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WEST AFRICAN FERTILIZER STUDY - PHASE II

IFDC has just completed for AID/W an overall study describing the present and future capability to produce, market, and consume fertilizer in west Africa. Problems have been identified and a basic long-term strategy is beginning to unfold. This has been all covered under Phase I of the overall study. Some of the general findings are as follows:

1. Major food deficits now exist in the Sahelian countries (1.8 million mt in 1974) and are likely to become even larger in the near future (2.5 million mt in 1980) unless a major effort is made to accelerate food production.
2. While several projects are now under way to offset the food problem the likelihood of success seems remote unless large quantities of fertilizer are used in conjunction with these efforts.
3. With the exception of Senegal, no indigenous capacity to produce fertilizer exists and all fertilizer must be imported and moved over rather long and expensive transport routes before reaching the farmer. However, the region does possess substantial quantities of rock phosphate, some of which is of suitable quality to merit exploitation.
4. Fertilizers, while needed, are too expensive under present conditions in the Sahel to warrant extensive use on food crops. What small quantities are used are primarily for use on such export crops as cotton, peanuts, etc.

5. A further complicating factor, with the exception of Senegal, is that very little reliable data on farm fertilizer response for food crops are available to develop suitable educational programs to promote fertilizer use.

6. Finally, without exception, the food and fertilizer policies followed by the governments of these countries are such that farmers do not find it suitable to produce food or use fertilizer on food crops at the levels needed to offset food deficits.

As a result of these findings, it was concluded that for fertilizer to play a major role in helping narrow the gap in food production the cost must be reduced, more technical information made available to predict "on farm level" response, and agricultural policies, particularly food production and fertilizer policies, must be changed and made favorable to the farmer.

Phase II Activities and Objectives

The activities and objectives of Phase II of the West African Study are based upon the above findings and proposed as follows:

I. General Objectives

There are four basic objectives to be accomplished in Phase II of the overall study. These are as follows:

1. Carry out detailed feasibility studies to find ways to lower the cost of fertilizer in the west African region.
2. Carry out initial studies to identify the necessary policy changes needed to increase fertilizer use.
3. Develop further projects that will better define the on-farm response of fertilizer by food crops.

4. Provide the needed advisory service to AID and the Club des Amis du Sahel to ensure that the overall planners of assistance to the countries of West Africa understand the role fertilizer might play in the overall development of the region.

II. Description of Activities Planned for Phase II

A brief description of each project is as follows: (More detailed discussions appear in appendices A-G.)

1. Lower the Cost of the Fertilizer Materials

The cost of fertilizer to the farmer in the Sahelian region is two to three times that found in the United States. This is due to the fact that no production units exist within the area (except those in Senegal) and fertilizer must be imported over great distances; hence, transport costs represent the major component of the final price to the farmer.

Several opportunities have been identified in Phase I to reduce these costs. Some of these appear below:

a. Development Of Existing Deposits

Substantial reserves of phosphate rock are already known to exist in Mali and Upper Volta. Substantial information already exists on the Tilemsi deposits of Mali and the Arli and Kodjari deposits of Upper Volta such that feasibility studies can now begin for simple mining and grinding operations. The details of the two proposed projects (one for each country) appear in appendix A as projects A_1 and A_2

and are feasibility studies for rock mining and grinding operations in Mali and Upper Volta.

For the Kodjari deposit (30 million mt) and an additional deposit at Aloub-Djouna (50 to 100 million mt), insufficient information is available regarding ore quality to warrant a general program of exploitation. The work proposed under project B_1, appendix B, is designed to remove this obstacle. It is a research project.

b. Further Identification of Reserves

Phosphate rock deposits are known to exist in Mauritania, and there is some evidence of their existence in Chad as well. The activities proposed in appendix C, projects C_1 and C_2, are exploration studies designed to (1) establish the size of reserves in Mauritania; and (2) verify the existence of phosphate rock near Lake Chad in Chad.

c. New Innovations in Bulk Handling and Blending

While development of local deposits of phosphate rock offers a major opportunity for reducing costs of fertilizer, substantial quantities of fertilizer will still have to be imported, particularly N and K if the full potential of the current effort in food production is to be realized.

Handling of fertilizer imports in bulk or semi-bulk form and bulk blending with special innovations to fit west African conditions offer an immediate and distinct opportunity to reduce the cost of getting fertilizer to the farmer. Projects described in appendix D are aimed mainly at conducting feasibility studies for establishing bulk-blending units in Chad, Upper Volta, and Mali (projects D_1, D_2, and D_3).

2. Improve Food and Fertilizer Policies to Ensure Small Farmers Motivation to Produce Food

The IFDC study conducted in Phase I clearly indicated current policies for food and fertilizer use in the west African countries do not benefit the farmer or encourage him to produce a marketable surplus of food.

The activities described in appendix E, project E, are designed to identify in one country (Senegal) what changes are needed in fertilizer policy, particularly those needed to stimulate fertilizer use on food crops.

3. Advisory Services

Sections I and II deal mainly with studies proposed for Phase II. In addition, IFDC proposes to supply technical services (2 man-months) to assist AID/W personnel in developing a PRP for the soil fertility project identified in Phase I of the overall study. Additional services, yet to be identified and totaling 9 man-months, are proposed for supplying technical expertise on fertilizer to the Club des Amis du Sahel and to the various USAID missions within the region. The details of these appear in appendix F.

4. Other Activities

No provision was made to print and publish for external distribution the report developed under Phase I of this overall effort. Details are presented in appendix G for providing both English and French versions of the study.

III. Summary Budget of Proposed Phase II Activities

The attached table summarizes the total inputs proposed for Phase II. These total 101 man-months and $475,457. Greater detail may be found in the attached table and in the specific budgets for individual projects described in appendices A-G.

APPENDIX A - ROCK MINING & GRINDING - PROJECT A

PROJECT PROPOSAL SUMMARY STATEMENT

Project Title: Phosphate Rock Mining and Grinding, Tilemsi Valley, Mali--Feasibility Study.

Project Originator: International Fertilizer Development Center (IFDC)

Project Initiation: October 1, 1976

Project Completion: October 1, 1977

Project Objectives:

1. Review the plans of the Government of Mali for exploitation of the Tilemsi Valley phosphate deposits.
2. Study the available geological data and the actual mine site and devise a mining plan.
3. Determine the optimum location for the grinding and bagging facility.
4. Recommend equipment components, configuration and size for mining and grinding the phosphate rock for direct application.
5. Make a preliminary engineering study for a plant to meet the above objectives. This would include major component selection, general arrangement engineering, and an accurate cost estimate for the plant.

Project Description: A team consisting of a mining engineer and a mechanical engineer will visit Mali to discuss the project with government agencies, visit possible grinding sites, visit the site of the phosphate deposits, and recommend a plan (including costs) for mining, grinding, and bagging the phosphate rock.

PHOSPHATE ROCK MINING AND GRINDING, MALI

Feasibility Study of Mining and Grinding Tilemsi Valley Phosphates

Reserves of approximately 20 million metric tons of phosphate rock (PR) exist in the Tilemsi Valley north of Tamaquilett. The ore contains about 27.5% P_2O_5 but can be upgraded to 31.5% P_2O_5 by simple manual methods: screening and hand picking. Mali is currently using nearly 4,000 mt/year of P_2O_5 or 13,000 mt/year of PR equivalent. Grinding of locally available PR for direct application could be used to supply about 50% of this requirement.

Mining and grinding of PR on a small scale is not widely practiced in the world. However, since transport cost for importing fertilizer into Mali is so high, use of locally available materials is attractive even on a small scale. Timely availability of a cheap source of P_2O_5 would benefit the small farmers and lead to increased crop production. Beginning development of an indigenous resource would provide employment for local labor and also be an excellent starting point for future extension of industrial fertilizer activities.

As a result of the West Africa Fertilizer Study, IFDC recommended a project for mining, grinding, and bagging the Tilemsi Valley PR. The purpose of this study is to determine the feasibility of such a project.

