:	?		
Estimated Starting	:	January 1992		
Government Inputs	:	In kind - not costed		

Brief Description:

The project aims at assisting the three countries in the development and assimilation of technology of converting the colossal amounts of cotton crop residues which are now wasted or burnt, into animal feed for ruminants both at the farm and commercial production levels.

The resulting feed would probably meet a substantial portion of the feed demands in the three countries thereby providing farmers and herdsmen with cheap, well balanced animal feed; cotton growers will benefit through eradication of pests and diseases hibernating in plant residues and the Governments will benefit as the present-practice of using subsidized human staple food will cease and importation of the expensive foreign feeds will be very much reduced.

On behalf of	Signature	Date	Name / Title
UNDP			
Executing Agency			
Associate Agency			
Government of Egypt			
Government of Sudan			
Government of Syria			

## A. CONTEXT

### 1. Description of the sub-sector\*

The number of animal units in Egypt, Sudan and Syria has been steadily increasing over the past 18 years (Table 1). It has been more than doubled in Syria during this period and has increased in both Egypt and Sudan by about 60%. Such increase in animal population must have put considerable pressure on the pasture lands during a period characterized by a low and erratic rainfall, resulting in overgrazing and range deterioration. The production of animal feeds has not kept pace with the increase in animal population and remained almost unchanged.

Table 1, Rate of increase of animal wealth (in animal units) from 1970 to 1988 in Egypt, Sudan and Syria.

Country	Total Animal Units (000)			% increase		
	1970	1979	1988	Total	Annual 70-79	Annual 70-88
Egypt	4914	5123	7946	62.07	0.45	4.12
Sudan	15562	22231	24800	59.36	3.40	1.16
Syria	1654	2349	3472	109.91	3.40	3.85

The existing (1988) animal feed balance (excluding the use of grains) indicates that traditional animal feeds in Egypt, Sudan and Syria satisfies only 71%, 62% and 55% of the needs of present animal population in the three countries respectively. The deterioration of pastures and the rise in the price of fodder crops, at the time wheat and wheat products are being subsidized, has encouraged farmers and herdsmen to use the latter in animal feeding. However, wheat consumption for feeding animals, expensive as it is, has not increased the locally produced meat and milk.

Some crop residues are used as animal feeds in certain areas while the same practice is not even known in others. In Egypt, wheat straw is the main animal feed in summer. The inclusion of legume straws with wheat straw in the animal diets was not practised in Egypt until 5 years ago. Some potential crop residues (such as cotton and maize stalks) are not used in feeding because of their texture.

\* Based on a study financed by UNDP and executed by AOAD in 1990.

In the Sudan, the relatively small amounts of manufactured animal feeds contain cotton seed cake. Some farmers may formulate some rations for their dairy animals containing groundnut or sesame cake. Wheat bran, wheat straw, and sorghum stalks are completely utilized for animal feeding in the irrigated areas. About half of the production of the same is used in the rainfed areas while the remaining is used for fuel. Sheep and goats are allowed to graze cotton leaves and plant tops before the clean-up campaign in which cotton stalks are burnt in situ. Present attempts aim at carbonizing and/or briquetting cotton stalks to produce a marketable source of energy.'

The local production of wheat in Syria provides each inhabitant with about 183 kg/yr. On the world average, per capita consumption of wheat is 80 - 100kg used for bread, macaroni, pastries etc. This means that Syria produces about 82% more wheat than required on the basis of world average. Yet the country imports annually about one million tons of wheat and flour not counting other cereals.

In some areas, and during feed-shortage spells, bread is used as animal feed. It is also a common practice that stockmen use wheat, barley and corn grain as animal feed mix. It has been estimated that the amount of cereals and cereal products annually consumed by animals is 4.4 times that of human consumption.

The use of wheat and barley straws in feeding seems to be a new experience in Syria. Corn and sorghum stalks are not in use yet for feeding. Sheep and goat are used to grazing leaves of cotton after harvest. The bare cotton stalks are left standing or piled up in the fields for months for domestic use as fuel.

It has been calculated that the area cropped to fodder and animal feeds constitutes 61.78% of the cultivable area (assuming that 44.8 of the wheat area, 100% of the barley, corn, millet, sorghum and green fodder are planted for animal feeding).

Because of the virtual lack of natural pasture in Egypt, 95% of the animal population is raised in an intensive system. The main forage crops that occupy more than 1/3 of the limited agricultural land are lucerne (berseem) (Trifolium alexandrinum) used during the winter and spring with alfalfa (Medicago sativa) and Sudan grass and others being used in summer and autumn. Agricultural by-products and field wastes are extensively used. Wheat straw, rice straw, sugar-cane tops, cotton leaves, rice bran and hulls, wheat bran, cottonseed cake, corn (yellow), bean straw are all used. A considerable portion of the per capita consumption of wheat and flour goes nevertheless to animal feeding.

Cotton stalks are collected and piled up on the roofs of farmers' houses for domestic use as fuel. They become a source of pest and disease carry-over and potential fire hazard. The Government of Egypt, through the village cooperatives, pays the equivalent of 10 US cents for each kilogramme of unopened cotton bolls collected and delivered by the farmers to be burnt to reduce carry-over of bollworms.

### Strategies of Participating Countries

Within the context of the Fourth Cycle of the Regional Programme for Arab States, 1988 - 92, a UNDP Mission was fielded to the Arab Region to, *inter alia*, identify priority areas that need UNDP intervention, and briefly describe projects to support the transfer of new appropriate technologies that can be utilized in agricultural development efforts.

The UNDP Mission reported that one of the priority areas that had been emphasized by Arab authorities was the need to rationalize current disposal practices of farm wastes and agricultural by-products such as cotton field residues, rice-milling by-products, grape, olive and sugar beet bagasses and many others.

A high priority was also assigned to the utilization of non-conventional roughages in ruminant diets as the demand for animal feed continues to increase and the grain processing costs continue their upward trend. Some crop residues are increasingly used in animal diets such as the case of wheat straw in Syria. Inclusion of different legume straws in the feed mix in Egypt is gaining impetus. However, the scale of production of suitable roughages has remained far below the market needs and there is interest to explore possibilities of untapped field residues such as those of cotton.

