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FIRST ANNUAL PROGRESS REPORT

Project Title: Fertilizer Policy Research Program for Tropical Africa

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### Background

Since the 1970s, the per capita food and agricultural production in most of Africa has been worsening. To reverse this trend, agricultural production technology for increasing and maintaining land productivity must be adopted. The adoption of such a technology involving the widespread use of improved inputs and farm management practices requires policies and action programs on agricultural research, extension, and services. Technological change that brings about increments in land productivity is a necessary condition for increased agricultural production and economic development of the sub-Saharan region.

Fertilizer is one of the crucial major modern inputs necessary for increasing food and agricultural production and has played a dominant role in modernizing world agriculture since World War II. The speed with which fertilizer spread throughout the world during this period has been phenomenal and unparalleled in the history of diffusion of agricultural technologies. Total nutrient consumption rose from around 15 million tons in 1950 to about 133 million tons in 1986/87. Rapid developments in industrial production of fertilizers, growth of international trade, and domestic marketing institutions have spread the use of fertilizer to every corner of the world. The use of fertilizers has enhanced returns to investments in other factors of production and technologies and has been a major factor in solving the world food problem. As the diffusion of fertilizer use continued to occur, a plethora of institutional arrangements and corresponding policies also emerged which in turn influenced the rate of growth in the use of fertilizer. Depending upon these developments, overall economic conditions, and technical conditions of agriculture, diffusion rates varied considerably in different countries. Countries in sub-Saharan Africa have had, in general, slower growth and intensity of fertilizer use than the rest of the world. It is in this context that the role of fertilizer policy research in the countries of sub-Saharan Africa has to be considered and USAID project entitled "Fertilizer Policy Research Program for Tropical Africa" covered under Grant No. 698-0435-G-IN-7996-00 was sanctioned.

Despite the recognized value of fertilizer as a key input for agricultural development, the fertilizer sector in tropical Africa is the least developed of any of the developing regions of the world. Chemical fertilizer use in 1983 in this region averaged a low of 7 kg/ha, which compares to 81 kg/ha in Asia and 32 kg/ha in Latin America. Organic fertilizer use data are scarce or nonexistent in most countries. Chemical fertilizer production facilities in the region are virtually nonexistent, and of those in place many are underutilized or mothballed. With fertilizer use primarily dependent on imports, tropical African countries face fluctuating international supply situations, poor to nonexistent national supply routes, and a weak purchasing power in addition to a general lack of knowledge regarding the role of fertilizers in increasing crop production and the income of the rural poor. Even if fertilizer is imported, these countries generally lack the marketing system and extension program to reach the farmer. To make matters worse, donors operating in these countries often provide conflicting advice with regard to fertilizer policies, reflecting their own interest and/or a general lack of data on which to base better advice.

With these limitations, the emergence of a fertilizer sector will often require the establishment of new policies that will remove the constraints to fertilizer use. Such policies generally are linked to a shift in budgetary priorities in the country and thus need to be based on sound information and policy analysis.

Currently, the ability of policymakers in most African countries to devise appropriate policies is largely constrained by the lack of knowledge about how key policies affect the availability and use of fertilizers and other technology-carrying inputs. Hence, research on fertilizer policy is needed to (a) identify key variables affecting the supply and demand sides of fertilizer sector and their impact on fertilizer use and (b) evaluate various fertilizer policies which may be adopted to increase the use of fertilizers by farmers, in terms of the economic and social benefits and costs that such policies can have for the country. On the supply side, policies to be considered may involve import strategies and the allocation of hard currencies and credit, institution building and private sector development, infrastructure development, and pricing policies. On the demand side it involves policies on pricing of marketable surplus, research and extension, and farm-level credit. In addition, in those countries endowed with natural resources

suitable for use as fertilizers or fertilizer raw materials, policies on their exploitation will need to be established.

In view of the urgency of need in tropical Africa to provide assistance in fertilizer policy analysis to national programs and donors alike, the International Fertilizer Development Center (IFDC) with its aim of eliminating constraints to fertilizer use through research, training, and technical assistance and the International Food Policy Research Institute (IFPRI) with its aim to identify and analyze strategies and policies to meet food needs in the world, particularly in low-income countries, have agreed to jointly develop and implement this research program. The program involves principal staff located at the IFDC West Africa Division in Togo as well as at IFDC and IFPRI Headquarters in the United States. The two Centers have highly complementary resources and programs that can lend support to such a collaborative effort. The IFDC West Africa Division in Togo provides the necessary presence in the region from where data collection and information dissemination are coordinated.

### Objectives

The principal objective of this project is to generate information about the benefits, costs, and income distribution effects of various policies which could be adopted by governments of tropical African countries to increase food production, generate income for the rural poor, and promote agricultural development while preserving the natural resource base through the judicious use of organic and/or chemical fertilizers. Such information will facilitate the decisionmaking process in these countries and promote the adoption of more effective policies to achieve economic and rural development and expand the availability of food.

The project, to be implemented in collaboration with policy decisionmakers from sub-Saharan countries, has the following specific objectives:

1. Collection of primary data necessary to conduct a sound analysis of the fertilizer sector in sub-Saharan African countries and establish computerized databases for data storage and retrieval. Although the project involves collection of primary data, particularly at the farm level, it will collaborate with other programs within IFDC and IFPRI to

- collect and use experimental, micro and aggregate data relevant for policy analysis and will provide guidelines to other projects within and outside the collaborating institutes on the type of data that should be collected to facilitate policy analysis.
2. Analysis of primary and secondary data to evaluate fertilizer policies to promote fertilizer use, whether chemical, organic, or combinations thereof, in sub-Saharan countries, in terms of their benefits, costs, and income distribution effects.
  3. Exchange and transfer of information regarding policy analysis in the region through the association and collaboration with national programs in a network format and the undertaking of an annual workshop on fertilizer sector development involving policy advisors and policymakers in tropical Africa.
  4. Serve as an exchange agent of fertilizer policy information for the primary audiences, the national governments, the client systems, and the donor community, both through direct contact as well as through scholarly documents. The policy research group visualized in this project will interact closely with the technical assistance unit of the IFDC West Africa Division which serves the outreach function.

#### Scope of Work

Policies which may be subject to in-depth analysis cover all aspects of the supply and demand sides of the fertilizer sector and their linkages. On the supply side, policies to be considered may involve import strategies and the allocation of hard currencies and credit, institution building and private sector development, fertilizer distribution and marketing strategies, infrastructure development, and pricing policies. On the demand side, policies on pricing of marketable surplus, agricultural research and extension, and farm-level credit will be considered. In addition, in those countries endowed with natural resources suitable for use as fertilizers or fertilizer raw materials, policies on their exploitation will need to be evaluated.

In order to maximize the benefits of this research, data collection and policy analysis efforts are being concentrated on critical policy

issues in selected countries. The research program is planned to be carried out in two stages.

In the first stage, the fertilizer sectors of most countries in sub-Saharan Africa are being examined to evaluate and identify critical policy issues.

The scope of work for this first stage involves:

1. A detailed review of relevant literature.
2. The collection and storing of data and information available from secondary sources into a Fertilizer Policy Database System to facilitate data retrieval and analysis.
3. Analysis of data and information to establish criteria for countries' classification and selection and to determine relevance of various policy issues.
4. The establishment of priorities about the policies that should be subject to in-depth analysis and evaluation and the countries where such an evaluation should be conducted.

The first stage of this research should provide priority sets of policies. As a means of initiating the program, an Introductory Workshop will be organized within the first 6 months of the project. Policymakers from various countries and agencies will be invited to review policies in Africa related to fertilizers and address research needs in fertilizer policies which could be undertaken in association with the project. This workshop will help identify and define the knowledge gaps and provide focus to the research program to be undertaken in Phase 2. This will allow for the selection of policies and countries for in-depth policy analysis in the second stage of this research to achieve greater and more immediate impact.

During the first stage a detailed workplan will be developed, specifying for each participating country the type of research activities and the extent of this research effort. It is expected that the first stage of the program will require 18-22 months.

The second stage of this research program involves the in-depth analysis and evaluation of priority policy issues in selected countries. For this purpose, a policy analysis approach and methodology will be designed for selected policy issues and country situations, and data collection activities undertaken in those countries. Economic theory, in general, and agricultural production economic theory, in particular, provide the basic conceptual and analytical framework that will be adopted to evaluate policies in terms of

their benefits and costs. This general framework will be applied to design methodology for conducting policy analysis on various policy issues under diverse country situations.

Data collection activities to be undertaken in the second stage of the research program will depend on the policies identified for in-depth analysis and the availability of data in the countries where these policies are evaluated. Survey techniques will be used extensively to obtain data from farmers, fertilizer dealers, sources of credit, extension services, and other institutions. About 8-10 countries representing different levels of fertilizer sector development will be included in this second stage of research.

Additionally, information regarding fertilizer supply and marketing in the region, collected through a "Fertilizer Marketing Information and Training Program" proposed to the Government of the Netherlands for funding, will be made available to the fertilizer policy research unit. The marketing effort will provide data on fertilizer procurement patterns, import prices vis-a-vis world market prices, grade selection, timing of delivery, storage, marketing, and distribution process in selected countries in the region.

Although initiated as a 5-year project, IFDC and IFPRI are aware of the continuing need for policy analysis and adjustment and will seek to continue the program with a broad donor support base in the future as well.