Objectives

The overall objective of the study will be to review current plans for exploitation of PR deposits in Mali and make detailed recommendations for mining, grinding, and bagging PR for direct application.

Specific objectives are as follows:

1. Review the plans of the Government of Mali for exploitation of the Tilemsi Valley phosphate deposits.

2. Study the available geological data [illegible] ine site and devise a mining plan.
3. Determine the optimum location for the grinding and bagging facility.
4. Recommend equipment components, configuration, and size for mining and grinding the phosphate rock for direct application.
5. Make a preliminary engineering study for a plant to meet the above objectives. This would include major component selection, general arrangement engineering, and an accurate cost estimate for the plant.

Description of the Project

Sufficient reserves of PR have been identified in the Tilemsi Valley to support a phosphate industry. Demand in Mali for P_2O_5 is quite low compared to world standards. However, there appears to be sufficient demand to support a small grinding and bagging operation. A project involving mining, grinding, and bagging PR for direct application was recommended by the IFDC West Africa Fertilizer Study team.

It is proposed that a study team consisting of a mining engineer and a mechanical engineer experienced in design of grinding equipment visit Mali to determine the feasibility of mining, grinding, and bagging the PR. It is anticipated that accomplishment of this objective will require detailed discussion with appropriate government agencies, visits to the deposits and possible plant sites, development of a mining plan, development of basic design of the process and equipment (including costs), and preparation of a report detailing the findings and recommendations. The time required for the mining engineer is estimated at 3 weeks,

1-1/2 weeks for preparation and report writing and 1-1/2 weeks in-country. The time required for the mechanical engineer is estimated at 4 weeks, 1-1/2 weeks for preparation and report writing and 2-1/2 weeks in-country. In addition, a preliminary engineering study (preinvestment) would be carried out by a firm familiar with mining and grinding equipment.

BUDGET

Mining Engineer 3 weeks @ $1,600/week (Consultant)*	$ 4,800
Mechanical Engineer 4 weeks @ $1,000/week (Consultant)*	4,000
International Travel	3,000
Per Diem 28 days @ $50/day	1,400
Internal Travel	500
Preliminary Engineering Study	15,000**
Interpreter 15 days @ $100/day	1,500
Report	
50 copies @ $10/copy	500
Total before administrative charge	$30,700
Administrative charge @ 35%	10,745
TOTAL COST OF STUDY	$41,445

*To be named

**Includes:

Mechanical Design Engineer 4 weeks @ $1,000/week	$ 4,000
Cost Estimator 4 weeks @ $1,000/week	4,000
Draftsman 7 weeks @ $800/week	5,600
Secretarial 1.5 weeks	400
Design Report (Drawings and Specifications)	1,000
	$15,000

APPENDIX A - ROCK MINING & GRINDING - PROJECT A2

PROJECT PROPOSAL SUMMARY STATEMENT

Project Title: Phosphate Rock Mining and Grinding, Kodjari Deposit, Upper Volta--Feasibility Study.

Project Originator: International Fertilizer Development Center (IFDC)

Project Initiation: October 1, 1976

Project Completion: October 1, 1977

Project Objectives:

1. Review the plans of the Government of Upper Volta for exploitation of the Kodjari phosphate deposits.
2. Study the available geological data and the actual mine site and devise a mining plan.
3. Determine the optimum location for the grinding and bagging facility.
4. Recommend equipment components, configuration and size for mining and grinding the phosphate rock for direct application.
5. Make a preliminary engineering study for a plant to meet the above objectives. This would include major component selection, general arrangement engineering, and an accurate cost estimate for the plant.

Project Description: A team consisting of a mining engineer and a mechanical engineer will visit Upper Volta to discuss the project with government agencies, visit possible grinding sites, visit the site of the phosphate deposits, and recommend a plan (including costs) for mining, grinding, and bagging the phosphate rock.

PHOSPHATE ROCK MINING AND GRINDING, UPPER VOLTA

Feasibility Study of Mining and Grinding Kodjari Phosphates

Reserves of approximately 30 million metric tons of phosphate rock (PR) exist in the area of Kodjari. The ore contains about 26.5% P_2O_5. Upper Volta is currently using nearly 3,000 mt/year of P_2O_5 or 11,300 mt/year of PR equivalent. Grinding of locally available PR for direct application could be used to supply about 50% of this requirement.

Mining and grinding of PR on a small scale is not widely practiced in the world. However, since transport cost for importing fertilizer into Upper Volta is so high, use of locally available materials is attractive even on a small scale. Timely availability of a cheap source of P_2O_5 would benefit the small farmers and lead to increased crop production. Beginning development of an indigenous resource would provide employment for local labor and also be an excellent starting point for future extension of industrial fertilizer activities.

As a result of the West Africa Fertilizer Study, IFDC recommended a project for mining, grinding, and bagging the Kodjari PR. The purpose of this study is to determine the feasibility of such a project.

Objectives

The overall objective of the study will be to review current plans for exploitation of PR deposits in Upper Volta and make detailed recommendations for mining, grinding, and bagging PR for direct application.

Specific objectives are as follows:

1. Review the plans of the Government of Upper Volta for exploitation of the Kodjari area phosphate deposits.

2. Study the available geological data and the actual mine site and devise a mining plan.

3. Determine the optimum location for the grinding and bagging facility.

4. Recommend equipment components, configuration, and size for mining and grinding the phosphate rock for direct application.

5. Make a preliminary engineering study for a plant to meet the above objectives. This would include major component selection, general arrangement engineering, and an accurate cost estimate for the plant.

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Sufficient reserves of PR have been identified in the Kodjari a to support a phosphate industry. Demand in Upper Volta for P_2O_5 is te low compared to world standards. However, there appears to be suffi- nt demand to support a small grinding and bagging operation. A project olving mining, grinding, and bagging PR for direct application was ommended by the IFDC West Africa Fertilizer Study team.

It is proposed that a study team consisting of a mining engineer a mechanical engineer experienced in design of grinding equipment it Upper Volta to determine the feasibility of mining, grinding, and bag- g the PR. It is anticipated that accomplishment of this objective will uire detailed discussion with appropriate government agencies, visits the deposits and possible plant sites, development of a mining plan, elopment of basic design of the process and equipment (including costs), preparation of a report detailing the findings and recommendations. time required for the mining engineer is estimated at 3 weeks,

1-1/2 weeks for preparation and report writing and 1-1/2 weeks in-country. The time required for the mechanical engineer is estimated at 4 weeks, 1-1/2 weeks for preparation and report writing and 2-1/2 weeks in-country. In addition, a preliminary engineering study (preinvestment) would be carried out by a firm familiar with mining and grinding equipment.

BUDGET

Mining Engineer 3 weeks @ $1,600/week (Consultant)*	$ 4,800
Mechanical Engineer 4 weeks @ $1,000/week (Consultant)*	4,000
International Travel	3,000
Per Diem 28 days @ $50/day	1,400
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Administrative charge @ 35%	10,745
TOTAL COST OF STUDY	$41,445

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Includes:

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Cost Estimator 4 weeks @ $1,000/week	4,000
Draftsman 7 weeks @ $800/week	5,600
Secretarial 1.5 weeks	400
Design Report (Drawings and Specifications)	1,000
	$15,000

APPENDIX B - PHOSPHATE ROCK RESEARCH STUDIES - PROJECT B

PROJECT PROPOSAL SUMMARY STATEMENT

Project Title:	Upper Volta Phosphate Rock Studies--Characterization and Methods for Use in Fertilizer Production
Project Originator:	International Fertilizer Development Center (IFDC)
Project Initiation:	October 1, 1976
Project Completion:	October 1, 1977
Project Objectives:	1. Complete characterization of Upper Volta ore. 2. Determine methods for liberation of phosphate from the matrix. 3. Demonstrate the use of the ore directly or in upgraded form for production of fertilizers. 4. Report technical factors of the above.
Project Description:	Through fundamental and applied research activities determine technical (and limited economic) factors for use in developing methods of utilizing Upper Volta ore as fertilizer, whether as direct application material or as modified thermal-chemical forms.