In addition to the two priorities above, the three governments have expressed deep concern over the declining food security situation and the increasing reliance on imported staple food. It has been estimated that the value of food imports in 1984 / 86 in relations to the value of merchandise exports amounts to 83% in Egypt, 52% in Sudan and 38% in Syria. Domestic food production, could comfortably meet all, or the greater part of human food consumption needs if staple foods are not used as animal feed.

### Prior or Ongoing Assistance

In response to the emphasis made by the national authorities in Egypt and Sudan on the importance of the use of non-conventional roughage in animal feeding, UNDP organized an expert consultation on the "Utilization of Cotton Stalks in the Production of Animal Feeds" in Cairo, 5 - 7 July 1988. The consultation was attended by specialists from the two countries, and proposed, inter alia a preparatory assistance project entitled (Utilization of Cotton Crop Residues in the Production of Animal Feeds: PA).

A preparatory project under this title, RAB/89/018 was prepared, financed by UNDP and executed by the Arab Fund for Economic and Social Development (AFESD) / Arab Organization for Agricultural Development (AOAD). The main objectives of the PA project were:

- (i) to review, assess and analyse current practices of disposal of farm wastes and agricultural by-products in five countries, and
- (ii) to formulate a full-scale project document on utilization of cotton crop residues in production of animal feed.

In Syria, FAO is assisting the Department of Animal Production of the Directorate of Agricultural Scientific Research (DASR) in the use of agricultural and field wastes (Wheat Straw / bran) in animal feeding. In Egypt, a UNDP - financed project in cooperation with the Ministry of Agriculture established a centre for treating roughages with gaseous ammonia. This centre has been replicated in additional 11 sites by an EEC grant. It is now a common practice in Egypt to prepare straws of wheat, beans and rice in a pelleted form to be used in feed mills. These mills are gradually widening up the range of their raw material to include corn cobs, rice, sugarcane tops and different types of bagass.

In the Sudan, because of the acute shortage of energy resources, attention has been directed towards transforming cotton stalks into coal with the assistance of GTZ.

### 4. Institutional Framework

Responsibility for development in the three areas of interest to the project, (namely animal nutrition, cotton agronomy and agricultural engineering) in participating countries is entrusted to the following national institutions:

Egypt

- Animal Production Research Institute.  
Agriculture Research Centre (ARC).  
Ministry of Agriculture and Land Reclamation.
- Cotton Research Institute (ARC).
- Agricultural Mechanization Research Institute (ARC).
- Central Directorate of Animal Resources.
- Faculties of Agriculture of Cairo and Alexandria Universities.
- General Organization of Food and Feed Manufacturing.

Sudan

- Cotton Research  
Agricultural Research Corporation (ARC)  
Ministry of Agriculture and Animal Resources.
- Animal Production Research Administration  
Ministry of Agriculture and Animal Resources.
- Directorate of Feed Milling.  
Ministry of Agriculture and Animal Resources.
- Directorate of Range Management  
Ministry of Agriculture and Animal Resources.
- National Council for Research..
- Faculties of Agriculture and Institute of Animal  
Production, University of Khartoum and Faculty of  
Agriculture Gezira University.

Syria

- Department of Animal Production  
(Dier Al-Hajar).
- Directorate of Agriculture and Scientific Research  
(DASR).  
Ministry of Agriculture and Agrarian Reform.
- Directorate of Animal Production  
Ministry of Agriculture and Agrarian Reform.
- Directorate of Cotton Bureau, Aleppo
- Supreme Authority of Animal and Poultry Feeds.
- Faculties of Agriculture of Damascus and Aleppo  
Universities.



## E. PROJECT JUSTIFICATION

### 1. Problems to be Addressed: The Present Situation:

As explained earlier, the problems to be addressed are, in brief, the increasing animal population, the deteriorating pasture and the shortage and stagnation of feed production which resulted in the use of subsidized human staple food to feed the animals. Increasing the area of cultivated fodder crops is no solution since any shift in the farming system in this direction will be at the expense of the area cultivated with human basic foodcrops. (In Egypt green fodder presently occupies about 1/3 of the total cropped area)

As the demand for animal feed continues to increase and, feeding animals continues to encroach on human food, the importance of maximizing the utilization of non-conventional roughages in ruminant diets becomes of paramount importance. It is estimated that cotton crop field residues in the three countries amount to about 4.2 million tons of dry matter (Egypt 2.0 M, Sudan 1.8 M and Syria 0.4 M tons). 25% of this amount constitutes dried leaves. The amount of feed based on utilization of cotton roughages would possibly meet a substantial portion of each country's need.

The whole dried plant with the leaves still attached to the stalks, contains as high as 12.2% crude protein. This percentage falls to 2% in the stalk alone and reaches 35% in the detached leaves. The lower vegetative branches are highly lignified but the top fruiting branches are far less so.

The total area cropped to cotton is about 425,000 ha in Egypt, 368,000 ha in Sudan and 171 ha in Syria. The farming systems in the three countries are somewhat different and the project will take into account these differences when choosing the technologies to be adopted. In Sudan, the farming system is based on large scale production of both the American and Egyptian cotton types. In Egypt, it is small-scale farming system and the cotton is exclusively Egyptian. The system in Syria falls between the two scales and is exclusively American type cotton. Handling of the bulky cotton field residues should take into account differences in the tenancy system and the scale of production.

Utilization of cotton crop residues in production of animal feed has been tried in a number of animal nutrition laboratories inside and outside the region. The main constraints in using cotton crop residues are:

- a physical structure that makes the plant difficult to consume by the animal
- high content of lignin in the basal internodes of the vegetative branches, and low content of lignin at the top where leaves, unopened and fruiting branches are found, and
- possible presence of pesticide residues and gossypol traces.

Technologies are now known for improving the palatability, digestibility and feeding value of cotton residues and, in the mean time the breakdown of pesticide residues and gossypol traces.

## 2. Expected Situation at the End of the Project

It is envisaged that by the end of this project, models of successful systems of animal feeding will be developed and popularized in the three countries: Egypt, Sudan and Syria. The new systems will depend to a great extent on cotton crop residues and other field wastes, nutritionally and palatably improved through various treatments. They will be applicable at the small farmer level as well as at the commercial production scale.