The project has had difficulty identifying the senior staff to employ. However, Dr. Nagy joined IFDC in September and is scheduled to arrive in Lomé. Dr. Teboh, a recent graduate from Texas A&M will join in November. For the progress made this year the program has relied on the services of Dr. Sidhu, who conducted an in-depth review of fertilizer policy literature available to date. This review will be a complement to the proceedings of the workshop held in Lomé.

### Workshops

As a part of its ongoing activities, West Africa Division of the International Fertilizer Development Center organized a workshop in Lomé, Togo, November 24-26, 1987, to address fertilizer procurement, communications, and market information problems in sub-Saharan Africa. In addition to several IFDC staff members, the workshop was attended by 19 participants from 13 countries of sub-Saharan Africa. Representatives from the Netherlands, Belgium, USAID, and IFPRI also attended the workshop as observers. The

Implementation Plan

<u>Activities</u>	<u>Purpose</u>	<u>Dates</u>	
		<u>Months</u>	<u>Year</u>
<u>First Stage</u>			
1. Review of literature	Identification of gaps in data, information, and knowledge in countries of sub-Saharan Africa <sup>a</sup>	6	First
2. Collection of available data and information from secondary sources			
3. Introductory workshop with policymakers from various countries and agencies	Identification of country collaborators		
4. Complete data collection and carry out analysis to (a) group countries by stage of agricultural/fertilizer sector development and (b) identify priority policy issues	To identify most important policy issues and the countries where in-depth analysis of these policies will be undertaken <sup>b</sup>	6 8	First Second
5. To conduct first annual workshop and prepare workplan on research and training	To discuss (during workshop) results of analysis and prepare detailed workplan specifying the type of research activities and the extent of research efforts in selected countries--second stage	4	Second
	To identify training requirements and outline training programs on policy analysis		

a. The following countries will be included in initial studies: Benin, Botswana, Burkina Faso, Burundi, Cameroon, Central African Republic, Chad, Congo, Côte d'Ivoire, Ethiopia, Gabon, Gambia, Ghana, Guinea, Kenya, Liberia, Madagascar, Malawi, Mali, Mauritania, Mozambique, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, Somalia, Sudan, Tanzania, Togo, Uganda, Zaire, Zambia, and Zimbabwe.

b. In-depth studies will be carried out in at least two countries from each of the groups obtained.

Implementation Plan (Continued)

<u>Activities</u>	<u>Purpose</u>	<u>Dates</u>	
		<u>Months</u>	<u>Year</u>
<u>Second Stage</u>			
1. Undertaking of data collection from primary sources (farmers, fertilizer dealers, institutions) to conduct in-depth policy analysis	To obtain additional data needed for in-depth policy analysis	Last 3 years	of project
2. Establishment of Fertilizer Policy Database System for countries of sub-Saharan Africa	To facilitate the dissemination of data and information and the undertaking of policy analysis	Last 3 years	of project
3. Establishment of mechanisms for the monitoring of policy changes and their impact in selected countries	To meet overall objectives of project	Last 3 years	of project
4. Implementation of training programs on (a) methodology and techniques for policy analysis and (b) expansion and use of the Fertilizer Policy Database System	To meet overall objectives of project	Last 3 years	of project
5. Annual workshops to (a) present and discuss results of in-depth policy analysis in selected countries, (b) present and discuss progress in establishment of Fertilizer Policy Database System, (c) discuss training programs, and (d) prepare annual workplan for policy research and related training for following year	To meet overall objectives of project	Last 3 years	of project
6. Preparation and publication of scholarly documents and reports		Last 3 years	of project

workshop was supported by Kellogg Foundation and USAID funding. This workshop has an obvious relationship to the policy project.

The country presentations included information about the fertilizer sector in each country. The workshop recommended to establish a network on fertilizer information exchange among sub-Saharan African countries to overcome the lack of knowledge and information which was cited as a major reason for inefficiency in procurement, production, marketing, distribution, and use of fertilizer. IFDC West Africa Division has undertaken this responsibility. A summary of the proceedings of this workshop has been published by IFDC.

The first policy project workshop was held April 5-7, 1988, at IFDC West Africa Division, Lomé, Togo. With the emergence of fertilizer sectors in Africa there is a need to establish clear policies that will facilitate the adoption of fertilizers. The fertilizer policy project is designed to assist countries of sub-Saharan Africa in identifying the key variables affecting the supply and demand side of the fertilizer sector, and in designing and evaluating various fertilizer policies to stimulate sector development. The project seeks strong links with national programs. The workshop was held with the purpose of sorting out the problem areas and issues in the development of fertilizer sectors in sub-Saharan countries and setting the research agenda of the project.

Policymakers and policy analysts from Ministries of Planning and Agriculture from 12 countries were invited to participate in the workshop and present their views and recommendations on what they perceive as major constraints to increased fertilizer use in their countries. These countries were selected to reflect different stages in the development of the fertilizer sector in the sub-Saharan region. Ten of the invited countries attended the workshop and delivered country papers on their fertilizer sectors. These countries are: Benin, Cameroon, Côte d'Ivoire, Ghana, Kenya, Malawi, Nigeria, Togo, Zambia, and Zimbabwe. Senegal could not attend the workshop but submitted a paper.

In addition to Dr. Paul L.G. Vlek the workshop was attended by six senior IFDC staff members who delivered four papers and by four IFPRI staff members two of which also delivered a paper. In all, there were sixteen papers presented and discussed at the workshop. The lack of proper statistics constraining the design of effective policies was invariably recognized as one of the major problems and various country participants urged the project to

help generate primary data impinging on fertilizer use and policy formulation. The papers presented at this workshop are being edited for publication as a compendium. In addition to IFDC and IFPRI, representatives from USAID and international research centers IITA, ICRISAT, and CIMMYT also attended the workshop. The sixteen papers presented and discussed at the workshop were as follows:

1. Amuka, Peter M. 1988. "Fertilizer Policy in Kenya," Paper presented at IFDC-IFPRI Workshop on Fertilizer Policy Program for Tropical Africa, Lomé, Togo, April 5-7, 1988 (Kenya).
2. Baanante, C. A., and T. P. Thompson. 1988. "Micro-Socio-Economic Research on Constraints to Fertilizer Use in Sub-Saharan Africa for Policy Development," Paper presented at IFDC-IFPRI Workshop on Fertilizer Policy in Tropical Africa, Lomé, Togo, April 5-7, 1988 (IFDC).
3. Bumb, B. 1988. "Fertilizer Supply in Sub-Saharan Africa: An Analysis," Paper presented at IFDC-IFPRI Workshop on Fertilizer Policy Program for Tropical Africa, Lomé, Togo, April 5-7, 1988 (IFDC).
4. Connolly, M., and R. Coster. 1988. "Strategies to Enhance the Dissemination of Fertilizer Information in the Sub-Saharan Region," Paper presented at the IFDC-IFPRI Workshop on Fertilizer Policy in Tropical Africa, Lomé, Togo, April 5-7, 1988 (IFDC).
5. Dapaah, S. K., and E. S. Otinkorang. 1988. "The Place of Fertilizers in Ghana's Quest for Increased Agricultural Productivity," Paper presented at IFDC-IFPRI Workshop on Fertilizer Policy in Tropical Africa, Lomé, Togo, April 5-7, 1988 (Ghana).
6. Desai, G. M., and V. Gandhi. 1988. "Fertilizer Consumption in Sub-Saharan Africa: An Analysis of Growth and Profile of Use," Paper presented at IFDC-IFPRI Workshop on Fertilizer Policy in Tropical Africa, Lomé, Togo, April 5-7, 1988 (IFPRI).
7. Maida, J.H.A., and E. S. Malindi. 1988. "Fertilizer Supply and Demand in Malawi," Paper presented at IFDC-IFPRI Workshop on Fertilizer Policy Program for Tropical Africa, Lomé, Togo, April 5-7, 1988 (Malawi).
8. Mokwunye, A. U., A. Baciono, and Paul L.G. Vlek. 1988. "Agronomic Aspects of Mineral and Organic Fertilizer Use in Sub-Saharan Africa," Paper presented at IFDC-IFPRI Workshop on Fertilizer Policy Program for Tropical Africa, Lomé, Togo, April 5-7, 1988 (IFDC).

9. Muleya, Kabeta. 1988. "Fertilizer Policy in Zambia," Paper presented at IFDC-IFPRI Workshop on Fertilizer Policy Program for Tropical Africa," Lomé, Togo, April 5-7, 1988 (Zambia).
10. Ologide, L. O. 1988. "Fertilizer Policy and Programs: Nigeria Experience," Paper presented at IFDC-IFPRI Workshop on Fertilizer Policy Program for Tropical Africa," Lomé, Togo, April 5-7, 1988 (Nigeria).
11. Sakala, E. 1988. "Fertilizer Use in Zimbabwe: Supply, Demand, Policy and Related Problems," Paper presented at IFDC-IFPRI Workshop on Fertilizer Policy Program for Tropical Africa," Lomé, Togo, April 5-7, 1988 (Zimbabwe).
12. Atchou, Y. K. 1988. "Issues Related to Fertilizer Use in Togo," Paper presented at IFDC-IFPRI Workshop on Fertilizer Policy Program for Tropical Africa," Lomé, Togo, April 5-7, 1988 (Togo).
13. Nkonabong, F. 1988. "Major Constraints Related to Fertilizer Use in Cameroon," Paper presented at IFDC-IFPRI Workshop on Fertilizer Policy Program for Tropical Africa," Lomé, Togo, April 5-7, 1988 (Cameroon).
14. Koffi, K. 1988. "Fertilizer Sector in Ivory Coast," Paper presented at IFDC-IFPRI Workshop on Fertilizer Policy Program for Tropical Africa," Lomé, Togo, April 5-7, 1988 (Côte d'Ivoire).
15. Robert, V. T. 1988. "Fertilizer Policy in Popular Republic of Benin," Paper presented at IFDC-IFPRI Workshop on Fertilizer Policy Program for Tropical Africa," Lomé, Togo, April 5-7, 1988 (Benin).
16. Ndiaye, W. 1988. "Fertilizer in Senegal, Current Situation and Outlook," Paper presented at IFDC-IFPRI Workshop on Fertilizer Policy Program for Tropical Africa," Lomé, Togo, April 5-7, 1988 (Senegal).