UPPER VOLTA PHOSPHATE ROCK STUDIES--

Characterization and Methods for Use in Fertilizer Production

Upper Volta has phosphate ore from which a large portion of its phosphate needs as well as that of neighboring countries could be met. The deposit at Kodjari is estimated at 30 million mt of ore. However, little information is available concerning ore quality and these data are needed prior to commercial attempts to exploit the deposit. Only small samples of the ore have been received. As an outgrowth of the recent West Africa Fertilizer Study for AID by IFDC, about 200 kg of pit numbers 2 and 3 ore was received; this project described herein is a direct result of this study and is a detailed project proposal based on information given in appendix IV, Potential Projects, cited on page 24 of the appendix. The project is expanded over that originally suggested because of the severe lack of data and the need to supply at least a portion of the phosphate requirements from local available raw materials.

Objectives

The project is written in the context of a research project at this stage, with the plan that basic data are needed before any commercial ventures are undertaken; no testing is planned above laboratory stage in this phase of the work. Results should suggest further research needed and indicate methods of how the ore may ultimately be utilized. It will provide basic information necessary to scale up to pilot-plant testing, but actual pilot testing is reserved for a later phase.

Specific objectives are as follows:

1. Complete ore characterization.
2. Determine methods for liberation of phosphate from the matrix.
3. Demonstrate the use of the ore directly or in upgraded form for production of fertilizers.
4. Report technical factors concerning the above.

In this phase of work, technical data will receive priority, but economic estimates will be included to the extent possible. Economic estimates at the fundamental-applied research level are considered premature and should await pilot-scale research.

Description of the Project

Based on very preliminary examination, the phosphate in Upper Volta ore exists in one of the most finely divided states ever observed. In addition, it is a siliceous ore with the phosphate mixed through a massive cherty matrix. Liberation of the phosphate from this matrix poses some very special problems. The key to successful utilization of the ore will be to define a practical method of phosphate liberation.

Specific studies to be carried out are as follows:

I. Complete Characterization of the Ore

The ore will be completely characterized, including a chemical and mineralogical analysis, determination of texture, and amenability to upgrading through beneficiation, selective extraction and its potential for use as direct-application fertilizer. This phase of the work is the backbone of the research approaches to be tested to define methods for

using the ore. An estimate can be made of the value of the material for direct application in fine-ground form (or granulated form) to the soil, single and triple superphosphate, phosphoric acid, nitric phosphates, Rhenania-type phosphate or other forms of thermally-chemically altered phosphate.

II. Studies of Phosphate Liberation and Separation

A. Simple Grinding

This entails grinding the entire matrix in a manner such that the phosphate can be liberated as is and hence may be of value for direct application to the soil with no further processing. Such information would be essential if a small cottage industry were to be set up requiring only a very minimal capital outlay.

B. Grinding for Chemical Extraction

In testing this method, the ore would be less finely ground and less costly, but the ore would have to be chemically treated in order to liberate the phosphate. The material in this state may be suitable for treatment with sulfuric or phosphoric acid for making such products as single or triple superphosphate. Acid treatments will be conducted to determine recovery. Additional studies not included in this project will be required to determine the best alternatives.

C. Grinding to Improve Amenability to Upgrading by Flotation

The testing will be done to determine the best grinding conditions to produce a feed for beneficiation through flotation. A beneficiated ore probably will be required to make comparable grades of superphosphates which could otherwise be obtained only through importation; this may also

improve its characteristics for use in production of wet-process acid. This looks somewhat toward long-range use of the ore in the event the material is not agronomically effective for direct application.

D. Thermal Treatments to Improve Beneficiation

Based on preliminary evidence that the fabric of Upper Volta ore is controlled by silica cementation of an opaline or "cherty" nature, it is possible that moderate thermal treatment (200° to 500° C) will promote dessication of the silica hydrogel bond, thereby leading to induced internal strain to weaken the bonding and facilitate grinding. This effect of thermal treatment will be investigated in conjunction with the grinding tests.

E. Phosphate Recovery Through Beneficiation

As the ore is siliceous, it may be possible to improve the grade to enhance its value for use in fertilizer production. One method to be studied is upgrading by physical means through flotation. Based on the ore characteristics and if the phosphate can be liberated, it may be possible to float by addition of chemical reagents. The study will include tests of flotation to separate the phosphate from the silica, using reagents such as fatty acid/fuel oil mixtures and ammoniated amine reagents; other potential reagents and effect of variables on wet beneficiation will be studied.

At this point, the potential for dry beneficiation cannot be predicted, but due to a reduction in cost compared to wet beneficiation, this approach will be investigated. For example, some upgrading through classification during the grinding operation may be possible. This will depend on the relative hardness of the mineral components comprising the ore. Both beneficiation methods will be studied at the laboratory stage.

III. Use of the Ore in Preparation of Fertilizers

A. Preparation of Thermal Phosphate-Type Fertilizers

The apatite mineral component of phosphate rocks can be made to react with reagents such as silica, alkaline earth carbonates, or alkalies (chlorides, hydroxides, carbonates, etc.) to promote defluorination and reorganization of the phosphate into compositions that are much more available to plants. These reactions are generally promoted in the temperature range of 1000° to 1400° C. For example, the two most attractive prospects with Upper Volta phosphate ore would be the thermally promoted interaction of the apatite and silica components to produce calcium silicophosphate glasses (nagelschmidite type), or the reaction of apatite with added natron (Na_2CO_3 or K_2CO_3) to produce the Rhenania-type compositions, $Ca(Na, K)PO_4$. Both product types have established histories of agronomic usage. The thermal studies proposed here would be to evaluate the potential of Upper Volta rock to undergo the desired thermal reactions to produce simple phosphatic fertilizers having a high P-availability. The selection of these two particular process options is based on the availability of either silica or natron (trona) reagents in the west Africa region.

B. Wet-Process Acid and Ammoniated Products

During the investigation some limited tests will be made to determine if the run-of-mine ore or beneficiated ore would be suitable for the production of wet-process phosphoric acid. This appears to be a long-term usage that might be considered, but due to the limited demand in the country and region, the alternative probably should not be emphasized. However, if a small-scale, low-technology acid process could be developed, it might economically fit into this situation. The acid made in the

laboratory would be converted into solid ammoniated products, such as mono and diammonium phosphate, to determine chemical properties. As they would be made in laboratory equipment only, physical properties testing would only be relevant to a limited extent.

C. Single and Triple Superphosphate

One solid product of much interest in the region is single superphosphate, due to the low investment required for production. It is an excellent P fertilizer and also contains sulfur, if needed for a given crop or soil. Therefore, experiments will be carried out to determine the suitability of Upper Volta ore for superphosphate, with emphasis on single superphosphate. The other raw material, sulfur, probably would need to be imported to support the project. Some limited testing would be done to determine ore suitability for triple superphosphate production; this product depends upon wet-process acid and thus would be considered in long-range planning. Here again, work will be at the laboratory stage only and no pilot-plant tests are planned in this phase of work.

D. Use as Direct Application Fertilizer

Fundamental studies will be carried out with fine-ground run-of-min ore and liberated ore to determine if they would be effective as fertilizer without the need for chemical processing. Solubility tests to determine the availability or reactivity of Upper Volta rock in comparison to other roc be made. Variables such as effect of particle size, including special rock grinds, solution pH, etc., will be investigated. Also, the rock will be incubated in acidic soil to determine the solubility and available P in the soil solution, compared with other values from more common rocks. With the data, a prediction can be made of the relative suitability of the rock

for direct application; true agronomic effectiveness can only be determined by field experiments and none are to be included as part of this project.

It is understood that the Federal Republic of Germany is funding an agronomic program to determine its suitability. Results from these studies should be coordinated with the laboratory solubility and incubation data obtained by IFDC.