## 3. Target Beneficiaries

Direct beneficiaries are the small resource - poor farmers who own limited numbers of animals. This group will be provided with the simple technology of making proper feed for their animals using mainly field residues of their own cotton crop. Middle farmers who may produce more crop residues than they actually need for their animals will be able to sell the roughage to roughage-feed mills thereby increasing their income. Owners of large herds who used to suffer from severe seasonal fluctuations in availability of animal feeds will have a more regular and cheaper supply through production of roughage-feed mills. The farmers at the three levels, will be provided with well balanced animal feed at a reasonable price.

Cotton growers will benefit through the decline in losses caused by the pests and diseases hibernating in crop residues particularly in bolls and stalks. An expert in the Entomology Research Institute (ARC - Egypt) estimated that the gains in cotton yield and the saving in the expenses of controlling the boll insects would amount to more than LE 60 million per year, let alone minimizing chemical control and environmental hazards.

The Governments will benefit as the present practice of using subsidized human staple food as animal feed will cease. Importation of animal feeds will be much reduced thereby improving the balance of payments. Consumers will benefit as the present upward trend in the price of meat and other animal products will be reversed or slowed down as a result of using cheaper, more balanced and more regularly available feeds.

#### 4. Project Strategy and Institutional Arrangements

The project will adopt two main approaches in each country to formulate a reasonably nutritious and cheap animal feed composed mainly of cotton and other crop residues. The first approach will aim at providing small scale farmers with a practical recipe to use cotton field residues in the preparation of enough feed for his own animals. A unit will be equipped with technicians and a mobile set of machinery to extend the technology to the farmers.

The second approach will be through establishing an experimental roughage feed mill within the activity area of the project. The mill will manage a series of activities including collection of residues at the farm gate, crushing or chopping of stalks, conveyance to the mill premises, storage under controlled conditions, and feed processing. Various physical, chemical and biological treatments and additives will be tested to improve the quality of the feed.

The mill will be producing manufactured animal feed based on cotton and other crop residues produced throughout the year.

A multidisciplinary team of researchers and a national team leader (national coordinator) will be appointed by the Government in each country. The team will include specialists in animal nutrition, agricultural engineering, animal husbandry and *agric.* economics. The National Coordinator will normally be a senior animal nutritionist. There will be a Regional Project Coordinator to coordinate and supervise the implementation of project activities in the three counties. Technical backstopping will be provided by a panel of experts (consultants) from within and outside the Region. The overall responsibility for policy orientation and decision making will be vested in the Project Steering Committee. This will be composed of ex-officio members as well as competent scientists in pertinent fields of concern to the project appointed in their personal capacity.

## 5. Reasons for Assistance from UNDP

The technology of formulating animal feeds based on crop residues is a new experience in Egypt. It is still not used to any discernable degree in Sudan and Syria. Introduction of this technology requires certain expertise, equipment and operational funds so that it may become acceptable and widely adopted. A regional project covering Egypt, Sudan, and Syria having national large scale production of cotton as the common denominator, will be more cost-effective and will promote technical cooperation among these countries. External assistance will be necessary however to assist in the organization of a cooperative frame, fill in technological gaps, provide extra support to strengthen research institutions and to demonstrate the feasibility of the concept.

## 6. Special Considerations

Animal feeding patterns are somewhat different in the three countries. In Egypt, where natural pastures are virtually nonexistent, animals are intensively fed on cropped fodder, straw and some agro-industrial by-products (bran, seed-cakes-molasses) over the years. The majority of cattle and buffaloes are used as draught animals, a situation which is not found in Sudan and Syria. In Sudan, where monsoon rains prevail in the summer, animals depend on natural pasture and move to the agricultural areas during the dry winter season. In Syria, the rains are in winter and the animals feed on natural pastures and move during summer to agricultural area where they are given expensive diets.

The project will aim at involving research institutions, extension service and the private sector to ensure the viability and feasibility of the generated technology and the quality of the produce.

As women have an important role in the animal production sector, a special effort will be exerted to extend to them project achievements. The produced feed will certainly facilitate the work load of the rural women and save much of their effort and time.

The project will promote TCDC concept among participating countries as most of the technical work will be carried by the national institutions and movement of national experts between these institutions will be encouraged and research results and experience exchanged.

The project will have a colossal impact on environment protection. It will reduce to a minimum dependence on pesticide (aerial) sprays against boll pests and others, it will reduce the clean-up campaign and the burning in situ of cotton stalks, and finally it will reduce the period cotton stalks are left in the field and becoming a source of pest carry-over.

#### 7. Coordination with Similar Ongoing Projects

With the exception of the two national projects mentioned above on the use of field wastes in animal feeding in Syria and the treatment of roughages with gaseous ammonia in Egypt, there is no other major relevant activity in the three countries. Coordination will be sought with the ongoing national projects and the experience and practical lessons learned so far will be tapped.

#### 8. Counterpart Support Capacity

Each of the participating countries has a national programme on production and improvement of animal feeds in the Ministry of Agriculture / Animal Resources. Other research institutions and faculties of agriculture and veterinary sciences are also engaged in animal nutrition research and have contributed substantially to the development of the animal production subsector.

National capabilities, however, need augmentation in manpower upgrading in the particular infrastructure need to be updated in order to undertake the adaptive research required for feed formulations based on cotton and other crop residues.

#### 9. Selection of Project HQs Site

The project Headquarters will be established in Egypt because of its being central between Syria and Sudan, its easy connections and good communication service, and because of the experience it has already gained in the field of competence of the project.

### C. DEVELOPMENT OBJECTIVES

The project will seek to develop a new animal feeding system based on using cotton and other crop field residues in balanced and cheap feed formulations. This will reduce the cost of production and consequently the price of animal products thereby

improving the level of nutrition of the people. Sustained availability of animal feeds will check the use of human, subsidized staple food in feeding animals with consequent reduction of food imports and improvement of balance of payments. Indirectly, major cotton pests will be controlled and the environment will be preserved.

D. IMMEDIATE OBJECTIVES, OUTPUTS AND ACTIVITIES

Immediate Objective 1

Establishment of a network of national institutions and selection of project site in participating countries.

Output 1.1

Establishment of Network Coordination Office.

Activities

- 1.1.1. Appoint Project Coordinator as prescribed in the project document.
- 1.1.2. Recruit administrative support staff.
- 1.1.3. Furnish and equip Project Coordination Office.
- 1.1.4. Establish links with concerned national institutions, other competent relevant institutions and feed mill supplying firms in-developed countries.
- 1.1.5. Develop a tentative annualized work plan for the operation of the project.