At the end of the workshop it was agreed that by the end of 1988 various individuals working on the project from IFPRI and IFDC would develop papers on the following topics related to sub-Saharan Africa:

- Fertilizer information dissemination systems (Coster)
- Import, production, and price structures (Bumb)
- Fertilizer demand (Baanante)
- Fertilizer use (Desai and Gandhi)
- Macroeconomics and fertilizer supply (Tshibaka)

Emerging from the workshop were several issues and problem areas for further research which are included in the next section.

### Literature Review

Following the workshop in April 1988, an in-depth literature review paper has been prepared by S. S. Sidhu, IFDC. This review paper covers a large volume of the literature relevant to enhancing the role of fertilizer-related policies and programs for increased food and agricultural production and rural incomes in the countries of sub-Saharan Africa. The paper is titled "Fertilizer Policy for Sub-Saharan Africa: A Review of the Literature." This vast undertaking was pursued with the aim of raising and posing the issues for fertilizer research policy program. It endeavors (1) to specify why the questions raised are relevant and important for the development of a meaningful fertilizer policy program for sub-Saharan Africa, (2) to comment on the current state of knowledge concerning them, and (3) to outline possible approaches for attacking them. The paper includes annotated summaries of the April 1988 Workshop papers and other literature relevant to fertilizer policy and discusses numerous major food and agricultural development policy issues related to fertilizer policy. A summary of the paper, including suggestions for fertilizer policy research and a topical outline for such research, is included here.

### Summary and Policy Research Suggestions

1. Fertilizer policy in the context of agricultural development in sub-Saharan Africa is a complex set of activities, highly interrelated and interdependent upon other sectoral activities and policies, upon taxation and trade regimes and general macro policies and strategies. It is highly variable within and among countries. It is probably impossible to make any statement that would be true about particular fertilizer-related policies over all countries of sub-Saharan Africa. A neat delineation of specific issues for fertilizer policy is made vastly intractable by this overwhelming interrelatedness. At times one easily wanders into general issues of agricultural and economic development. But then that is the essence of this interdependence. No easy ways to define boundary lines are possible.

## 2. Diversity of Sub-Saharan Africa

Another problem pertains to the need for generalization about a heterogeneous region. Often references to sub-Saharan Africa are made as if it is a homogeneous region. Quite the contrary, countries in sub-Saharan Africa have a vast amount of heterogeneity in their natural physical environments, geography and history. They are different in their educational, social, economic and institutional structures. Yet statements are routinely made comparing sub-Saharan Africa with India as if it is a single homogeneous unit. Whereas certain amount of generalization based on observable similarities in various structural characteristics is possible, useful and sometimes even necessary, developmental aims are better served by treating each country as a special case, because that is the unit for which policy formulation and implementation are relevant.

Groupings of countries into sub-regions is sometimes made for some special purposes based on some unifying characteristics. For example, FAO in its Fertilizer Program divides sub-Saharan Africa into Sahelian, Western, Central, Southern and East African zones which are agroclimatically relatively homogeneous. Sub-Saharan Africa is often classified as Semi-arid tropics, Sub-humid tropics and Humid tropics. (see for example, Binswanger and McIntire, 1987). Many other sub-divisions, for example, oil exporting and oil importing, low income and middle income countries, estatist and market-oriented countries, Francophone and Anglophone countries, land-locked countries and those with access to ocean ports, countries with strong and weak market intervention policies, low resource-carrying and high resource carrying countries, countries with bimodal or unimodal agricultural structures.

All these ways of looking at the rapidly changing African scene are useful. For fertilizer policy considerations some additional groupings should also be considered: countries with domestic production of fertilizers and those that are entirely import dependent, countries which have significant private sector involvement in fertilizer trade and those which depend only on public sector, countries with potential for development of domestic resources and those which have no such

resources, countries which have basically depended upon their own resources for fertilizer imports and the ones that are heavily aid dependent, and countries with heavy fertilizer subsidies and no fertilizer subsidies. Aboyade (1985) has developed an interesting classification scheme based on a combination of high or low resource carrying capacity, unimodal or bimodal agricultural organization, fixed or flexible exchange rate regimes and weak or strong market intervention domestic policies. It may be useful to examine his taxonomic approach to see if it could be applied for fertilizer policy analysis.

3. Size of the Food-Grain Market

World food-grain markets have captured substantial shares of larger urban food-grain markets in many sub-Saharan countries. At present accumulated food-grain stocks in the developed countries and their program costs are at record levels. During the 1980s, the discrepancy between producer grain prices in the developed grain surplus countries and the international grain prices widened dramatically (Miller, 1987). Food-grain prices in the international markets during 1986/87 were record low (FAO, 1987). Food imports into sub-Saharan countries have, of late, accelerated, leaving a small residual share of the food-grain market for the widely dispersed domestic food produces. This small fragmented food-grain market does not constitute an assured market for domestically produced food. Of course, the situations are further aggravated by rural labor constraints brought about by a whole host of policies accelerating the flow of labor out of agriculture. The situation does not portend for a rapid diffusion of fertilizer technology without major policy changes.

4. Pricing Domestically Produced Fertilizer Products

The pricing of domestically produced fertilizer products for the domestic market should be an important issue for Nigeria. This matter attains special significance because of the Government plans to eliminate fertilizer subsidies. However, since NAFCON is reported to be already exporting its production the social opportunity cost of these products should be readily available. It should be important to appropriately

link the domestic prices to the social opportunity costs of various fertilizer products as reflected in their export prices. This type of work would influence pricing policies for current and future domestically produced fertilizer products in other countries.

5. Pan-Territorial Pricing of Fertilizers

Most sub-Saharan African countries have policies to sell fertilizer at uniform farm-gate prices throughout the country. Such policies are considered as fair to all farmers. It seems that by now the public authorities in several of these countries are becoming convinced that such a system does not work very well. It misallocates fertilizer which does not move to everywhere as desired by the authorities. There are excess supplies in nearby places and shortages in the interior giving rise to a black market in fertilizers. The current thinking in some of the countries (Nigeria, Ghana) is to involve private traders as registered retailers and to relax the policy of uniform farm-gate pricing. The principle of uniform pricing would be applied upto major (selected) distribution points. Then on the retail prices should be freely determined. Benton's (1987) papers to encourage sufficient competition at the retail level and to assure an efficient supply of fertilizers to the farmers suggest a framework for a cost effective and fair system of fertilizer distribution at the retail level. Such a system is essential for timely availability of fertilizers in the rural areas. Additionally it is only such a system that would start generating the necessary data on month by month requirements of fertilizer in different parts of the country and a means to update them. Such data are essential for timely planning of supplies and constitute the basis for the creation of an efficient national fertilizer distribution system.

6. Evolution in Nigerian Fertilizer Policy Shifts

The background and reasons for the Nigerian evolutionary policy shifts from nitrate fertilizers to urea and from single superphosphate to DAP and from imports to domestic production, that is, shifts from more costly low-analysis to high-analysis fertilizers should be researched. Nigeria also had a prolonged period of bagged imports rather than bulk.

What was the final reasoning for domestic production of high-analysis fertilizers in plant size sufficient to avail modern economies of scale? These are worthy topics for fertilizer policy research. The documentation of the Nigerian experience is likely to influence the future shape of fertilizer industry for SADCC countries in important ways. The timelessness of this research will be of crucial significance to influence fertilizer policy development for the sub-Saharan countries.

7. Sulphur Needs and Fertilizer Mix

In some countries there is some procrastination in making a shift from low-analysis S-containing fertilizer products (AS, SSP) which are more costly to high-analysis products (like urea and DAP) which are low cost. For some crops and soils sulphur needs are the basis for this confusion. The needs for sulphur in these situations should be carefully studied and if possible independent ways to meet sulphur requirements established.

8. Food Aid and Cheap Imports

Several papers have argued that the current policies of food aid and food imports do not offer a long-term solution to the food problem. That is in many cases the rising share of cheap food imports and donations have been eating away the share of food demand faced by domestic producers. This is related to item 3.