Reporting of Results

The project is for 12 months, beginning October 1, 1976, and ending October 1, 1977. During the course of the work, quarterly progress reports will be submitted to AID for the work completed to date. At the termination of the project a draft of the final report will be submitted to AID for review within 30 days after project completion. After acceptance by AID, IFDC will provide 50 copies of the final report in English; IFDC will not translate into another language as part of this project.

Implementation

The project described herein can begin at the indicated time upon completion of the contract with IFDC. As IFDC already has on hand about 200 kg of Kodjari, Upper Volta ore, no delay is anticipated in beginning the work. If larger-scale tests are warranted throughout the study, additional rock will be required. The quantity on hand is sufficient, however, to carry out the majority of testing required to cover the work specified by this contract.

A multidisciplined group will be required to carry out the work ranging from geologist, chemist, to chemical engineer. Beneficiation

specialists are included having expertise in treatment of siliceous ores such as the Upper Volta type. The work can be carried out by IFDC at Muscle Shoals, Alabama, and no plans are included to contract to any outside agencies. As IFDC is located adjacent to the Tennessee Valley Authority, it has access to the latter's laboratories and experts in fertilizer technology, including the technical library. TVA will lend considerable technical support to the project.

Budget

Table 1 gives a detailed budget estimate for the project, including salaries and benefits, travel, secretarial, special chemical analyses, and receiving of additional rock (if needed). As the work is to be performed in IFDC laboratories, no international travel is required. The total cost of the project is estimated to be $155,899 including 35% overhead.

Biodata

A summary of biodata of personnel involved in the project is as follows: (Forms to be filled in.)

Table 1. Estimated Budget for Studies of Upper Volta Ore

NAME	JOB TITLE OR FUNCTION	MAN-MONTHS	SALARY + BENEFITS/MONTH	COST TO PROJECT
I. Salaries and Benefits				
O. W. Livingston	Project Coordinator	1.00	$ 4228	$ 4228
G. H. McClellan	Geologist	1.50	3764	5646
D. R. Waggoner	Chemical Engineer	2.00	3764	7528
S. H. Chien	Research Chemist	2.00	2583	5176
T. G. Jarnigan	Chemical Lab Analyst	3.00	1141	3423
C. D. Allen	Chemical Lab Analyst	3.00	960	2880
R. C. Horn	Analytical and Research Chemist	3.00	2826	8478
B. W. Biggers	Chemical Lab Analyst	4.00	1141	4564
R. A. Dittrich	Metallurgical Engineer	4.00	1894	7576
P. S. Fakunle	Chemical Lab Analyst	4.00	1141	4564
To be filled[a]	Chemical Engineer--Wet-Process Acid Expert	3.00	2376	7128
J. F. Haseman	Consultant - Beneficiation Expert	2.00	2900	5800
T. P. Hignett	Consultant - Phosphate Process Exp.	0.50	3000	1500
To be filled[b]	Chemical Engineer--Superphosphate, Granulation Specialist	1.50	2376	3564
J. R. Lehr	Mineralogist	0.75	3866	2901
L. R. Gremillion	Rock Characterization Expert	1.50	2914	4371
S. R. Hunter	X-ray Technician	1.00	1805	1805
S. S. Hsieh	Grinding Studies Leader	3.00	2037	6112
J. Smith	Grinding Studies Technician	3.00	1861	5583
W. D. Wilhide	Thermal Studies Leader	1.50	3376	5064
A. D. Mair	Thermal Studies Investigator	1.50	2463	3694
			SUBTOTAL SALARIES & BENEFITS	$101,585

[a]To be filled, October 15, 1976.
[b]To be filled, [illegible]

			COST TO PROJECT
II.	Secretarial and Typing		$ 2,650
III.	Report Reproduction (50 copies @ $20/copy)		1,000
IV.	Travel and Per Diem (U.S. Only)		
	Air Travel (Muscle Shoals to Washington, DC, Round Trip) $200 x 6 people	= $1,200	
	Per Diem ($50/day x 3 days x 6 people)	= 900	
	Air Travel (Florida to Muscle Shoals, Round Trip) (Consultant) $200 x 3	= 600	
	Per Diem ($50/day x 30 days)	= 1,500	
V.	Rock Shipment (air plus truck freight, up to 400 kg)		4,200
VI.	Special Chemical Analyses (40 samples $ $100/sample)		2,046
			4,000
	PROJECT, SUBTOTAL		$115,481
	OVERHEAD (35%)		40,418
	TOTAL		$155,899

APPENDIX C - PHOSPHATE ROCK EXPLORATION - PROJECT C

Project Proposal Summary Statement

Project Title: Phosphate Rock Identification, Mauritania; Detailed exploration, Cive and Taoudeni Basin deposits--Feasibility Study.

Project Originator: International Fertilizer Development Center (IFDC)

Project Initiation: October 1, 1976

Project Completion: October 1, 1977

Project Objectives:

1. Review current status of exploration of the Cive and Taoudeni Basin deposits.
2. Review the plans of the Government of Mauritania for further exploration and development of the deposits.
3. Inspect the deposits to determine how much detailed exploration is required.
4. Develop recommendations and a plan for carrying out the exploration.
5. Estimate costs involved in the exploration and make an assessment of the benefits derived.

Project Description: A geologist will visit Mauritania to assess the current data available on the deposits, visit the deposits, and develop a plan (including costs) for detailed exploration of the deposits.

PHOSPHATE ROCK IDENTIFICATION, MAURITANIA

Feasibility of Study of Detailed Exploration

of Cive and Taoudeni Basin Deposits

Rough estimates of phosphate reserves indicate that approximately 5 million tons are known to exist. The government-owned mining company, Societe National d'industrie Miniere (SNIM), believes that the deposits contain considerably more reserves than now estimated. Agricultural testing of these phosphate materials for direct application has not been undertaken at this time, nor has either of the deposits been explored in detail. Detailed exploration of the deposits and agricultural testing of the rock must be carried out before decisions can be made concerning the future use of the phosphate resources. As a result of the West Africa Fertilizer Study, IFDC recommended projects for agricultural testing of the rock and detailed exploration. The purpose of this project is to study the feasibility of the detailed exploration project.

Objectives

The overall objective of the study will be to assess the current level of knowledge of the phosphate deposits, what additional knowledge is needed, and make recommendations on the feasibility of further detailed exploration of the deposits.

Specific objectives are as follows:

1. Review the current status of exploration of the Cive and Taoudeni Basin deposits.
2. Review the plans of SNIM for further exploration and development of the deposits.

3. Inspect the deposits to determine how much detailed exploration is required.
4. Develop recommendations and a plan for carrying out the exploration.
5. Estimate costs involved in the explorations and make assessment of the benefits derived.

Description of the Project

Sufficient preliminary exploration has been done to identify at least 5 million tons of phosphate ~~ore~~ reserves in deposits in the area of Cive and in the Taoudeni Basin. Possibilities exist for using this phosphate for direct application, producing soluble phosphates, and exportation Decisions concerning the final use of the rock cannot be made without the benefit of detailed exploration. A project for carrying out the detailed exploration was recommended by the IFDC West Africa Fertilizer Study.

It is proposed that a geologist visit Mauritania to assess the current situation with respect to the deposits and determine the feasibility of further detailed exploration. It is anticipated that accomplishment of this objective will require detailed discussions with appropriate government agencies including SNIM, visits to the deposits, estimation of the additional prospecting required (including costs), evaluation of the benefits to be derived and preparation of a report detailing the findings and recommendations. The total time for the geologist is estimated as 7 weeks; 4 weeks in-country, 1 week preparation prior to country visit, and 2 weeks following the in-country portion to finish the report.