Output 1.2

Network of concerned institutions established and fully operational.

- 1.2.1. Discuss with concerned national institutions (for animal production, cotton, and agricultural engineering) a tentative work plan and the role played by each.

- 1.2.2. Organize the First Network Steering Committee (NSC) to discuss, scrutinize and approve the programme of work, the specific tasks to be assigned to each institution, and agree on collaborating scientists.
- 1.2.3. NSC approve project site proposed by each participating government, available physical facilities for field trials, and feeding experiments and feed mill plants.
- 1.2.4. N.S.C. approve list of equipment required for laboratory testing, feeding trials and feed processing.
- 1.2.5. Organize subsequent NSC Meetings.

### Immediate Objective 2

Establishment of an experimental roughage feed mill, and an extension service centre in each participating country.

#### Output 2.1

Roughage feed mill established.

#### Activities

- 2.1.1. Select the site of the feed mill in consultation with national collaborating scientists. The site should be close to a cotton / animal production farming system and provided with electrical power and communication facilities. *Should be accepted by local farmers.*
- 2.1.2. Invite suppliers of feed mills and support facilities to tender for supply, install and test experimental mills capable of producing compound animal feeds from cotton and other crop residues along with other specified ingredients. Specifications of feed mills should suit situations in each participating country and should be approved by the NSC. Successful bidder(s) should provide description of civil works suitable for smooth operation of the supplied machinery (Annex II).

Output 2.2

An extension service centre established.

Activities

- 2.2.1 Select the site for the extension centre near the feedmill and equip with necessary facilities (Annex III).

Immediate Objective 3

Production of compound animal feeds.

Output 3.1.

Appropriate technology for animal feed production based on the utilization of cotton and other crop residues developed and improved.

Activities

- 3.1.1. Assist collaborating institutions to undertake adaptive research on (i) methods of collection, conveyance and storage of crop residues, (ii) roughage treatment and feed processing, (iii) improvement of nutritional value, palatability and digestibility, (iv) effect of various feed-mix formulations and additives on animal productivity.

Output 3.2.

Socio-economic evaluation of produced feeds.

Activities

- 3.2.1. Assist collaborating institutions to undertake studies on (i) cost-effectiveness (including the development of a costing model for pricing milk and meat obtained from animals fed on the produced feeds), (ii) marketing and (iii) Socio-economic impact taking into consideration pest management, environment protection, health hazards and alternative usages of crop residues.

Immediate Objective 4

Upgrading manpower technical capabilities.



Output 4.1

National capabilities upgraded through training programmes for researchers and agriculturalists in animal nutrition, evaluation and quality control of animal feeds, operation and management of feed mills and marketing of compound animal feeds, etc.

Activities

- 4.1.1. Advanced non-degree fellowships for researchers through cooperative arrangements with specialized institutions in animal nutrition. The area and duration of training for each participating country will be determined by the NSC taking into consideration the gaps and priorities of each national system. Twenty-four m/m during the project's life will be allocated for each country during the project's life.
- 4.1.2. Advanced training in evaluation and quality control of animal feeds in specialized institutions. Eighteen m/m during the project's life will be allocated for each country during the project's life.
- 4.1.3. Short term training for prospective managers through cooperative arrangement with specialized institutions and suppliers of feed mills. Twelve m/m will be allocated for each country during the project's life.
- 4.1.4. Study tour of 6 animal nutrition specialists in three European countries to visit feed mills and feed-mill supplying firms.
- 4.1.5. Three joint inter-country technical consultations of the project technical and managerial staff in the three countries to be organized for 15-20 participants each meeting.
- 4.1.6. In-service 15 day long group training for technicians, 2-3 to be conducted in each country to cover operational aspects, maintenance of machinery, packaging etc.

Output 4.2

Technical backstopping provided.

Activities

- 4.2.1. Provide backstopping as required through a total of 12 m/m consultancy services during the project's life.

Output 4.3

Research facilities of national programmes related to the project fields of interest improved.

Activities

- 4.3.1. Assist national programmes in procuring research equipment, material and supplies with a view of upgrading their research capacities.

Immediate Objective 5

Creation of awareness of the potentials of produced compound animal feeds using cotton and other crops field residues.

Output 5.1.

Research - extension interface strengthened.

Activities

- 5.1.1. Conduct feeding trials through offering flock- and herdsmen free - or subsidized amounts of the produced feed so that they may test it on some of their animals. Other incentives may also be used to help farmers see for themselves the advantages of using the new feed.
- 5.1.2. Prepare and distribute extension pamphlets on potentials of the new feeds
- 5.1.3. Organize meetings with extension agents for briefing on practical recipes for the preparation of feed by the small scale farmer for his own animals from cotton and other crop residues.

## E. INPUTS

### 1. Government Inputs

#### 1.1. Personnel

In each of the three participating countries, the Ministry of Agriculture / Animal Resources, will assign the appropriate research institution(s) the responsibility of the project activities by making available:

- 1.1.1. A National Project Coordinator who will be responsible for the implementation of the project activities in the country, for coordination between the national institutions involved and for the timely preparation of the necessary technical reports.
- 1.1.2. Scientific and technical staff from collaborating institutions duly qualified.
- 1.1.3. Local staff for training at all levels.
- 1.1.4. Staffing of the feed mill and the extension service centre.

#### 1.2. Physical Facilities

The Ministry of Agriculture / Animal Resources will make available:

- 1.2.1. Necessary constructions for the experimental feed mill plant and the extension service centre.
- 1.2.2. Existing laboratories for animal nutrition research.
- 1.2.3. Experimental farm provided with animal houses, sufficient number of animals for feeding trials, farm implements, etc.
- 1.2.4. Transportation for staff and equipment inside the country.
- 1.2.5. Suitable communication facilities.

1.3. Inputs by the Country Hosting the Network Coordination Office:

In addition to the above, the host country of the Coordination Office will make available the following office facilities:

- 1.3.1. Office space for the Regional Project Coordinator and support staff.
- 1.3.2. Communication facilities.
- 1.3.3. Office equipment and supplies.
- 1.3.4. Messenger
- 1.3.5. Driver
- 1.3.6. Rent, Water, gas, electricity supplies, etc.