9. Foreign Exchange Constraint

From IFDC-IFFRI Workshop (April 3-5, 1988) papers and several other researchers there are strong indications that foreign exchange allocations constrained fertilizer imports. This could even theoretically be expected in view of the import-substitution development strategies adopted by most sub-Saharan countries. Foreign exchange requirements of the protected industrial activities are of ever-expanding nature. Diversion of foreign exchange to such expanding activities could leave insufficient allocations for the import of fertilizers and other modern inputs. Country based research to demonstrate the costs in terms of

foregone output and loss in foreign exchange earnings due to exchange related fertilizer import constraints, could lead to substantial policy changes. In this context, the role of fertilizer aid (commodity and/or free foreign exchange) should be explored.

10. Country-Specific Response Analysis

Several crucial supply and distribution problems aside, a buldgeoning demand for fertilizers also has not manifested in sub-Saharan Africa. It seems demand conditions in sub-Saharan Africa are vastly different compared to the Asian countries. Major factors affecting fertilizer demand are fragmented and thin commodity markets heavily shared by cheap food imports depressing food prices, low response of major crops to fertilizer use, and as yet sufficient opportunities for farmers to pursue relatively extensive agricultural strategies because of relative land abundance (McIntire). For fertilizer policy programming the impact of all these factors should be looked into for each country separately. Generalized versions are for developing a broad view about policy questions. Specific policy programming depends upon country-specific problems and issues.

11. Fertilizer Response Research

This review brings out a stark fact that studies estimating fertilizer response are quite meagre in the sub-Saharan countries. McIntire (1986) from a review of FAO and a few other studies concludes that (1) for given output and input prices, rice, maize, millet/sorghum, in that order, provide the strongest incentive for fertilizer use, (2) crop responses to fertilizer use are lower on farm than on station, (3) better response to fertilizer in wetter areas, and (4) fertilizer can profitably be applied to these crops in different situations.

Information about crop response to fertilizer use and profitability is, obviously, quite limited. A more extensive search of such information on crop by crop and country by country basis should be carried out and gaps identified. In some cases data exist but need to be analyzed. However, not much more may be available and more detailed farm-level

trials may have to be planned on the lines of IFDC Soil Fertility Restoration Project to generate appropriate data sets for different countries. Even though the start of fertilizer extension education programs need not and should not wait, knowledge created by research would be essential for any meaningful fertilizer extension activity and promoting the role of fertilizer in the development of agriculture.

12. Fertilizer Use and Risk

Shalit and Binswanger, and McIntire emphasize the unimportance of risk because risk explained no more than 10%-20% of the shortfall in fertilizer consumption from the risk-averse economic optimum. This conclusion is important as far as policies are contemplated (for example insurance) to cope with individual farm risks. However, weather related production risks measured as over time variance of crop yield, areas planted, and the difference between areas planted and harvested are highly variable across crops and space. That is to say that production risks are higher in some areas (and crops) than in others and accordingly profitability of fertilizer use is more or less risky. Risk research of the first kind is unimportant. Analysis of disaggregated time series data on crop areas and yields to estimate production risks could provide immensely useful information to geographically delineate areas and crops for more or less intensive fertilizers use strategies. This type of research is highly recommended.

13. Fertilizer Use by Crop and Estimating Fertilizer Needs

Mudahar (1986) synthesized data from several studies showing estimated shares of NPK consumption for different crops in some selected countries of sub-Saharan Africa. This is very useful information for purposes of policy planning. Expansions of this work should receive immediate attention and would be a high pay-off activity in terms of improving the role and efficiency of fertilizer use. A suggested detail of the expansion of this work should be as follows.

Each fertilizer retailer should be required to maintain a daily record of all sales of each fertilizer by crop and area of each crop to be

fertilized. From these records bi-weekly or monthly summaries should be prepared for each retail area for each fertilizer sold by crop and areas of each crop fertilized. Such data have obvious importance for planning of fertilizer movements, storage, inventories and estimating requirements (demand). A synthesis of these data at the regional and national levels is necessary for planning of storage, transport and financial requirements.

An alternative approach to assess fertilizer use by crop is to carry out farm surveys. While necessary, farm survey data are less satisfactory for estimating and planning for monthly requirements. On the other hand farm survey data can generate a more richer detail of farm-level constraints necessary for proper estimation of crop response and fertilizer demand. In fact the two approaches reinforce each other in building the necessary fertilizer use data base.

#### 14. Balanced Use of Fertilizer

The term "balanced fertilizer use" has been variously used in the literature. It is yet as difficult and elusive to comprehend as the long history of its use. In general the concept implies a balance in the use of plant food nutrients especially nitrogen (N), phosphate ( $P_2O_5$ ) and potash (K), and is expressed as N:P:K ratio. The question is: what is the balanced ratio for a particular country that should guide its import and supply arrangements? So the term has a tremendous operational significance. How should one go about to determine an operationally meaningful ratio?

In mature fertilizer using economies it is less of a problem. History of past use provides a first approximation of the desirable ratio which can to some extent be tempered with the anticipated impact of the expected changes in prices. In market-oriented systems such problems are automatically solved by the market.

For a developing country at an early stage in its history of fertilizer use, it is generally a problem to guide itself about the desirable N:P:K ratio. McIntire (1986) shows that for the sub-Saharan Africa, as a

whole, the mean shares of use of N,  $P_2O_5$  and  $K_2O$  were about 50%, 31% and 19% in 1978-82 and were about the same during 1974-76. However, there is a large amount of intercountry variability in these shares. For example, the share of N varies from a low 23.1% in Guinea to a high of 99.2% in the Sudan, and that of phosphate from a low of 0.8% in the Sudan to a high of 62.1% in Gambia. Botswana, Ethiopia, Sudan, and Uganda did not use potash at all. Different crops show different response to the application of different nutrients in a given soil-climatic environment. Similarly nutrient response varies for each crop in different soil-climatic environments. Since most of the sub-Saharan countries are at low levels of fertilizer use an alternative approach has to be followed.

In-country research should be done to analyze agronomic fertilizer response trials crop by crop. Wherever farm-level survey data are available they should be included in this analysis. Analysis should be done to determine optimal levels of N, P and K use for each crop. Then crop areas, preferably fertilized crop areas, should be used as weights to establish a weighted average N:P:K ratio. Such ratios should be considered as first approximations to guide balanced fertilizer use in different countries. Notice the linkage of this discussion with item Nos. 10, 11 and 13.

15. Fertilizer Import Demand

McIntire (1986) attempts to systematically explore the factors which determine fertilizer import demand in sub-Saharan Africa and as such has made a very useful contribution toward an understanding of the role of various factors influencing import demand in a global sense. The estimates show that N imports are significantly influenced by export earnings and irrigated areas. Official development assistance and areas under rice also encouraged imports but not that strongly. Export earnings, areas under rice, roots and tubers were strong factors encouraging imports of  $P_2O_5$  while domestic production and prices discouraged its imports.

His analyses also show that Nigeria, Madagascar and Zaïre imported less N and P<sub>2</sub>O<sub>5</sub> due to subsidy related constraints. It seems to me that if the number of observations for individual countries is sufficiently large, country-specific estimates would be of greater value in predicting import demands of individual countries. In cross-sectional estimates considerable parametric variation across countries should be expected in view of the heterogeneity of African countries. Obviously the cross-section sample is not very homogeneous. For example, rice and wheat are not grown in many countries and their impact is estimated to be insignificant. In countries with large areas under these crops, their impacts in determining import demand would be substantial. Such impact, however, could be masked in the type of cross-section model estimated. The imposition of a common structure in the form of cross-section models for vastly different countries is thus a drastic simplification. It is important, therefore, that to supplement the useful results obtained for purposes of deriving implications for sub-Saharan Africa as a whole, an attempt must be made toward an assessment of the import demands for individual countries on the basis of time series data. Desai's (1988) paper provides encouragement that such data of reasonable lengths are now possible. Vastly more useful results for policy planning in the fertilizer sectors of individual countries should be expected from such a thrust.

16. Small Size of Fertilizer Market

Bumb (1988) brings out very clearly that the small size of the fertilizer market in many countries of sub-Saharan Africa is a crucial problem. These countries cannot avail the benefits of economies of bulk imports and consequently incur much higher costs for their imports relative to larger importers. During 1984-86, 28 of the 40 sub-Saharan countries imported less than 20,000 tons of fertilizer nutrients each and 17 of them imported even less than 5,000 tons each. Only 6 countries imported more than 50,000 tons each and together they accounted for about two-thirds of the total sub-Saharan imports. The heart of the fertilizer problem of most countries in the sub-Saharan Africa is the very low level of demand. As a result, the c.i.f. prices are higher by 20% to 50% compared to many other countries. The border

prices for the land locked countries are further increased, in some cases quite sharply, because of the high inland transport costs.

Fertilizer policy research program will have to grapple with these twin problems of low demand and high import costs to find both short-term and long-term solutions for the countries involved. The problems are of course further aggravated by pressures on available exchange resources and policies for pricing of and lack of market for agricultural output.

Domestic distribution costs of fertilizer in most sub-Saharan countries are also much higher than countries in Asia because of relatively poorer development of the market infrastructure and institutions. Could these costs be high because of inefficiencies in the whole systems of procurement, storage, transport and distribution, in addition to poor infrastructure? Fertilizer policy project would have to design research in this area on country by country basis.

17. Subsidies and Budget Constraints on Supply

In some of the literature there are strong indications that fertilizer subsidies with budget constraints might actually reduce fertilizer consumption.

There is evidence that several important countries (in particular Nigeria, Madagascar and Zaïre) had significantly lower imports than they should have had at the time that they heavily subsidized fertilizers (McIntire, 1986; Olayide and Idachaba, 1987).