Budget

Geologist - 7 weeks @ $1,000/week*	$ 7,000
Interpreter - 15 days @ $100/day	1,500
International travel	1,500
Per diem - 28 days @ $50/day	1,400
Internal travel	500
Secretarial assistance	
$240/week x 2 weeks	480
Benefits (25.00%)	120
Leave accrual (16.07%)	80
Report - 50 copies @ $10/copy	500
Total before administrative charge	$13,080
Administrative charge at 35%	4,578
Total cost of study	$17,658

*If not IFDC staff member will be a Consultant

APPENDIX C - PHOSPHATE ROCK EXPLORATION - PROJECT C2

PROJECT PROPOSAL SUMMARY STATEMENT

Project Title: Phosphate Rock Identification, Chad; Explorations in the Bahr el Ghazal Area--Feasibility Study.

Project Originator: International Fertilizer Development Center (IFDC).

Project Initiation: October 1, 1976.

Project Completion: October 1, 1977.

Project Objectives:

1. Review the plans of the Government of Chad for exploration to locate phosphate rock deposits.

2. Assess the feasibility of using an aerial radiometric survey as a first reconnaissance.

3. Develop recommendations and a plan for carrying out the radiometric survey and subsequent exploration.

4. Estimate costs involved for both the radiometric survey and subsequent exploration.

Project Description: A geologist will visit Chad to discuss the project with government agencies, visit the sites to be explored, and recommend a plan (including costs) for the exploration.

PHOSPHATE ROCK IDENTIFICATION, CHAD

Feasibility Study of Explorations in the Bahr el Ghazal Area

To date, phosphate deposits have not been identified in Chad. However, there is a strong feeling in the Ministry of Mines that phosphates do exist. The basis for this feeling is the geological history of the Chad basin and the known presence of other minerals, such as diatomite, which usually appear along with phosphates. The area in question is the Bahr el Ghazal, a depression running northeast from the eastern end of Lake Chad.

Since phosphates usually contain traces of uranium, a radiometric survey by slow-flying aircraft or helicopter has been recommended as a first reconnaissance. Radiometrics has been used extensively to explore for other minerals in Chad.

The purpose of this project is to study the feasibility of phosphate exploration in Chad.

Objectives

The overall objective of the study will be to assess the current level of knowledge of the existance of phosphates in Chad and make recommendations on the feasibility of further exploration for phosphates.

Specific objectives are as follows:

1. Review the plans of the Government of Chad for exploration to locate phosphate deposits.
2. Assess the feasibility of using an aerial radiometric survey as a first reconnaissance.

3. Develop recommendations and a plan for carrying out the radiometric survey and subsequent exploration.

4. Estimate the costs involved for both the radiometric survey and subsequent exploration.

Description of the Project

The Bahr el Ghazal depression is known to contain minerals whose presence usually indicate the presence of phosphates. Phosphate, if located, could be used for direct application in local agriculture and for producing more soluble forms such as superphosphates and Rhenania phosphates. Manufacture of Rhenania phosphates also requires sodium carbonate as a raw material. Trona, a mineral containing sodium carbonate as a major constituent, is currently being mined commercially in Chad. Discovery of phosphates in Chad and their use in local agriculture could be a major factor in improving food production. A project for carrying out the detailed exploration was recommended by the IFDC West Africa Fertilizer Study.

It is proposed that a geologist visit Chad to assess the current situation with respect to exploration for phosphates and determine the feasibility of aerial radiometric survey and subsequent exploration. It is anticipated that accomplishment of this objective will require detailed discussions with appropriate government agencies, visits to the area to be explored, estimation of the extent of prospecting required (including costs), evaluation of the benefits to be derived, and preparation of a final report detailing the findings and recommendations.

The total time for the geologist is estimated as 7 weeks; 4 weeks in-country, 1 week preparation prior to country visit, and 2 weeks following the in-country portion to finish the report.

BUDGET

Geologist 7 weeks @ $1,000/week*	$ 7,000
Interpreter 15 days @ $100/day	1,500
International Travel	1,500
Per Diem 28 days @ $50/day	1,400
Internal Travel	500
Secretarial Assistance	
$240 week for 2 weeks	480
Benefits (25%)	120
Leave accrual (16.07%)	80
Report	
50 copies @ $10/copy	500
Total before administrative charge	$13,080
Administrative charge @ 35%	4,578
TOTAL COST OF STUDY	$17,658

*If not IFDC staff member will be a Consultant

APPENDIX D - BULK BLENDING - PROJECT D

PROJECT PROPOSAL SUMMARY STATEMENT

Project Title:	Bulk Blending of Fertilizer, Chad; Feasibility Study.
Project Originator:	International Fertilizer Development Center
Project Initiation:	October 1, 1976
Project Completion:	October 1, 1977
Project Objectives:	1. Work out details of importing and handling 1-ton containers for importing raw materials (including port handling and costs). 2. Choose an optimum site for location of the bulk-blending equipment. 3. Assist in design of the plant layout and writing specifications for the equipment. 4. Work out an implementation plan for establishing a bulk-blending industry in Chad. 5. Estimate the investment required.
Project Description:	An engineer will visit Chad to work out the details for establishment of a simple low-technology type bulk-blending facility to provide N-P-K mixtures for agriculture of Chad. A plan will be devised for receiving and storing raw materials in 1-ton disposable containers.

BULK BLENDING OF FERTILIZER, CHAD

Feasibility Study For Establishment of a Low-Technology Bulk-Blending Facility

Chad is currently using about 11,000 mt/year of mixed fertilizers. All of this requirement is imported as finished fertilizers. A simple low-technology type blending facility based on import of raw materials in 1-ton containers could be used to provide the N-P-K mixtures needed in Chad at lower costs than imported finished goods. Timely arrival of cheaper fertilizers would benefit the small farmers and lead to increased crop production. Establishment of a bulk-blending facility would also provide an excellent base for future extension of industrial fertilizer activities. As a result of the West Africa Fertilizer Study, IFDC recommended establishment of such a facility in Chad. The purpose of this study is to explore the details of the project recommended by IFDC.

Objectives

The overall objective of the study will be to work out the details including costs for the establishment of a simple low-technology type bulk-blending facility in Chad. Specific objectives are as follows:

1. Work out details of importing and handling 1-ton containers for importing raw materials (including port and handling costs).
2. Choose an optimum site for location of the bulk-blending equipment.
3. Assist in design of the plant layout and writing specifications for the equipment.
4. Work out an implementation plan for establishing a bulk-blending industry in Chad.
5. Estimate the investment required.

Description of the Project

The classical approach to bulk blending is to receive raw materials in bulk into a bulk storage and handling facility. For this project, raw materials would be received in 1-ton disposable containers which would eliminate the need for expensive bulk handling and storage facilities. Raw materials such as diammonium phosphate, ammonium sulfate, and potassium chloride would be imported in the semi-bulk 1-ton containers. The raw materials would be stored in the containers and fed into a simple bulk-blending, bagging operation capable of producing 12 mt/hour.

It is proposed that an engineer visit Chad to determine the feasibility of such a project. It is anticipated that accomplishment of this objective will require detailed discussions with appropriate government agencies in Chad, discussions with port authorities and freight forwarders at the port, visits to possible plant sites, development of an implementation plan and basic design of the process (including costs), and preparation of a final report detailing the findings and recommendations. The time required for the engineer is estimated as 8 weeks; 3 weeks in-country and 5 weeks preparing specifications for the equipment, estimating costs, determining the layout and preparation of the report. In addition, a mechanical engineer will be required for 2 weeks to help with equipment design and specifications.

BUDGET

Chemical Engineer 8 weeks @ $1,000/wk*	$ 8,000
Mechanical Engineer 2 weeks @ $1000/wk**	2,000
International Travel	1,500
Internal Travel	500
Per Diem 21 days @ $50/day	1,050
Interpreter 15 days @ $100/day	1,500
Secretarial Assistance	
$240 wk for 3 weeks	720
Benefits and leave accrual (41.07%)	300
Report	
50 copies @ $10/copy	500
Total before administrative charge	16,070
Administrative charge @ 35%	5,625
TOTAL COST OF STUDY	$21,695

*D. R. Waggoner or M. T. Frederick
**Consultant to be named

APPENDIX D - BULK BLENDING - PROJECT D2

PROJECT PROPOSAL SUMMARY STATEMENT

Project Title: Bulk Blending of Fertilizer, Mali; Feasibility Study.