2. UNDP Inputs

2.1. Personnel

- 2.1.1. Regional Project Coordinator for the duration of 60 months (full-time, NPPP).
- 2.1.2. Administrative Assistant (full-time, NPPP).
- 2.1.3. Secretary/Typist (full-time, NPPP)
- 2.1.4. Short-term consultants (total 12 m/m)
- 2.1.5. Professional NPPP (total 60 m/m)

2.2 Training

- 2.2.1. Fellowships (non-degree) (total 72 m/m)
- 2.2.2. Advanced training (54 m/m)
- 2.2.3. Short-term training (36 m/m)
- 2.2.4. In-service group training (2-3\_
- 2.2.5. Joint inter-country technical consultations (3).

### 2.3. Equipment

As per attached Annexes II and III.

### 2.4. Miscellaneous Expenses

For operation and maintenance of equipment and machinery, reporting cost and sundries.

## F. RISKS

The only risk of significance may be the inability of a participating country to provide necessary inputs intine (technical personnel, physical facilities and local operating resources) to counterpart the project contribution. Implementation of the project may be delayed in that country, but will proceed as planned in others.

The anticipated project life of five years should be sufficient to achieve the project objectives. However, a few activities may have to be extended for a short Phase II to ensure a positive impact of the project achievements on agricultural development at large.

## G. PRIOR OBLIGATIONS AND PREREQUISITE

1. The commitment of participating countries to initiate, if has not already done so, and sustain national programmes for the utilization of agricultural by-products and field crop residues in production of animal feeds.
2. The commitment of participating countries to provide necessary staff and nominate the national coordinator and make available necessary laboratory and field facilities including a flock/herd of reasonable size.
3. The commitment of participating countries to allow free exchange of research results and other findings between member countries.

## H. PROJECT REVIEWS, REPORTING AND EVALUATION

The project will be subject to tripartite reviews by UNDP, the executing agency and the Chairman of the Steering Committee representing participating governments. The first such review will be held after 12 months of the beginning of full implementation.

The three National Coordinators will prepare and submit to each tripartite review, through the Regional Project Coordinator, a Project Performance Evaluation Report (PPER). Additional PPERs may be requested, if deemed necessary, during the project's life.

A project terminal report will be prepared for consideration at the terminal tripartite review.

The project will be subject to evaluation approximately 36 months after the beginning of full implementation and one at the end of the fifth year. The terms of reference and timing will be decided after consultation between participating countries, the Steering Committee and UNDP.

#### I. LEGAL CONTEXT

This Project Document shall be the instrument referred to as such in Article 1, Paragraph 1, of the Basic Assistant Agreement between the United Nations Development Programme and the Governments of those participating countries which have signed such Agreement. Alternatively, for those participating countries which have not signed such Agreement, this Project Document shall be the instrument referred to as a Plan of Operation in Article 1, Paragraph 2, of the Agreement concerning assistance under the Special Fund Sector of the United Nations Development Programme, between UNDP and the Governments of those participating countries which have signed such latter Agreement.

#### J. ORGANIZATIONAL STRUCTURE

The rationale of the networking in this project is to mobilize available expertise in the three participating countries to develop a suitable technology for the utilization of cotton and other crop residues in the production of earnestly needed animal feeds.

##### National Collaborating Institutes

Collaborating R/D institutions will undertake back-up research on aspects assigned to each relevant to agric-engineering, animal nutrition husbandry, crop husbandry etc. Such research will be carried out largely from the institutions' own resources. However, the project will help in filling gaps in physical facilities, in manpower development and in coordination.

### Technical Support Institutions

The project will promote exchange of experience between national institutions involved in the project activities and R/D institutions and firms in industrialized countries known for their expertise in the relevant fields of competence. The NSC, in consultation with these institutions, will devise a modus operandi for cooperation between the two parties.

### National Coordinator

The National Coordinator will be a specialist in animal nutrition appointed by the Government and will undertake the following tasks;

- Manage and Coordinate project activities among the national collaborating institutions.
- Supervise the experimental feed mill plant installed for the project.
- Organize all project meetings held in his country.
- Supervise the implementation of training programmes at the national level.
- Advise the Regional Coordinator on consultancy needs and suggest consultants profiles.
- Assist the Regional Coordinator by providing equipment specifications and participating in their selection.
- Manage and supervise funds allocated for activities authorized by the Regional Coordinator.

### Regional Project Coordinator

*The Regional Project Coordinator will be recruited from amongst nationals of the 3 countries ( Egypt, Syria, Sudan ), preferably from the last two if possible.*

The minimum qualification will be a university degree with post-graduate qualification in animal nutrition and a minimum of ten years experience in feed formulation using agricultural roughage. He should have sound managerial and reporting experience. Proficiency in Arabic and English is essential.

In close collaboration with the National Coordinators and under the guidance of the Network Steering Committee, the Regional Coordinator will undertake the following responsibilities;

- Establish the Regional Network Coordination Office.
- Prepare a detailed workplan for the entire duration of the project for consideration by the NSC.
- Supervise and monitor the implementation of the project workplan.
- Be responsible for the recruitment of consultants.
- Be responsible for ordering and eventual installment of project equipment and machinery as approved by the NSC.
- Manage and supervise the use of funds allocated for project personnel and labour in accordance with UNDP procedures.
- Monitor and report on project progress in accordance with UNDP policies and procedures.
- Submit Project Performance Evaluation Reports (PPERs), terminal reports, technical and other ad hoc reports in accordance with UNDP reporting procedures.
- Report to the NSC on progress and achievements made as well as on major problems impeding the smooth implementation of the project.

#### Network Steering Committee (NSC)

The overall responsibility for policy orientation and decision making will be vested in the NSC composed of:

- National Coordinators (ex-officio)
- Three members nominated each by the respective government to represent disciplines other than animal nutrition.
- UNDP representative.
- Regional Project Coordinator (Technical Secretary).
- A maximum of three co-opted members of outstanding experience in relevant technical fields invited in observer capacity .



The Chairman of the NSC will be elected by the Committee from amongst National Coordinators for one year term and will be eligible for re-election for another term.