The fertilizer policy project should try to clearly document that in countries where the price is fixed below unit import costs, fertilizer imports are actually constrained by the allocation of total subsidy. If so the fertilizer distribution system would most likely resort to rationing and black market in fertilizer would appear which are easily verifiable. The information would be uniquely valuable for policy improvement. This short-term research should be planned on priority basis.

18. Farm-Level Demand Constraints

18. Farm-Level Demand Constraints

The paper by Baanante and Thompson (1988) lays the foundation for detailed research on agroecological, social and economic factors which influence farmers in their business of farming and which the policymakers can and have to use in promoting the use of fertilizers, food production and agricultural development. Among the factors affecting demand for fertilizers the paper places heavy emphasis on the domestic and foreign demand for agricultural commodities but more so on the domestic demand. The level of demand for food and agricultural commodities is a basic force to determine their prices which in turn determine the profitability of their production and the use of purchased inputs like fertilizers. Sustained high levels of crop prices overtime induce various types of investments in farming essential for improvements in resource productivity. In relation to the fertilizer policy project the paper recommends research to document the influence of crop prices on fertilizer use, the problems that farmers face in the sale of farm products and pattern of disposal and use of crop output including the by-products. The emphasis should be to document farmers' views and responses.

Demand for farm products is unmistakably a crucial factor to promote fertilizer use, food production and agricultural development. Because of the increasing population and incomes demand for food in a general sense has been increasing in sub-Saharan Africa. Ordinarily, in such a situation food production should not have stagnated. In many cases the rising share of cheap food imports and donations have been eating away the share of demand faced by domestic producers (Aboyade, 1985 and 1987). Indeed, the phenomenon of cheap imported food moving backwards from urban to rural areas is starkly visible in many sub-Saharan countries depressing prices for domestically produced food. Under these circumstances the role that fertilizer can potentially play in increasing food production and agricultural development is likely to remain low. Research in this area should receive immediate attention.

The paper has identified several other research problems. In particular research should be designed to ascertain farmers' views as to the type

of food and agricultural marketing arrangements, institutions and market infrastructures that would (1) induce them to produce marketable surpluses and (2) involve them in their development. Fertilizer and other input markets should be included in this research program. The authors are experienced researchers in microsocioeconomic research and should be encouraged to design and carry out survey work in relation to the areas of research that they have identified.

19. Use of Organic Manures and Fertilizers

Organic fertilizers and manures are important sources of plant nutrients and improve the physical properties of soils. By tradition, sub-Saharan farmers have used organic manures as means of maintaining soil fertility and increasing crop production wherever possible. There is ample evidence about the contribution of organic manures in increasing soil fertility and crop production and that farmers recognize the value of organic manures. However, the basic constraints to the use of organic manures are the limited supplies and high labor and transportation costs. Few sub-Saharan farmers have access to sufficient supplies of organic manures to maintain continuous cultivation and soil fertility (Lombin and Abdullahi, 1977). The lack of adequate supplies of organic manures is explained in part by the fact that few animals are owned by small farmers. This further explains why farmers throughout the subcontinent primarily use organic manures on food and cash crops grown very near the households (Lassiter, 1981).

There has been a paucity of research on how organic manures affect agricultural production and productivity under conditions of continuous cultivation (Eicher and Baker, 1982). However, research has shown that increases in crop yields are obtained when organic manures are used in conjunction with chemical fertilizers than when only one source is used (Sedago, 1985). Recent evidence from western Niger suggests that farmers do not abandon organic manures when chemical fertilizers are used (Thompson and Baanante, 1988). Thus, organic manures and chemical fertilizers appear to behave more as complementary inputs rather than substitutes. Microsocioeconomic research is needed to document (1) the farm-level availability and use of organic fertilizers and manures,

(2) their impact on crop yields and fertilizer demand, (3) the complementarity between organic manures and chemical fertilizers, and (4) to examine their role for long-term sustainability of agricultural growth and improvement of the environment.

20. Dissemination of Fertilizer Know-How

Dissemination of fertilizer-related knowledge and information is crucial for expanding the role of fertilizer to increase food and agricultural production. In sub-Saharan Africa, in areas of policy, trade and marketing of fertilizers there are often no structures or systems in place, and therefore the problems related to the adoption of research results are compounded. Research is recommended as a priority task to develop an overview of the existing infrastructure for information generation, dissemination and adaptation in the fertilizer sector at both regional and in-country levels. A networking approach for senior personnel at national levels to be involved in the task, may be adopted. There is also need for appropriate training of the national personnel for extension of fertilizer know-how.

Another important aspect of dissemination of fertilizer-related knowledge and information is how best to capsule such knowledge to convey it to the policymakers who must be convinced about its worthwhileness to effect appropriate policy changes.

21. Credit

Fertilizer subsidy is often considered necessary to accelerate the rate of adoption of fertilizer use in its early stages. However this argument could be applicable to all other important inputs. The costs of subsidy thus easily become unmanageable and often difficult to reverse. There are other undesirable aspects of subsidies when they are accompanied by input supply constraints. Fertilizer and other inputs are best sold at market prices.

On the provision of credit for the purchase of fertilizer and other inputs to relax liquidity related constraints particularly on small

farmers there is a general support in the literature. In the absence of technology carrying modern inputs in situations of relative land abundance and farming still in the self-sufficiency mold there may not be much demand and/or supply for credit (Binswanger and McIntire, 1987). However with the introduction of fertilizer and other inputs demand for credit emerges immediately. Farm sector then should have the same claim for credit as other sectors in the economy. Some even think that credit is the key to the use of modern inputs and argue for the desirability to subsidize credit linked to the purchase of modern inputs (Krishna, 1982). The case for farm credit on terms and conditions at least as favorable as to other sectors is undeniable.

There are however plenty of examples in the literature lamenting about the problems of credit administration particularly recovery. Adams (1987) suggests strengthening of the credit institutions handling farm credit rather than direct public provision of credit. In countries where fertilizer retail trade is being privatized, the possibility of farmers credit through retailers for fertilizer purchase should be researched. Financial institutions are encouraged to provide credit to the retailers for the purchase of fertilizer which they sell to the farmers on credit and are themselves responsible for its recovery. These retailers should be trained in technical aspects of fertilizer use. Thus an integration of the provision of credit and fertilizer use know-how would be a good answer to the loan repayment problems.

## 22. Wheat Research for Tropical Environments

Wheat in sub-Saharan Africa is presently grown in selected areas where climatic conditions are favorable and/or irrigation facilities have been developed. However since 1982 more rigorous research efforts are going on by CIMMYT and its collaborating organizations with the aim to develop wheats suitable for warmer tropical environments. Twenty-two sub-Saharan countries have been identified that could potentially benefit from the development of wheats with better adaptation to these marginal areas (UNDP/CIMMYT 1987).

In sub-Saharan countries food consumption patterns are rapidly changing in favor of superior grains of wheat and rice induced by cheaper imports and rising urban incomes. Developments in the wheat improvement program should be carefully watched because once some improved strains become available their diffusion process will depend upon fertilizer and other public policies.

23. Fertilizer Production and Supply Constraints

Zimbabwe, Zambia, Malawi, and Southwestern Tanzania have a very high potential for fertilizer use. Maize is a food staple but the region has a wide base of fertilizer using food and nonfood crops. Soil-climatic conditions are favorable for agricultural growth through the increased use of fertilizers. Commercial sectors are already high users of fertilizers. The small farm sectors are on the threshold of becoming major fertilizer users, thereby stimulating agricultural and economic growth in these countries.

A major fertilizer policy question for Zimbabwe (or perhaps SADCC countries together) concerns its fertilizer industry. Zimbabwe depends for its fertilizer supplies on domestically produced nitrate-based products for nitrogen and low-analysis phosphatic products, all of which are high cost. Imported urea subsidizes to some extent nitrate-based domestic production. Ordinarily the situation would call for a major modernization of fertilizer production in Zimbabwe to avail of the substantial economies in production and to save on distribution costs by producing high-analysis products like urea, DAP, etc. But there has been procrastination on this point partly induced by civil and political strife in and around the country, perhaps partly due to inertia and the interests involved of the current fertilizer producing commercial sector for which one should expect an amicable resolution. Somehow the costs of not modernizing fertilizer production and distribution on terms of higher fertilizer costs and slower agricultural and economic growth remain hidden from the policymakers. Nigeria went through a similar prolonged period of procrastination before making a shift from nitrate fertilizers to urea imports (but never shifted to bulk imports) and subsequently to domestic production of high-analysis urea, DAP, and complexes. It is our judgment that Zimbabwe in particular and SADCC

countries as a group are likely to gain from this modernization. The likely gains from such changes should be assessed.