Project Originator: International Fertilizer Development Center

Project Initiation: October 1, 1976

Project Completion: October 1, 1977

Project Objectives:

1. Work out details of importing and handling 1-ton containers for importing raw materials (including port handling and costs).

2. Choose an optimum site for location of the bulk-blending equipment.

3. Assist in design of the plant layout and writing specifications for the equipment.

4. Work out an implementation plan for establishing a bulk-blending industry in Mali.

5. Estimate the investment required.

Project Description: An engineer will visit Mali to work out the details for establishment of a simple low-technology type bulk-blending facility to provide N-P-K mixtures for agriculture of Mali. A plan will be devised for receiving and storing raw materials in 1-ton disposable containers.

BULK BLENDING OF FERTILIZER, MALI

Feasibility Study For Establishment of a Low-Technology Bulk-Blending Facility

Mali is currently using about 12,000 mt/year of mixed fertilizers. All of this requirement is imported as finished fertilizers. A simple low-technology type blending facility based on import of raw materials in 1-ton containers could be used to provide the N-P-K mixtures needed in Mali at lower costs than imported finished goods. Timely arrival of cheaper fertilizers would benefit the small farmers and lead to increased crop production. Establishment of a bulk-blending facility would also provide an excellent base for future extension of industrial fertilizer activities. As a result of the West Africa Fertilizer Study, IFDC recommended establishment of such a facility in Mali. The purpose of this study is to explore the details of the project recommended by IFDC.

Objectives

The overall objective of the study will be to work out the details including costs for the establishment of a simple low-technology type bulk-blending facility in Mali. Specific objectives are as follows:

1. Work out details of importing and handling 1-ton containers for importing raw materials (including port and handling costs).
2. Choose an optimum site for location of the bulk-blending equipment.
3. Assist in design of the plant layout and writing specifications for the equipment.
4. Work out an implementation plan for establishing a bulk-blending industry in Mali.
5. Estimate the investment required.

Description of the Project

The classical approach to bulk blending is to receive raw materials in bulk into a bulk storage and handling facility. For this project, raw materials would be received in 1-ton disposable containers which would eliminate the need for expensive bulk handling and storage facilities. Raw materials such as diammonium phosphate, ammonium sulfate, and potassium chloride would be imported in the semi-bulk 1-ton containers. The raw materials would be stored in the containers and fed into a simple bulk-blending, bagging operation capable of producing 12 mt/hour.

It is proposed that an engineer visit Mali to determine the feasibility of such a project. It is anticipated that accomplishment of this objective will require detailed discussions with appropriate government agencies in Mali, discussions with port authorities and freight forwarders at the port, visits to possible plant sites, development of an implementation plan and basic design of the process (including costs), and preparation of a final report detailing the findings and recommendations. The time required for the engineer is estimated as 8 weeks; 3 weeks in-country and 5 weeks preparing specifications for the equipment, estimating costs, determining the layout and preparation of the report. In addition, a mechanical engineer will be required for 2 weeks to help with equipment design and specifications.

BUDGET

Chemical Engineer 8 weeks @ $1,000/wk*	$ 8,000
Mechanical Engineer 2 weeks @ $1000/wk**	2,000
International Travel	1,500
Internal Travel	500
Per Diem 21 days @ $50/day	1,050
Interpreter 15 days @ $100/day	1,500
Secretarial Assistance	
$240 wk for 3 weeks	720
Benefits and leave accrual (41.07%)	300
Report	
50 copies @ $10/copy	500
Total before administrative charge	16,070
Administrative charge @ 35%	5,625
TOTAL COST OF STUDY	$21,695

*D. R. Waggoner or M. T. Frederick
**Consultant to be named

PROJECT PROPOSAL SUMMARY STATEMENT

Project Title:	Bulk Blending of Fertilizer, Upper Volta; Feasibility Study
Project Originator:	International Fertilizer Development Center
Project Initiation:	October 1, 1976
Project Completion:	October 1, 1977
Project Objectives:	1. Work out details of importing and handling 1-ton containers for importing raw materials (including port handling and costs). 2. Choose an optimum site for location of the bulk-blending equipment. 3. Assist in design of the plant layout and writing specifications for the equipment. 4. Work out an implementation plan for establishing a bulk-blending industry in Upper Volta. 5. Estimate the investment required.
Project Description:	An engineer will visit Upper Volta to work out the details for establishment of a simple low-technology type bulk-blending facility to provide N-P-K mixtures for agriculture of Upper Volta. A plan will be devised for receiving and storing raw materials in 1-ton disposable containers.

WEST AFRICAN FERTILIZER STUDY - PHASE II

IFDC has just completed for AID/W an overall study describing the present and future capability to produce, market, and consume fertilizer in west Africa. Problems have been identified and a basic long-term strategy is beginning to unfold. This has been all covered under Phase I of the overall study. Some of the general findings are as follows:

1. Major food deficits now exist in the Sahelian countries (1.8 million mt in 1974) and are likely to become even larger in the near future (2.5 million mt in 1980) unless a major effort is made to accelerate food production.
2. While several projects are now under way to offset the food problem the likelihood of success seems remote unless large quantities of fertilizer are used in conjunction with these efforts.
3. With the exception of Senegal, no indigenous capacity to produce fertilizer exists and all fertilizer must be imported and moved over rather long and expensive transport routes before reaching the farmer. However, the region does possess substantial quantities of rock phosphate, some of which is of suitable quality to merit exploitation.
4. Fertilizers, while needed, are too expensive under present conditions in the Sahel to warrant extensive use on food crops. What small quantities are used are primarily for use on such export crops as cotton, peanuts, etc.

5. A further complicating factor, with the exception of Senegal, is that very little reliable data on farm fertilizer response for food crops are available to develop suitable educational programs to promote fertilizer use.

6. Finally, without exception, the food and fertilizer policies followed by the governments of these countries are such that farmers do not find it suitable to produce food or use fertilizer on food crops at the levels needed to offset food deficits.

As a result of these findings, it was concluded that for fertilizer to play a major role in helping narrow the gap in food production the cost must be reduced, more technical information made available to predict "on farm level" response, and agricultural policies, particularly food production and fertilizer policies, must be changed and made favorable to the farmer.

Phase II Activities and Objectives

The activities and objectives of Phase II of the West African Study are based upon the above findings and proposed as follows:

I. General Objectives

There are four basic objectives to be accomplished in Phase II of the overall study. These are as follows:

1. Carry out detailed feasibility studies to find ways to lower the cost of fertilizer in the west African region.
2. Carry out initial studies to identify the necessary policy changes needed to increase fertilizer use.
3. Develop further projects that will better define the on-farm response of fertilizer by food crops.

4. Provide the needed advisory service to AID and the Club des Amis du Sahel to ensure that the overall planners of assistance to the countries of west Africa understand the role fertilizer might play in the overall development of the region.

II. Description of Activities Planned for Phase II

A brief description of each project is as follows: (More detailed discussions appear in appendices A-G.)

1. Lower the Cost of the Fertilizer Materials

The cost of fertilizer to the farmer in the Sahelian region is two to three times that found in the United States. This is due to the fact that no production units exist within the area (except those in Senegal) and fertilizer must be imported over great distances; hence, transport costs represent the major omponent of the final price to the farmer.

Several opportunities have been identified in Phase I to reduce these costs. Some of these appear below:

a. Development Of Existing Deposits

Substantial reserves of phosphate rock are already known to exist in Mali and Upper Volta. Substantial information already exists on the Tilemsi deposits of Mali and the Arli and Kodjari deposits of Upper Volta such that feasibility studies can now begin for simple mining and grinding operations. The details of the two proposed projects (one for each country) appear in appendix A as projects A_1 and A_2

and are feasibility studies for rock mining and grinding operations in Mali and Upper Volta.