The NSC will exercise the following functions:

- Review, and approve annual work plan.
- Coordinate all relevant activities.
- Consider relocation of the Regional Network Coordination Office.
- Approve R/D programme, required consultancies and training programme.
- Consider other issues referred to it from national coordinators and/or the Regional Coordinator.
- Review and approve the annual report prepared by the Regional Coordinator on progress, achievements, impediments and future plans.
- Establish, if deemed necessary, sub-committees to examine specific issues.
- Approve the appointment of co-opted members of the NSC as observers.

The NSC will meet at least once every year.

K. PROJECT BUDGET COVERING UNDP CONTRIBUTION

COUNTRIES : Egypt, Sudan, Syria.  
 PROJECT NUMBER : RAB/89/018  
 PROJECT TITLE : Utilization of Cotton Crop Residues in the  
 Production of Animal Feeds.  
 DATE PRINTED : 1/4/1991  
 UNDP CONTRIBUTION IN US\$ 1000:

Project Components	Total		1992		1993		1994		1995		1996	
	m/m	Amt	m/m	Amt	m/m	Amt	m/m	Amt	m/m	Amt	m/m	Amt
10. <u>Project Personnel</u>												
11. <u>International Experts</u>												
11.50 Consultants	12	120	2	20	3	30	3	30	2	20	2	20
11.90 Sub-total	12	120		20		30		30		20		20
13. <u>Administrative Support Personnel</u>												
13.01 Admin Support Staff	60	90	12	18	12	18	12	18	12	18	12	18
13.02 Labour		240		40		50		50		50		50
13.99 Sub-total		330		58		68		68		68		68
15. <u>Duty Travel</u>		75		15		15		15		15		15
16. <u>Mission Cost</u>		75		15		15		15		15		15
17. <u>National Professionals</u>												
17.01 Regional Coordinator	60	180	12	36	12	36	12	36	12	37	12	36
17.02 NPPP	60	120	8	16	14	28	14	28	12	24	12	24
17.99 Sub-total		300		52		64		64		60		60
19. <u>Component Total</u>		900		160		192		192		178		178

K. PROJECT BUDGET COVERING UNDP CONTRIBUTION (CONT.)

COUNTRIES : Egypt, Sudan, Syria.  
 PROJECT NUMBER : RAB/89/018  
 PROJECT TITLE : Utilization of Cotton Crop Residues in the  
 Production of Animal Feeds.  
 DATE PRINTED : 1/4/1991  
 UNDP CONTRIBUTION IN US\$ 1000:

Project Components	Total		1992		1993		1994		1995		1996	
	m/m	Amt	m/m	Amt	m/m	Amt	m/m	Amt	m/m	Amt	m/m	Amt
<b>20. Sub-Contracts</b>												
21. Sub-contract A		320		320								
22. Sub-Contract B		320		320								
23. Sub-Contract C		320		320								
<b>20 Component Total</b>		<b>960</b>		<b>960</b>								
<b>30 Training</b>												
<b>31.00 Fellowships</b>												
31.01 Animal Nutrition	72	108	18	27	18	27	18	27	18	27		
31.02 Feed Quality	54	81			18	27	18	27	18	27		
31.03 Management control of Feed Mills	36	54			12	18	12	18	12	18		
32. Study tours/group training		60				15		15		15		15
33. In-service training		60				20		20		20		20
<b>39 Component Total</b>		<b>363</b>		<b>27</b>		<b>107</b>		<b>107</b>		<b>107</b>		<b>15</b>
<b>40 Equipment</b>												
41. Expendable / Supplies		120		30		30		20		20		20
42. Non-expendable		360		120		90		60		60		30
<b>49 Component Total</b>		<b>480</b>		<b>150</b>		<b>120</b>		<b>80</b>		<b>80</b>		<b>50</b>
<b>50 Miscellaneous</b>												
51. Operation and Maintenance		170		20		40		40		40		30
52. Reporting Cost		45		5		10		10		10		10
53. Sundries		45		9		9		9		9		9
<b>59 Component Total</b>		<b>260</b>		<b>34</b>		<b>59</b>		<b>59</b>		<b>59</b>		<b>49</b>
<b>99 UNDP Contr.</b>		<b>2963</b>		<b>1331</b>		<b>478</b>		<b>438</b>		<b>424</b>		<b>292</b>













a. Selection of technology

The experimental feed mill will be established as a prototype demonstrating the feasibility of producing animal feed mainly from cotton and other crop residues.

The selected capacity of the plant will be about 3 ton/hour. This is based on the need first to test the adopted technology and second to minimize the conveyance distance of the bulky raw material. The three ton / hour plant would require about 18500 tons of raw material annually. This amount may be collected from 5 - 6 thousand hectares. Assuming that the plant is situated in the centre of this area, the farthest point will be at 4 km distance. This distance could be crossed either by camels, mules or even donkeys. However, if the raw material is chopped at farm gate and packed in jute sacks, conveyance becomes much easier and quicker using draught animals or tractor driven trailers.

A storing area of about 3 hectares will be required if whole plants are stalked. Chopped raw material would require half this area.

Roughage based diets containing not more than 25 - 30% concentrates are well consumed, digested and utilized by ruminants. This roughage to concentrate ratio is also easier to manufacture than whole roughage diets. Alkali treatment of the residues may be compensated for by the critical balancing of calcium to phosphorus. From 40 to 70% improvement in the performance of animal is achieved by adjusting the calcium to phosphorous ratio in the diet. Balancing of energy to protein, nitrogen to sulfur, non soluble proteins in the rumen .. etc. will add to the value of the feed.

Alkali treatment is frequently avoided because of the undesirable effect of sodium hydroxide. Ammonia, ammonium hydroxide or urea is used. The mill of 3 ton/hour capacity, using roughages at a rate of 75%, will need 45 tons of treated roughages each day. The work should be organized in such a way that a treated heap of roughages of 45 tons, is ready for processing every day. A dryer will be required to reduce moisture content from 50-55 to 8 - 10 % if the treatment is done using ammonium hydroxide or urea.

b. Preparation of the Site

The area of the feed mill premises should not be less than 3 ha, connected to a paved road and provided with high voltage electricity, drinking water and communication facilities.

It is proposed to establish the feed mill in the following areas; Sakha (Egypt), El-Hasahisa (Sudan) and Aleppo (Syria). These areas grow cotton on a large scale and have high animal density.