#### Some Topics for Fertilizer Policy Research

1. Analysis of crop response to fertilizer use and potential demand for fertilizer.
2. Impact of food-grain and agricultural markets on producer prices and demand for fertilizer, size and fragmentation of the food-grain markets, a larger share of these markets being usurped by cheaper food-grain imports.
3. Role of market infrastructures and institutions (or lack thereof) to provide stable and assured access to markets for agricultural output and fertilizers and other inputs.
4. The case for modernizing domestic production from low-analysis to high-analysis fertilizers in Zimbabwe for SADCC countries to take advantage of economies of scale in production.
5. To examine the role of aid provided fertilizers for a smooth development of fertilizer sectors and to overcome foreign exchange constraints in the interim periods.
6. Country by country analysis of the constraints imposed by foreign exchange to reduce fertilizer imports and use. Generate estimates of foregone benefits (implicit costs) due to foreign exchange restrictions on import of fertilizers.
7. To demonstrate the adverse effects and economic costs of panterritorial uniform national pricing policies for fertilizers and food commodities.
8. To demonstrate the cost savings and improved access to fertilizers by privatization.
9. To examine by country when and how fertilizer subsidies may reduce fertilizer consumption and when and how it will increase consumption.
10. To document the farm-level availability and use of organic and chemical fertilizers and examine their role for long-term sustainability of agricultural growth and improvement of the environment.
11. Country by country assessment of training requirements for fertilizer sector staff. Nature and intensity of training for each category of

- staff and determination of their numbers required in the short term and the longer term.
12. Given the response based needs of N, P, K, and other nutrients to determine by country the least-cost combination (mix) of fertilizer products taking into consideration the procurement, transportation, storage, and distribution costs.
  13. Domestic pricing of imported fertilizers. By country determination of the number and locations of principal distribution points up to which uniformity of prices (based on costs) may be maintained.
  14. To demonstrate that increased allocations of foreign exchange for fertilizer imports and use can actually earn and save more foreign exchange. That is to show the implicit costs of income foregone by not using or using less fertilizer.
  15. Expansions in the use of fertilizer and several forms of agricultural mechanization could in many parts of sub-Saharan Africa be complementary. Empirical testing is needed.
  16. Research that would show that fertilizer use enhances the benefits of investments in irrigation in relation to existing or potentially feasible irrigation projects.
  17. Identify the countries and study the feasibility of using indigenous resources of phosphorus (phosphate rock), calcium (lime), and other plant nutrients.
  18. Detailed research is needed to identify agroecological, social, and economic factors which influence farmers in the use of fertilizers and to develop policy mechanisms for influencing their use.
  19. Country by country research: (1) to improve methods of assessing demand and its seasonality, that is, month by month requirements in different parts of the country, (2) to improve procurement procedures to tailor imports to monthly requirements, and (3) to assess the efficient (cost-effective) levels of necessary carryover stocks.
  20. Research by country on factors explaining fluctuations in imports.
  21. Examine the possibility if some of the countries which have small fertilizer markets, can join together to avail the benefits of economies of bulk imports.
  22. Examine the ways of packaging fertilizer-related knowledge and information especially methods of application and the ways for its dissemination.

23. Develop an overview of the existing infrastructure for information generation, dissemination, and adaptation in the fertilizer sector at both regional and in-country levels.
24. Lowest cost product mix for each country to meet the assessed requirements taking into consideration transport, storage, and handling costs.
25. The role of fertilizer in conjunction with the prospects of diffusion of maize in particular and also wheat, rice, and sugarcane by country.
26. Descriptions of crop marketing arrangements (institutional and physical infrastructures) and their linkage to production and to fertilizer and other input marketing.
27. In general, sub-Saharan Africa is a continent of relative land abundance. In some countries and in certain parts of other countries conditions of relative land scarcity and intensification of farming are emerging. Such areas are generally likely to be concentrated around or near the larger urban centers and require restoration of soil fertility. Since these areas would ordinarily use more fertilizer, their demarcation should be attempted.
28. Estimating import demands for N and  $P_2O_5$  by country from time-series data along the lines of (McIntire, 1986). This has a relation to item 20 above.
29. Research on the feasibility of modernizing fertilizer production in Zimbabwe for the market of SADCC countries.

ANNEX

WORKPLAN

FERTILIZER POLICY RESEARCH PROGRAM FOR TROPICAL AFRICA

IFDC/IFPRI COOPERATION

Period Covered: 1989

USAID Grant No.: 698-0435-G-IN-7996-00

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## WORKPLAN

### FERTILIZER POLICY RESEARCH PROGRAM FOR TROPICAL AFRICA

#### IFDC/IFPRI COOPERATION

#### I. INTRODUCTION

The IFDC/IFPRI Fertilizer Policy Research Project (FPRP) has its origins in the proposal entitled "Fertilizer Policy Research Program for Tropical Africa" dated April, 1987, USAID Grant No. 698-0435-G-IN-7996-00. The starting date of the project was August, 1987. Progress to date and the implementation plan can be found in the "First Annual Progress Report," August 1, 1987 to July 31, 1988.

The purpose of this document is to identify the work program that will be undertaken by IFDC-Africa, IFDC, and IFPRI for 1989. The 1989 work program is based on both the original project proposal and the issues arising out of the IFPRI/IFDC Fertilizer Policy Workshop held in Lomé, Togo, in 1988.

The research for the work program does heavily rely on existing data and information sources from past and on-going IFDC and IFPRI studies. A limited amount of primary data collection is being undertaken to enhance existing data and information sets where required. There is also extensive collaboration with sub-Saharan African National programs.

The workplan agenda includes the formation of a fertilizer policy research network and a fertilizer policy data information system which will be on-going throughout the life of the project. These efforts are research-supporting activities and represent the institutionalization of the data, information, and policy prescriptions that will be forthcoming from this project. Work will also be undertaken on the homogeneous grouping of sub-Saharan African countries based on several dominant and secondary characteristics to facilitate policy recommendations.

The research agenda also includes studies that address the impact on the fertilizer sector from recent policy changes--many of the policy changes have been initiated within the context of current structural adjustment programs. Specific topics include the impact from changes in credit and pricing policies, the effects of trade, exchange rate and other macro-economic policies, and issues surrounding the privatization of the fertilizer sector.

Another series of research topics explores fertilizer use potential and the effective demand for fertilizer. Specific research topics include an agroecological mapping of fertilizer use potential from both a technical and economic viewpoint, examination of the key determinants of fertilizer use potential

and effective demand, and how investment in fertilizers compares with other household investment choices. There is also an examination of the technical, financial, and organizational constraints to indigenous fertilizer production in sub-Saharan Africa.

## II. RESEARCH PERSONNEL

The IFDC-Africa team is now in place, but it must be noted that the team has arrived one and one-half years after the commencement date of the project. It is therefore difficult to adhere to the original implementation plans as spelled out in the proposal document. Work has, however, been initiated and carried out in the first year by IFPRI and IFDC, and accomplishments to date are noted in the first annual report. The current IFDC-Africa based staff are as follows:

Dr. Joseph G. Nagy, IFDC-Africa Teamleader/IFPRI Research Fellow. Arrived October/88.

Dr. Jacob F. Teboh, IFDC Junior Economist. Arrived November/88.

Mr. Yao Anku, Research Assistant. On staff November/88.

Mr. Honfoga Barthelemy, Research Assistant. On staff Jan/89.

The following IFDC staff will directly contribute to the 1989 research work program:

Dr. Carlos A. Baanante, Economist, Agro-Economic Division.

Dr. Balu L. Bumb, Economist, Outreach Division.

Dr. Julio Henao, Biometrician, Agro-Economic Division.

The following IFPRI Research Fellows will directly contribute to the 1989 work program:

Dr. Tshikala B. Tshibaka, Food Production Policy Program.

Dr. Joachim von Braun, Food Consumption & Nutrition Policy.

Dr. Guntant Desai, Food Production Policy Program.

Dr. Vasant Gandhi, Food Production Policy Program.

Dr. Dayanatha Jha, Food Production Policy Program.

Dr. Thomas A. Reardon, Food Production Policy Program.

## III. THE IFDC/IFPRI WORK PROGRAM FOR 1989

### A. Institutionalization and Country Groupings

#### 1. Fertilizer Policy Research Network and Annual Workshop

Researchers: J. F. Teboh and J. G. Nagy with assistance from other IFDC and IFPRI Personnel

A Fertilizer Policy Research Network will be formally initiated. The focal point of the network will be an annual

workshop--a workshop is tentatively scheduled for December 1989. The overall objective of the network and workshops is to exchange fertilizer policy-related issues and information among the IFPRI/IFDC fertilizer policy research project personnel and policy analysts and policymakers in the region. Specific objectives are to identify gaps in our current research and discuss emerging issues in the fertilizer policy area.

The December 1989 workshop follows from information obtained from a previous IFDC/IFPRI workshop in 1988 where country papers were presented by several sub-Saharan African countries along with papers by IFDC and IFPRI. The papers from the workshop provided much of the information for the design of the 1989 workplan. The December 1989 workshop will therefore take the opportunity to present, discuss, and exchange views on the focus and objectives of the 1989 workplan with country participants.

The agenda for the December 1989 workshop will also include a session on the soliciting of ideas from the national institutions on how they would like to see the Fertilizer Policy Research Network developed over time. Topics for discussion may include: (1) the establishment of a fertilizer policy data information system, (2) collaborative research possibilities, and (3) training in the area of fertilizer and policy analysis.

## **2. Fertilizer Policy Data Information System**

**Researchers. J. G. Nagy, J. F. Teboh, and J. Henao**

Secondary micro and macro data and information will be gathered during the project. These data and information will become part of the fertilizer policy data information system that will become operational in the latter part of the current Fertilizer Policy Research Program. Discussions with Dr. Henao, IFDC-HQ have taken place on this subject. Data will be put on computer files using dBASE III PLUS. The dBASE III has the facility to write report programs and to interface with statistical packages such as SAS. Further discussions with Dr. Henao will take place in the process of making the policy data information system operational. Coordination will take place with other IFDC-A programs that may be collecting complementary data such as the Fertilizer Marketing and Trade Information Program.