For the Kodjari deposit (30 million mt) and an additional deposit at Aloub-Djouna (50 to 100 million mt), insufficient information is available regarding ore quality to warrant a general program of exploitation. The work proposed under project B_1, appendix B, is designed to remove this obstacle. It is a research project.

b. Further Identification of Reserves

Phosphate rock deposits are known to exist in Mauritania, and there is some evidence of their existence in Chad as well. The activities proposed in appendix C, projects C_1 and C_2, are exploration studies designed to (1) establish the size of reserves in Mauritania; and (2) verify the existence of phosphate rock near Lake Chad in Chad.

c. New Innovations in Bulk Handling and Blending

While development of local deposits of phosphate rock offers a major opportunity for reducing costs of fertilizer, substantial quantities of fertilizer will still have to be imported, particularly N and K if the full potential of the current effort in food production is to be realized.

Handling of fertilizer imports in bulk or semi-bulk form and bulk blending with special innovations to fit west African conditions offer an immediate and distinct opportunity to reduce the cost of getting fertilizer to the farmer. Projects described in appendix D are aimed mainly at conducting feasibility studies for establishing bulk-blending units in Chad, Upper Volta, and Mali (projects D_1, D_2, and D_3).

2. Improve Food and Fertilizer Policies to Ensure Small Farmers Motivation to Produce Food

The IFDC study conducted in Phase I clearly indicated current policies for food and fertilizer use in the west African countries do not benefit the farmer or encourage him to produce a marketable surplus of food.

The activities described in appendix E, project E, are designed to identify in one country (Senegal) what changes are needed in fertilizer policy, particularly those needed to stimulate fertilizer use on food crops.

3. Advisory Services

Sections I and II deal mainly with studies proposed for Phase II. In addition, IFDC proposes to supply technical services (2 man-months) to assist AID/W personnel in developing a PRP for the soil fertility project identified in Phase I of the overall study. Additional services, yet to be identified and totaling 9 man-months, are proposed for supplying technical expertise on fertilizer to the Club des Amis du Sahel and to the various USAID missions within the region. The details of these appear in appendix F.

4. Other Activities

No provision was made to print and publish for external distribution the report developed under Phase I of this overall effort. Details are presented in appendix G for providing both English and French versions of the study.

III. Summary Budget of Proposed Phase II Activities

The attached table summarizes the total inputs proposed for Phase II. These total 101 man-months and $475,457. Greater detail may be found in the attached table and in the specific budgets for individual projects described in appendices A-G.

APPENDIX A - ROCK MINING & GRINDING - PROJECT A

PROJECT PROPOSAL SUMMARY STATEMENT

Project Title: Phosphate Rock Mining and Grinding, Tilemsi Valley, Mali--Feasibility Study.

Project Originator: International Fertilizer Development Center (IFDC)

Project Initiation: October 1, 1976

Project Completion: October 1, 1977

Project Objectives:

1. Review the plans of the Government of Mali for exploitation of the Tilemsi Valley phosphate deposits.
2. Study the available geological data and the actual mine site and devise a mining plan.
3. Determine the optimum location for the grinding and bagging facility.
4. Recommend equipment components, configuration and size for mining and grinding the phosphate rock for direct application.
5. Make a preliminary engineering study for a plant to meet the above objectives. This would include major component selection, general arrangement engineering, and an accurate cost estimate for the plant.

Project Description: A team consisting of a mining engineer and a mechanical engineer will visit Mali to discuss the project with government agencies, visit possible grinding sites, visit the site of the phosphate deposits, and recommend a plan (including costs) for mining, grinding, and bagging the phosphate rock.

BULK BLENDING OF FERTILIZER, UPPER VOLTA

Feasibility Study For Establishment of a Low-Technology Bulk-Blending Facility

Upper Volta is currently using about 16,000 mt/year of mixed fertilizers. All of this requirement is imported as finished fertilizers. A simple low-technology type blending facility based on import of raw materials in 1-ton containers could be used to provide the N-P-K mixtures needed in Upper Volta at lower costs than imported finished goods. Timely arrival of cheaper fertilizers would benefit the small farmers and lead to increased crop production. Establishment of a bulk-blending facility would also provide an excellent base for future extension of industrial fertilizer activities. As a result of the West Africa Fertilizer Study, IFDC recommended establishment of such a facility in Upper Volta. The purpose of this study is to explore the details of the project recommended by IFDC.

Objectives

The overall objective of the study will be to work out the details including costs for the establishment of a simple low-technology type bulk-blending facility in Upper Volta. Specific objectives are as follows:

1. Work out details of importing and handling 1-ton containers for importing raw materials (including port and handling costs).
2. Choose an optimum site for location of the bulk-blending equipment.
3. Assist in design of the plant layout and writing specifications for the equipment.
4. Work out an implementation plan for establishing a bulk-blending industry in Upper Volta.
5. Estimate the investment required.

Description of the Project

The classical approach to bulk blending is to receive raw materials in bulk into a bulk storage and handling facility. For this project, raw materials would be received in 1-ton disposable containers which would eliminate the need for expensive bulk handling and storage facilities. Raw materials such as diammonium phosphate, ammonium sulfate, and potassium chloride would be imported in the semi-bulk 1-ton containers. The raw materials would be stored in the containers and fed into a simple bulk-blending, bagging operation capable of producing 12 mt/hour.

It is proposed that an engineer visit Upper Volta to determine the feasibility of such a project. It is anticipated that accomplishment of this objective will require detailed discussions with appropriate government agencies in Upper Volta, discussions with port authorities and freight forwarders at the port, visits to possible plant sites, development of an implementation plan and basic design of the process (including costs), and preparation of a final report detailing the findings and recommendations. The time required for the engineer is estimated as 8 weeks; 3 weeks in-country and 5 weeks preparing specifications for the equipment, estimating costs, determining the layout and preparation of the report. In addition, a mechanical engineer will be required for 2 weeks to help with equipment design and specifications.

BUDGET

Chemical Engineer 8 weeks @ $1,000/wk*	$ 8,000
Mechanical Engineer 2 weeks @ $1000/wk**	2,000
International Travel	1,500
Internal Travel	500
Per Diem 21 days @ $50/day	1,050
Interpreter 15 days @ $100/day	1,500
Secretarial Assistance	
$240 wk for 3 weeks	720
Benefits and leave accrual (41.07%)	300
Report	
50 copies @ $10/copy	500
Total before administrative charge	16,070
Administrative charge @ 35%	5,625
TOTAL COST OF STUDY	$21,695

*D. R. Waggoner or M. T. Frederick
**Consultant to be named

APPENDIX G

PROJECT PROPOSAL SUMMARY STATEMENT

Project Title: Printing of West African Fertilizer Study

Project Origination: International Fertilizer Development Center (IFDC)

Project Initiation: October 1, 1976

Project Completion: January 30, 1977

Project Objectives:
1. Print West African Fertilizer Study in English.
2. Perform a technical review of French translation of West African Fertilizer Study.
3. Print West African Fertilizer Study in French.

Project Description: The IFDC will print 500 copies of each of the six country reports and 1,000 copies of a regional report of the West African Fertilizer Study in English. Also, a technical review will be performed of a French translation of the reports supplied by USAID, and IFDC will print 250 copies of each country report and 500 copies of the regional report in French. The English version will be published by off-set press and copies will be saddle stitched. The French version will be published by quick copy with similar cover and art as the English version but side stapled and taped.

Budget

Printing of English Version	
Country reports, 500 copies x 6 volumes x $2.20/copy	$ 6,600
Regional report, 1,000 copies x $1.40/copy	1,400
Printing of French Version	
Country reports, 250 copies x 6 volumes x $2.20/copy	3,300
Regional report, 500 copies x $1.40/copy	700
Art	600
Technical review of French, 1 mo. @ $3,764/mo. incl. benefits	3,764
	$16,364
Administrative charge @ 35%	5,727
Total	$22,091

APPENDIX E

PROJECT PROPOSAL SUMMARY STATEMENT

Project Title: Study of Public Policies on Price Stabilization and Equalization in Senegal

Project Originator: International Fertilizer Development Center (IFDC)

Project Initiation: January 1, 1977

Project Completion: July 1, 1977

Project Objectives:

1. Describe public policies on price stabilization and equalization for fertilizers, other inputs, and crops.

2. Define the effects of these policies upon food production, fertilizer use, and the sector, regional, and national economies.