- The site should be leveled and fenced with a main entrance allowing the passage of big trucks.
- The weighing bridge should be located at 30m distance from the main entrance to the right.
- The storage area of cotton and other crop residues should be divided longitudinally into 12m wide land strips separated by 3m wide roads. The land strips should be provided with open drains to avoid accumulation of rain water. Covering sheets made of water-proof garment will be used to protect the heaps from rain.
- Specifications of the construction work for feed-mill plant should be provided by the supplier.
- The water pipes and outlets with the respective water hoses designed for fire prevention should be approved by the state fire prevention authorities and the insurance company.
- The main transformer should be located adjacent to the standby electricity generator with the automatic switch in-between. All these devices should be kept under a suitable shed with fully open sides to enable aeration.
- The main fuel tank with its pump and the steam generator should be next to the stand-by electrical generator and all of them should be at a maximum distance from the raw material storage area.
- In addition to the main hall housing the feed mill plant, the building should include stores for chemicals and spare parts, laboratory, office rooms, cloth changing rooms and toilets.
- All inside buildings and roads, the fence and all working points should be illuminated.
- Purchase of machinery will be by competitive bidding to specifications approved by NSC. Suppliers will be asked to prepare production line designs and construction work for installing the machinery in addition to details of their offer.

c. Description of machinery and equipmentGeneral:

- All machinery should be of the heavy duty type.
- The machinery should be organized in a horizontal plane. Materials will be transferred from a part to another by bucket elevators.
- Control of operation of the plant should be of push button system.
- Alarming system for irregularities should be installed.
- All motors should be dust proof and equipped by devices of current disconnection on overloads.
- All cyclons should be fitted at its outlets by airlocks.
- Aerodynamics of the whole plant should be balanced precisely with the dust preventors.
- Electrical devices will operate using 220 volts (50 Herz).
- Capacity should be 2.5 to 3 metric tons per hour of a complete diet formulated from 75 percent roughages and 25 percent concentrate.
- Delivery of the plant will be after on week of continuous operation (three shifts per day) at the committed capacity of plant (2.5 - 3 tons per hour).
- A bond of 10 percent of the machinery price should be deferred for one year from the date of delivery against manufacturing defects.
- The buffering bins should be equipped with devices for indicating the empty and full levels of each bin with a suitable alarm for each case.
- All hammer mills should have different sieves of various hole diameter (5, 10, 15 mm).
- Supplier should deliver the specifications of the civil works of machinery stands and the lay-out of the plant.

Reception of Ingredients

- The concentrate ingredients reception (25 to 30 percent of total capacity).

- Reception ditch below ground level with a magnet sieve at the opening for receiving one ton of bran per 10 minutes. Conveying from the ditch to the mixer will be done by a screw.
- Hammer mill for cakes of the capacity of 500 kg. per 10 minutes fitted with a cyclon and an airlock before delivery to the mixer.
- A manually fit premixer of 150 kg. capacity per a batch. Contents of the premixer will be conveyed to the concentrates mixer by screws.
- Concentrates mixer will be of the capacity of 1.5 tons per 20 minutes.
- Concentrates mixer will be emptied by screws to a buffering bin of 7 tons capacity.
- Molasses tank of 45 tons capacity (storage capacity for 2 weeks) with an outlet slightly above its bottom level. Heating source of the outlet will be a water jacket fitted with 6 electrical electrodes each of one kilowatt. Molasses filter should be fitted between the outlet and the molasses pump to assure the accuracy of the selected rate of molasses addition. Pipes conveying molasses to its point of addition should be heat insulated.
- A tub grinder of one ton per hour capacity for cereal and legume straws with its feeding conveyer. A belt conveyer will transfer material from the tub grinder to the hammer mills.
- Chopper of one ton per hour capacity for corn and sorghum stalks and bagass with a feeding chain conveyer. Chopped materials will be blown up to a cyclon fitted with an airlock to drop it into the hammer mill.
- Two mobile cotton stalk choppers (tree-chopper) with P.T.O. shaft drive and each of 1.3 - 1.5 tons / hour capacity and appropriate delivery system to an adjacent trailer.
- Three hammer mills:
  - A hammer mill receiving from the top grinder (one ton per hour capacity)
  - A hammer mill receiving from the chopper (one ton per hour capacity).

- A hammer mill receiving from the cotton stalks choppe (one ton per hour).
- Each will blow the material to a cyclon fitted with a airlock.

d. Proportioning

- The three cyclons fitted after the three roughage hamme mills will drop the materials each in buffering bin of th following capacity:
  - Bin for receiving straw = 2 tons capacity
  - Bin for receiving corn and sorghum stalks and bagass = 2 tons capacity
  - Bin for receiving cotton stalks. = 1 ton capacity.
- The bin for concentrates and the bins for roughages should be built adjacent to each other as to enable delivery c their contents to the main mixer. Transfer of material from each bin to the main mixer will be done by prope screws (padle conveyer for roughages).
- Driving motors of the screw conveyers should be of variabl speed to enable the execution of variable formulas.

e. Mixing:

- The main mixer should be of one ton per batch capacity an it should be erected on a weighing cell to enabl proportioning from four bins. The main mixer will b slanted with a device that enables changing its shape (by motor). Mixing will be achieved by two padle screw revolving against each other.
- The main mixer will be emptied by a padle screw to buffering bin of two tons capacity.

f. Pressing:

- Molasses mixer will be receiving the materials from th buffering bin and mixing it with molasses atomized wit steam before delivering it to the press. This mixer i equipped with padle screw driven by a variable speed motor. The internal surface and shaft of this mixer should b treated in a way to prevent the sticking of molasse materials.

- The press should be of a horizontal flat die. Two diameters (12 and 18 mm.) of perforation will be required. Perforation suitable for mixtures of roughages plus concentrates in the ratios of 1:1, 1:2, and 2:1 will be required.
- Precautions against penetration of fines inside the rollers should be taken, e.g. two consecutive oil seals should be fitted at the sides of the bearings.
- There should be a thermometer indicating the temperature of the oil bath inside the press.
- The R.P.M. of the press head is preferred to be around 50 R.P.M.

g. Cooling:

- A steep bucket belt conveyer will receive the pelleted materials from the press to convey it to a cooler.
- A horizontal cooler with a variable speed motor and a distributing slide at the receiving point.
- A vibrating sieve will receive the cold materials to separate the fines from pellets, pellets will be conveyed by a belt conveyer by a bucket built conveyer to the end product storing bin. Fines will be conveyed by screws back to the press.

h. Bagging

- The end product storing bin will be equipped with 3 outlet openings, one for bulk loading and the other two will be fitted with automatic bag weighers. Filled bags will be dropped from each weighing point on an autom belt which in turn move it to the sewing machine.

i. Additional Equipment:

- An electrical lift of one ton capacity to be fitted above the press.
- A fork lift of one ton capacity operated by diesel fuel.
- Two electrical loading belts.