## **3. Groupings of Sub-Saharan African Countries**

**Researchers: J. G. Nagy and J. F. Teboh**

The objective is to establish criteria that would allow fertilizer and related policy analysis and recommendations to be meaningful to several homogeneous groups of sub-Saharan African countries. The groupings will be based on key similarities

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pertinent to fertilizer and related policy issues. Difficulties will arise in establishing clearly defined homogeneous groups because of the great diversity in natural and physical environments, socio-economics, and institutional structures. An attempt will therefore be made to establish several large homogeneous groups based on one or two dominant criteria from which several subgroups of countries, based on secondary criteria, can be formed. Thus a country may belong to one or more subgroups and will allow country groupings to be somewhat flexible.

Criteria for the grouping of countries can be classified according to the following country features: (1) those features that remain stable over the long run and (2) those features that can change in the short to intermediate run. Criteria that are of a long run nature are: agroclimatic characteristics, whether or not a country is landlocked or has access to ocean ports, availability of indigenous resources to produce fertilizers, and land area. Criteria that may change in the short to intermediate run include: present fertilizer use, government intervention in input and product markets, domestic fertilizer production versus fertilizer import dependency, the size and mix of agricultural production, food crop versus export crop production mix, and infrastructure development. This list is not exhaustive and these and other criteria will be considered.

After the establishment of the criteria, information and data collection will be undertaken. Secondary data sources such as World Bank and FAO publications will be used. Existing data and information from the IFDC-Africa Fertilizer Marketing and Trade Information Program will also be used.

## **B. Impact on the Fertilizer Sector From Changes in Policy**

### **1. Analysis of Fertilizer Subsidy Removal in Malawi**

**Researcher: T. B. Tshibaka**

Price distorting policies have provided many developing countries with some intractable problems that are now at the root of the current debate about fertilizer subsidy removal. The debate shows that the manipulation of prices, although at times a quick fix, does not provide a solution to the fundamental problem of how to increase and sustain the profitability of fertilizer use in sub-Saharan African agriculture. Critical questions that the study will attempt to address are whether fertilizer subsidies are economically justified and to what degree is fertilizer use dependent on fertilizer subsidies? The study will also try to provide policy actions on ways to enhance the profitability of fertilizer use at the farm level.

The study seeks to analyze the profitability of fertilizer use at the farm level subject to fertilizer and crop prices and

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prevailing fertilizer-crop responses. Specifically, the study will look at crop response to fertilizer use as a function of ecological and technical factors. The ecological factors include weather, soils, pests, and diseases. Technical variables include agricultural practices, crop variety, water, land, and pest management. A detailed decomposition of both fertilizer and crop prices from the farm gate to the world market will be part of the study.

The work is to be conducted in collaboration with Mr. Grey M. Limwado, Principal Scientific Officer at the National Research Council of Malawi. Mr. Limwado, an agricultural economist, was until recently the Agricultural Statistics Chief at the National Statistical Office of Malawi. Arrangements are being made to have the National Research Council of Malawi as a collaborating institution. The work is planned over a 2-year period.

## **2. Fertilizer Pricing Policies in Sub-Saharan Africa: A Survey**

**Researchers: B. L. Bumb and J. F. Teboh**

A survey of existing pricing policies in selected sub-Saharan African countries will be carried out. The survey will focus on three aspects: (1) the evolution of pricing policies, (2) the impact of pricing policies on fertilizer use, and (3) fiscal implications of pricing policies if farm-gate prices are kept below world prices or domestic cost of production. The survey will be confined to those countries where data are available. During the course of preparing the survey, an attempt will be made to develop country contacts so that in-depth analysis of subsidy issues could be carried out in collaboration with the selected countries in the following year.

## **3. Structural Adjustment and Fertilizer Policies in the Gambia**

**Researcher: J. von Braun**

This study examines the impact on farmers' fertilizer use levels and patterns in the Gambia from changes in policies toward the fertilizer sector as part of the country's overall structural adjustment policies. Existing data and information will also be available to explore the privatization of the Gambian fertilizer sector.

The data for the analysis comes from existing data sets collected in collaboration with the Gambian Ministry of Agriculture for a research project on technology and commercialization of Gambian agriculture. The work will be done with a Gambian colleague. The report is expected by the end of 1989.

#### **4. Macro-Economic Policy and the Senegalese Fertilizer Sector**

**Researcher: T. B. Tshibaka**

A study will be undertaken on the Senegalese fertilizer sector to examine the impact from changes in recent macro-economic policy. The analysis will compare the fertilizer sector over time contrasting the effects of current structural adjustment policy reforms with pre-policy changes on the supply and demand for fertilizer.

A collaborative arrangement is currently under way with Mr. Ibrahima Sène, Regional Inspector of Agriculture, Thies, Senegalese Ministry of Rural Development. Mr. Sène will contribute to data collection, analysis and also to the write-up of the report. An IFPRI 'Grey Cover' report is expected to be produced by the end of 1989.

#### **5. Privatization of the Fertilizer Sector in Sub-Saharan Africa: A Case Study**

**Researcher: J. F. Teboh with assistance from B. L. Bumb and J. G. Nagy**

Fertilizer sector privatization was identified for further study at the IFPRI/IFDC Togo workshop on "Fertilizer Policy in Tropical Africa". At the moment, Cameroon (Ghana may be another) offers an opportunity to study privatization. Cameroon is in the second year of implementing its privatization program.

In this initial year of the study, the process of privatization in Cameroon will be documented and monitored with a special focus on collecting data and information on improvements in import and distribution costs and timely delivery of fertilizer products throughout the fertilizer sector down to the farm level. Monitoring efforts would take place over the next two to three years. Arrangements are under way with USAID-Cameroon (Dr. T. Truong) and the Cameroon Government for involvement and collaboration in their monitoring efforts.

Data and information from the above descriptive and monitoring phase would be used in an analysis of the costs and benefits of the privatization policy changes in Cameroon. The analytical framework would come out of a proposed IFDC Outreach Division project involving the putting together of a team of three--an economist, a marketing and investment analyst, and an engineer to develop a framework to evaluate costs and benefits of various privatization options. The experience gained from the Cameroon study could be used to further develop the analytical framework within the context of the various fertilizer markets that exist in sub-Saharan Africa and made available for evaluating public versus private involvement in other countries.

Work on the further development of the analytical framework and commencement of analytical work would take place in 1990.

Along with the empirical analysis of costs and benefits of various public versus private options within a country's fertilizer sector, it is hoped that the information from this research could shed some light on the following, but not exhaustive, questions: (1) To succeed, when and under what circumstances should public sector involvement give way to private sector involvement? (2) What should government policy be to ensure private sector success once privatization takes place? (3) What is the 'modus operandi' by which privatization takes place?

### C. Analysis of Potential and Effective Fertilizer Demand

#### 1. Analysis of the Economic Potential of Fertilizer Use

**Researchers: J. G. Nagy and J. Henao**

The analysis of the economic potential of fertilizer use will consider the following: (1) the technical feasibility of the fertilizer-crop response curve; (2) the economic feasibility (profitability) and production risk of fertilizer use; and (3) the resource 'fit' or compatibility of fertilizer use with farmers' available on-farm and off-farm inputs and resources.

The technical and economic feasibility analysis will identify countries/agroecological regions where:

1. The economic potential of fertilizer use is low.
2. The economic potential of fertilizer use is high, and
  - (a) Fertilizer use is low, or
  - (b) Fertilizer use is high.

Once these have been delineated, further inquiries will be undertaken to understand the reasons why the country/agroecological region falls within one of the above categories. Reasons for low economic potential of fertilizer use may include poor fertilizer-crop response or poor return on fertilizer investment relative to other investments. Where the economic potential is high, but fertilizer use is low, reasons for the low use may be non-compatibility with the farmer's on-farm and off-farm resources (i.e., credit or labor constraints), and/or supply and distribution problems. Where fertilizer use is high, analysis and documentation will provide information that may be of use for policy prescriptions elsewhere.

The above work involves: (1) delineation of agroecological zones that have similar fertilizer-crop responses; (2) physical

fertilizer-crop response analysis by crop which includes, (a) response function estimation from available experimental data and (b) simulating response curves using the CERES model; and (3) the socioeconomic analysis of fertilizer-crop response which includes (a) economic profitability and production risk analysis and (b) analysis of the compatibility of fertilizer use with available on-farm and off-farm resources.

A survey will be undertaken of existing physical fertilizer-crop response functions already estimated by such sources as IFDC, FAO, IRAT, ICRISAT, IITA, WARDA, and national programs. Where fertilizer-crop response functions have not been estimated but data exist, contractual arrangements will be entered into to have the work done either by the institution itself or in collaboration with the Fertilizer Policy Research Project. Work will start with existing data from the IFDC-Africa "West African Fertilizer Management and Evaluation Network" (WAFMEN) with the help of Dr. J. Henao, IFDC.

The CERES model, developed by an international and interdisciplinary team of scientists and centered at IFDC, may be used to simulate fertilizer-crop responses to fill in areas where little or no experimental data exist. Part of this year's effort will be examining the feasibility of using the CERES model for this purpose.