3. Develop alternatives for establishing policies related to fertilizer use which could effectively meet government goals.

Project Description: An expatriate economist will work with counterpart economists from identified organizations in Senegal in gathering data and reporting to meet the above objectives.

STUDY OF PUBLIC POLICIES ON PRICE STABILIZATION AND EQUALIZATION IN SENEGAL

Fertilizer use level is highly dependent upon the cost-price relationship between fertilizer and a crop although other factors influence fertilizer use. Farmers tend to maximize net returns and do not use fertilizer if returns do not cover the cost plus risks involved.

Fertilizers can increase crop production if properly used. Generally, a kg of nutrient can be expected to give 8 to 10 kg of cereal grain. Then, importing fertilizer of 50% nutrient content can save 4-5 times the freight cost versus importing grain. An analysis of individual country situations would require consideration of many other factors but this gives a basis for close consideration of many factors in establishing prices and subsidies.

Establishing favorable fertilizer product prices could result in increased fertilizer use by small- and medium-sized farmers and increased food crop production provided other inputs are available for favorable response of crops to fertilizer. Given the varying cost:price ratios over the years, it would seem worthy of establishing guidelines.

Objectives

The overall objective of the study is to establish guidelines for public policies which will lead to increased food production through efficient fertilizer use. Specific objectives are:

1. Describe public policies on price stabilization and equalization for fertilizers, other inputs, and crops.
2. Define the effects of these policies upon food production, fertilizer use, and the sector, regional, and national economies.

3. Develop alternatives for establishing policies related to fertilizer use which could effectively meet government goals.

Description of the Project

An economist will spend about 6 weeks in Senegal gathering appropriate data from reports and interviews. He will work with two or three counterpart economists from the Ministry of Rural Development, National Development Bank, National Office of Cooperation and Assistance for Development, or Office of Price Stabilization and Equalization. He will prepare a draft report meeting the above objectives and return to Senegal for 2 weeks to review with appropriate officials. The entire study will require about 6 months.

BUDGET

Economist, 6 mos. @ $3,244/mo.	$19,465
Clerical assistance, 2 mos. @ $1,600/mo.	3,200
Travel	3,000
Per diem, 60 days @ $50/day	3,000
Interpreter, 60 days @ $100/day	6,000
Report	1,000
	$35,665
Administrative charge @ 35%	12,483
Total	$48,148

APPENDIX F

PROJECT PROPOSAL SUMMARY STATEMENT

Project Title: Technical Assistance to USAID and Club des Amis du Sahel

Project Originator: International Fertilizer Development Center (IFDC)

Project Initiation: October 1, 1976

Project Completion: September 30, 1977

Project Objectives:

1. Prepare PRP for a soil fertility project in Mali.

2. Present findings and recommendations of West African Fertilizer Study to appropriate government officials of the six Sahelian countries, explore feasibility and interest in proposed projects and study means of implementing desirable projects.

4. Perform other technical assistance (primarily in assisting working groups of the Club des Amis du Sahel) as mutually agreed upon by USAID and IFDC within the time allocation of the contract.

Project Description: Technical assistance will be provided to USAID and Club des Amis du Sahel in agronomy, economics, and engineering to identify and implement appropriate fertilizer projects in the six Sahelian countries.

TECHNICAL ASSISTANCE TO USAID AND CLUB DES AMIS DU SAHEL

The severe droughts of the late 1960's and early 1970's in the Sahelian countries caused greatly reduced food production and increased food imports. This resulted in much emphasis within the countries and donor agencies on projects to increase food production. The Club des Amis du Sahel ("Club") was established in March 1976 to coordinate overall development in the eight member countries.

The West African Fertilizer Study (WAFS) by IFDC among other things identified the need for increased crop productivity through fertilizer use. However, crop response data to fertilizer on small- and medium-sized farms is lacking. Therefore, soil fertility projects are proposed to obtain this information, train nationals, and demonstrate the value of fertilizer in terms of increased production to farmers. Mali has good potential for this type of project to greatly increase food production.

The "Club" established working groups to study various aspects of economic and social development of the member countries. The IFDC can give valuable assistance to these work groups in the fields of agronomic, economic, and engineering expertise relating to fertilizer. Several means were identified in the WAFS in which efficient fertilizer use can be increased, food production increased, and fertilizers can be supplied to the region at lower cost than under the present systems. These findings can form a basis for working with the member countries of the "Club" in implementing fertilizer development projects.

Objectives

The overall objective of this project is to provide technical assistance to USAID and the "Club" in implementing projects designed to increase food crop production through efficient fertilizer supply and use.

Specific objectives are:

1. Prepare a PRP for a soil fertility project in Mali.
2. Present findings and recommendations of WAFS to the "Club."
3. Present findings and recommendations of WAFS to appropriate government officials of the six Sahelian countries, explore feasibility and interest in proposed projects, and study means of implementing desirable projects.
4. Perform other technical assistance (primarily in assisting "Club" working groups) as mutually agreed upon by USAID and IFDC, within the time allocation of the contract.

Description of the Project

This technical assistance project is composed of three components: (1) preparing a PRP for a soil fertility project in Mali; (2) presenting findings of the WAFS to "Club" and appropriate officials of the six Sahelian countries and explore means of implementing projects; and (3) consulting with "Club" work group.

Preparation of PRP for Soil Fertility Project--A PRP for a soil fertility project in Mali will be prepared using the proposed project statements contained in the WAFS as a basis. The standard format for PRP's will be utilized. An agronomist and economist will each spend one month preparing the paper. The paper will be submitted to USAID by December 1, 1976.

Presentation of Findings of WAFS--The findings and recommendations of the study will be discussed with the "Club" at the next meeting. Discussions will be held with appropriate officials in each of the six countries to determine the interest in pursuing individual projects, revising projects, and exploring methods of implementation. This component will require three man-months' time and will involve an agronomist, economist, and engineer. The work will be completed by April 1, 1977.

Consulting with "Club" Work Groups--Representatives of IFDC will meet with "Club" work groups and assist in studies and evaluation of proposals dealing with development of fertilizer resources, supply, and use. This component will require three months' time of an agronomist, two months for an economist, and two months for an engineer. The work will be completed by September 30, 1977.

BUDGET

PRP Preparation (F_1)	
Agronomist, 1 mo. @ $3,750/mo.	$ 3,750
Economist, 1 mo. @ $3,244/mo.	3,244
U.S. travel, 2 tickets (MSL-DCA-MSL)	350
Per diem, 4 days @ $50/day	200
Secretarial, 0.25 mo. @ $1,600/mo.	400
	$ 7,944
Administrative charge @ 35%	2,780
Total	$10,724
Presentation and Implementation WAFS (F_2)	
Agronomist, 1 mo. @ $3,750/mo.	$ 3,750
Economist, 1 mo. @ $3,244/mo.	3,244
Engineer, 1 mo. @ $3,764	3,764
Travel	4,500
Per diem, 60 days @ $50/day	3,000
Secretarial, 1 mo. @ $1,600/mo.	1,600
	$19,858
Administrative charge @ 35%	6,950
Total	$26,808

Consulting with "Club" (F_3)

Agronomist, 2 mos. @ $3,750/mo.	$ 7,500
Economist, 1 mo. @ $3,244/mo.	3,244
Engineer, 1 mo. @ $3,764/mo.	3,764
Travel	3,000
Per diem, 40 days @ $50/day	2,000
Secretarial, 1 mo. @ $1,600/mo.	1,600
	$21,108
Administrative charge @ 35%	7,388
Total	$28,496
GRAND TOTAL	$66,028