- One diesel engine tractor of 60 H.P. fitted with front end loader hydraulically operated.
- Two trailers (4 wheeled) of the side tipping type of capacity 3 tons each. Each with drawbar, hydraulic cylinder, hydraulic hoses and fittings to a pulling tractor.
- A stand-by generator of 1000 kilowatt operated by diesel fuel. Its operation should be self-initiated by an attached automatic switch.
- Steam generator of half a ton dry steam per hour, to be diesel fuel operated and automatically ignited with proper alarms for any disorder. A water softener should be attached. Also meters for reading the pressure and steam flow should be fitted.
- A laboratory for proximate analysis (moisture, ash fiber, protein, calcium and phosphorus determinations). See attached description of this laboratory (Appendix).
- Fire extinguishers should be provided in proper capacity inside the plant. A network of water pipes should be designed and executed in the area of sorting raw materials with proper hose lengths and water outlet points.
- Fuel (diesel) storing tank with a pump for its filling and emptying.
- Water storing tank (40 m<sup>3</sup>).
- Two diesel engine tractors each of 60 H.P. and a draw bar for a trailer and hydraulic system for a tipping trailer and 540/1000 r.p.m. P.T.O. shaft.
- Two 4-wheeled trailers, each of 5 ton capacity and of the side tipping and a trailer drawbar.
- Also a set of hydraulic cylinders, hydraulic hoses and fittings for its operation.

Feed mill personnel provided by the Government

The required personnel for running the mill would be as follows:

Staff	No.
- Manager (Animal nutrition)	1
- Auditor	1
- Engineer (Mechanic)	1
<u>Assistants:</u>	
- Secretary	1
- Clerks	1
- Mechanic assistant	1
- Electrician assistant	1
- Agricultural engineer assistant	1
<u>Skilled Labourers:</u>	
- Weighing officer	1
- Tractor drivers	2
- Loader driver	1
- Store keeper	1
- Security chief	1
- Technical labourers	2
<u>Labourers:</u>	
- Guards	3
- Labourers	10



### Selection of Technology

An extension service centre will be established in the project area in each participating country to extend to small farmers and herdsmen a simple technology of transforming cotton and other crop residues into animal feed.

The center will provide - among others - movable choppers for cotton and other crop stalks, and will give advice on the types and amounts of crop residues that should be stored so as to ensure giving the animals to the extent possible feeds of constant composition. The centre will also distribute a pre-made supplement of molasses, urea and mineral mixture along with the technique of using it. In Egypt, where ammonia and ammonium hydroxide are available at economical price, the farmers will be trained to apply ammonia.

Treatment with alkali such as sodium hydroxide, ammonium hydroxide or ammonia gas improves the digestibility of the roughage. However, NaOH treatment is known to turn the soil alkaline on the longrun. Treatment with ammonia requires longer time (1 month in summer and 1.5 months in winter) than sodium hydroxide, but it does not do any harm to the soil. Moreover, it enriches the resulting feed with some extra protein and improves its digestibility by about 25%. Treatment with ammonia requires plastic sheets to tightly wrap crop residues to prevent any loss of ammonia during the treatment. Cylinders, or mobile tanks of liquid ammonia fitted with gas gauge will be required. The technique of treating the residues with equal amounts of 5% urea solution could also be used. It needs no special precautions like those needed when using ammonia. Urea will be hydrolyzed after 8 - 12 hours by natural micro flora giving ammonia and ultimately having the same effect.

Chopping of crop residues increases the exposed ends of the fibrils and so increases fiber digestibility in the rumen. The combination of chopping and treatment with ammonia enhance the improvement of the nutritive value.

Supplementation of the treated (or untreated) material with proper amounts of easily fermentable carbohydrates (molasses), cheap source of crude protein (urea) and minerals which may be deficient or lacking in the crop residues, will improve not only the nutritive value of such combination but also its assimilation at the tissue level of the animal. Hence the ratio of animal product obtained per kg consumed feed will be improved.

### Preparation of the Site

The area of the site should be about 1000 m<sup>2</sup>, and connected to a paved road and provided with electricity, drinking water and telephone services. It should have easy access to the feedmill. It should be leveled, fenced and provided with a small pre-fabricated huts for the manager, agricultural extension agent, other technicians, clerk/secretary, and toilets. Sheds for the machinery, a diesel storing tank provided with a pump, a stockroom for mineral salts, urea. Vitamin "A" etc. and a molasses storing tank with a heating outlet are required. The heating outlet device is a doublejacket container heated with water. A molasses pump draws the heated molasses and presses it into the storing tank. A filter should be fitted between the tank and the pump. A storing area of about 700 m<sup>2</sup> for cotton crop residues and the agricultural by-products should be made available.

### Description of Machinery and Equipment

A double jacket tank of one ton molasses capacity should be installed. The water in the jacket should be heated by 6 kw electrodes. The tank should be equipped with a stirrer driven by an electrical motor to dissolve urea and mineral salts in molasses. The tank should have an outlet tap to empty the molasses when still hot into jenkins to be distributed to farmers and herdsman. Also required:

- A weighing balance of 200 kg capacity.
- Two diesel fueled tractors each of 60 HP provided with trailers.
- Two small mobile tree choppers for cotton stalks and two straw choppers.

The center for Egypt should be provided with two ammonium hydroxide tanks each of one ton capacity loaded on a truck with the necessary gauges and pressure tubing and half a ton of heavy plastic sheets for wrapping the material to be treated.

The working team, provided by the Government, will be composed of:

Staff :           Manager (Animal nutritionist)  
                  Agricultural Extension Officer  
                  Agricultural Engineer.

Skilled Labour:   Tractor driver  
                      Mechanic  
                      Store keeper

Labour :           Guard  
                      Cleaner.