Fertilizer and crop prices, fertilizer application and transportation costs, farmers' minimum acceptable rate of return on capital, and adjustments to experimental yield to reflect farmer management will be obtained to examine the economic potential based on the fertilizer-crop responses obtained above. The analysis will give not only the optimal conditions for fertilizer use for existing farm-level conditions, but can also be used to simulate optimal conditions for changes in the economic parameters which are subject to government policy intervention.

The mapping of the economic potential for sub-Saharan Africa will continue throughout the current FPRP. The time available to the project will not allow an exhaustive mapping of all sub-Saharan Africa. Countries will, however, be chosen so that a maximum number of agroecological zones will be covered. To start with, three to four countries will be identified this year for the mapping of the economic potential for fertilizer use.

## 2. Time Series Analysis of Agronomic Potential of Fertilizer in Senegal

**Researchers:** T. B. Tshibaka and J. G. Nagy to oversee contractual arrangements and to collaborate where possible

In the context of the analysis of potential fertilizer use, IFPRI is in the process of setting up a collaborative project

with the Institut Senegalais de Recherches Agronomiques (ISRA). Jean Pierre Ndiaye, a soil scientist, and Guy Pochtier, an agronomist, have been identified as collaborators on the ISRA side. The objective is for them to estimate fertilizer-crop response functions from their 1964 to 1982 data for millet, sorghum, maize, rice, peanuts, and cotton. They would prepare a report that describes the various agroecological zones and changes that have occurred over the period in question and present the results of the fertilizer-crop response estimations. This report will be ready by December 1990. Similar collaborative research may be undertaken with other institutions under the Fertilizer Policy Research Project.

**3. Examination of the Processes Required to Convert the Potential for Fertilizer Use into Effective Farmer Demand**

**Researchers: V. Gandhi and G. Desai**

Among the larger countries in sub-Saharan Africa, Zimbabwe has the highest level of annual per hectare fertilizer consumption: 58 kg of nutrients per hectare (1979-83), which is much higher than the sub-Saharan African average of 7 kg/ha and comparable with the worldwide developing country average. Thus, potential for fertilizer use exists at least in Zimbabwe, if not in many other parts of sub-Saharan Africa. However, like the agricultural sector of Zimbabwe, fertilizer use is highly dualistic, with the bulk of consumption taking place on the large commercial farms, whereas very little apparently takes place on small farms. It has been reported, though, that the recent growth in fertilizer has come mainly from substantial increases in the consumption on small farms.

With the above background, a study is proposed that examines the processes which are important in converting the potential for fertilizer use into effective demand and observed consumption on the farms in an African setting. The study is also expected to facilitate discussion of issues related to dualism in the input delivery systems and how it constrains growth in fertilizer use even in countries with relatively high levels of fertilizer consumption.

Data and information for the analysis come from a Zimbabwe survey of 300 farms collected by Dr. S. Wanmali of IFPRI. Data collection was in collaboration with the Department of Physical Planning, Ministry of Local Government and Town Planning, Government of Zimbabwe for a project on rural infrastructure and services. The sample of farms is from different categories of farming systems ranging from commercial farms to peasant holdings. Through Dr. Wanmali, additional data and information requirements have been collected for the Gandhi/Desai study.

Preliminary results of the study are expected to become available within a year. While the study is exploratory in

nature, the researchers are confident that it will be very useful to design more in-depth studies on the conversion process at a later stage.

**4. Analysis of Farmer Investment Behavior From Income Generated Through Fertilizer Use**

**Researcher: T. B. Tshibaka and J. F. Teboh**

The study will heavily rely on data and information from the IFDC-Africa Soil Fertility Restoration Project currently under way in Ghana, Togo and Niger. A basic assumption underlying the Soil Fertility Restoration Project is that increases in crop output, and hence increases in income resulting from fertilizer use will lead to a continuous investment by farmers in fertilizer and other farm inputs in order to maintain a high level of farm productivity. The study proposes to test this hypothesis by examining farmers' investment behavior given the increased income generated by the use of fertilizer. The study will also document and identify key factors explaining farmers' investment behavior. This information can lead to policy actions that address problems that farmers have in investing in fertilizer and other farm inputs.

A limited amount of additional data is being collected by the Soil Fertility Restoration Project for this study. These include data on the sources and utilization of cash income generated in the household and farmers' perceptions of different investment alternatives. These data will be collected over the remaining life of the Soil Fertility Restoration Project--three to four more years. A report will be produced near the end of the current Fertilizer Policy Research Project.

**5. Analysis of Farmers' Fertilizer Adoption and Use Practices**

**Researcher: D. Jha**

This study is based on data collected from 300 households in the Eastern Province of Zambia in collaboration with the Rural Development Studies Bureau, National Council, and Eastern Province Agricultural Development Project. The data have been used to analyze adoption levels and patterns of fertilizer, hybrid maize, and oxen use. The proposed study will look more in-depth at farmers' fertilizer purchase behavior, credit use, use of different nutrients, method and timing of application, and deviations from recommended fertilizer practices. An attempt will also be made to review fertilizer response data collected from adaptive trials since 1981.

A report will be completed by the end of 1989.

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**6. Farmers' Investment in Fertilizer Within the Context of Household Decisionmaking**

**Researcher: T. Reardon**

Burkina Faso is used as a case study to explain farmers' investment in fertilizer within the context of household decision making. Factors for examination include: technology level (agriculture capital and technique), socioeconomic characteristics (demography, cropping patterns, other income sources, credit access), and location and time variables (approximating infrastructural and climatic effects). Commodity credit programs are also highlighted.

Data for the analysis come from an existing IFPRI/ICRISAT data set of 150 households collected over a four-year period (1981-85). The households within the sample range over different rainfall zones (400 mm to 1000 mm) which will enable the study to describe patterns of fertilizer use by agroecological characteristics.

Work on the patterns of fertilizer use by agroecological zones will be completed by July 1989. The work on farmer investment in fertilizer use within the context of household decisionmaking will be completed by the end of 1989.

**D. Indigenous Fertilizer Production Constraints**

**1. Constraints on Fertilizer Production in Sub-Saharan Africa: A Policy Perspective**

**Researcher: B. L. Bumb**

Various technical, financial, and organizational constraints on fertilizer production in sub-Saharan African countries will be analyzed. Potential for fertilizer production will also be explored. In the light of the projected fertilizer requirements (for food security) and effective fertilizer demand, variability of the existing facilities and future production possibilities will be assessed. The need for donor support will also be assessed, and the required changes in policies will be identified.

**E. Policy Workshop**

**1. Editing of IFPRI/IFDC Policy Workshop Proceedings**

**Editors: T. B. Tshibaka and C. A. Baanante**

Final editing of the IFPRI/IFDC Workshop proceedings that were held in Lomé, Togo, in 1988 will be completed in early 1989

and published under the title "Proceedings of the Workshop on Fertilizer Policy in Tropical Africa."

#### IV. SYNTHESIS

In its simplest form, a country's fertilizer system is made up of the following: (1) the supply of fertilizer (domestic and/or imported) which may be financed by (a) foreign exchange or (b) donor agencies; (2) the demand for fertilizer at the farm level which depends on (a) the fertilizer-crop response function, (b) profitability, and (c) compatibility with the farmer's on-farm and off-farm resources; and (3) the transportation, distribution, and information dissemination system that forms the infrastructure which ties fertilizer supply and demand together.

The fertilizer system is also subject to institutional arrangements and to government policies. Policies may be directed at the fertilizer industry itself or at other sectors in the economy that may affect fertilizer use, i.e., crop prices and exchange rates. Government policy and institutional arrangements for the fertilizer and related industries may range from: (1) public control (parastatals), (2) private competition, or (3) a mixture of the two.

The fertilizer system of an individual country is also shaped by its geographical location, agroecological setting, land area, population size, and domestic fertilizer production ability.

The Fertilizer Policy Research Project, with collaboration and information from other IFDC and IFPRI projects, will attempt to research relevant policy issues within the sub-Saharan Africa fertilizer sectors as described above. The 1989 Workplan is designed to continue the process of: (1) describing the various fertilizer systems in sub-Saharan Africa, (2) diagnosing the major problems and constraints that restrict fertilizer use, (3) researching the costs and benefits of various policy prescriptions put forward to alleviate major problems and constraints, and (4) establishing a network through which policy prescription information can be disseminated.

Available time and the resources at hand preclude an analysis of, and policy prescriptions for, all countries or even all country groups and subgroups in sub-Saharan Africa. Varying degrees of information and data will be available for each group and subgroup. It is hoped, however, that sufficient information will be available for several countries representing two to three country groupings or subgroupings to make policy prescriptions of a nature that spans from fertilizer supply to farm-level demand.

The research of the Fertilizer Policy Research Project would culminate in a synthesis of all the above research into overall policy prescriptions for the various selected country groupings

and subgroupings. The synthesis would also tie fertilizer policy prescriptions into overall development and structural adjustment policy research being conducted by IFPRI.

The Fertilizer Policy Research Program, in part, must be seen as a program that is in the stage of developing a methodology to research the complexities of the fertilizer industry in sub-Saharan Africa. The methodology that is being developed will be available at the end of the current Fertilizer Policy Research Program to do further research in specific countries and in country groups and subgroups that the current program has not researched thoroughly.