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MONITORING FERTILIZER PRICE, AVAILABILITY,  
AND QUALITY IN DEVELOPING COUNTRIES:  
THE CASE OF BANGLADESH

by

Mohinder S. Mudahar  
Economist

International Fertilizer Development Center

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APPENDIX: Fertilizer Marketing System in Bangladesh

## LIST OF ABBREVIATIONS

### Organizations

BADC--Bangladesh Agricultural Development Corporation  
BARI--Bangladesh Agricultural Research Institute  
EPADC--East Pakistan Agricultural Development Corporation  
IFDC--International Fertilizer Development Center  
USAID--U.S. Agency for International Development

### Fertilizers and Chemicals

DAP--Diammonium phosphate  
GTSP--Granulated triple superphosphate  
K<sub>2</sub>O--Potash (potassium oxide)  
MOP--Muriate of potash (potassium chloride)  
N--Nitrogen  
P<sub>2</sub>O<sub>5</sub>--Phosphate (phosphorus pentoxide)  
PTSP--Powdered triple superphosphate  
S--Sulfur  
TSP--Triple superphosphate

### Measurements and Conversions

kg--kilogram = 2.205 pounds = 1.07 seers  
lt--long ton = 2,240 pounds = 1.016 metric tons = 27.22 maunds  
md--maund = 37.32 kilograms = 82.29 pounds = 40 seers  
mt--metric ton = 2,205 pounds = 1,000 kilograms = 26.80 maunds  
TK--Taka, unit of Bangladesh currency = approx. US \$0.04 (Dec. 1983)

Other Abbreviations

c.i.f.--Cost, insurance, freight

NMS--New marketing system

NR--Nonremote

OMS--Old marketing system

PDP--Primary distribution point

R--Remote

TSC--Thana sales center

## Preface

This is a revised version of the paper that was prepared while the author was on assignment in Bangladesh (April/May 1983) assisting the Design Team entrusted with developing a project proposal for USAID's Fertilizer Distribution Improvement Project, Phase II, for Bangladesh. In this context, the concepts and overall framework of the paper were developed to satisfy the requirements of the Design Team.

The author gratefully acknowledges the valuable comments received from Mr. Charles H. Antholt and Mr. Carl W. Lawhead of USAID/Dhaka and from Dr. Raymond W. Hooker of USAID/Washington, D.C. The author also benefited from comments and discussions with IFDC colleagues in Muscle Shoals, Alabama, U.S.A., and in Bangladesh and from discussions with policymakers, planners, and BADC personnel in Bangladesh.

The primary purposes of the study were to make recommendations to improve the ongoing farm-level fertilizer price survey and economic analysis; to develop a system for monitoring, on a regular basis, fertilizer price, availability, and quality over time and space; and to develop a framework for generating appropriate economic indicators.

Even though the fertilizer monitoring system, fertilizer indicators, and economic analysis are designed for implementation in Bangladesh, the general concepts and methodology are applicable with appropriate modifications to other developing countries in Asia, Africa, and Latin America.

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MONITORING FERTILIZER PRICE, AVAILABILITY,  
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Introduction

Fertilizer is a strategic input in modernizing agriculture and expanding food production. Consequently, many governments have felt that they should exercise greater control over the fertilizer sector, including fertilizer production, trade, prices, and marketing. The felt need for government involvement was further reinforced by the events leading up to the 1973-75 world fertilizer crisis and the resulting instability in fertilizer prices at both national and international levels. At present, it is not uncommon to find government monopolies in the fertilizer sector of many developing countries.

The public sector, however, has not been able to demonstrate economic superiority over the private sector in fertilizer marketing; in fact, the opposite is often the case. As a result, many developing countries, including Bangladesh, are introducing reforms that would gradually expand the role of the private sector in fertilizer marketing. These reforms are designed to create healthy competition at all levels of a multichannel fertilizer marketing system. However, the strategy to expand the role of the private sector in fertilizer marketing can be characterized by cautious optimism on the part of respective governments.

The overall objective of this paper is to design a system to monitor the performance of the fertilizer marketing system in developing countries with respect to three important variables: fertilizer price, availability, and quality. The underlying justification for a fertilizer monitoring system is that preventive action is not only the cheapest but also the least painful course of action. The annual cost of implementing such a monitoring system is expected to be a minute fraction of the total annual fertilizer outlays.

The fertilizer monitoring system would diminish the alleged fear of government that the private sector might take undue economic advantage of farmers. It would provide "early warning signals" to the policymakers of

any impending crises so that an appropriate and timely corrective action might be taken. The system would also provide "baseline data" for fertilizer marketing research and planning, and it would generate "human capital" through on-the-job training and development of appropriate institutions. It is in this context that one component of the proposed fertilizer monitoring system, the fertilizer price survey, was initiated about 3 years ago in Bangladesh.

More specifically, the objectives of this paper are as follows:

1. To make recommendations in order to improve the ongoing fertilizer price survey and economic analysis.
2. To develop a conceptual framework for monitoring fertilizer prices, availability, and quality.
3. To discuss the design and implementation of appropriate fertilizer monitoring surveys.
4. To identify appropriate fertilizer monitoring indicators and develop methods for calculating them.
5. To outline an institutional framework to implement the proposed fertilizer monitoring system.
6. To discuss the usefulness of the fertilizer monitoring system as an aid to policymakers.

Even though the proposed system is designed to monitor the performance of the fertilizer marketing system in Bangladesh, the basic concepts and methodology can be applied to any developing country, irrespective of the nature and number of fertilizer marketing channels.

### Three Primary Concerns of the Government

In food-deficit, low-income, and agriculture-dominated countries like Bangladesh, fertilizer is an essential "strategic" commodity. Any instability in fertilizer supply or large fluctuations in fertilizer prices would greatly upset the "planned" agricultural development and national food self-sufficiency goals and hence national economic development. In the process of privatizing the fertilizer marketing system, government's stated, and to some extent justifiable, concerns can be divided into three broad areas: (1) fertilizer prices paid by the farmer, (2) fertilizer availability,

accessibility and equitable distribution to the farmer, and (3) fertilizer quality at the retail level<sup>1</sup>.

Underlying these heightened concerns is the assumption that the actions of government are not motivated by greed of profit making but rather by a desire to act in the best national interest, especially for the small farmers. However, governments cannot always ensure low fertilizer price (in the absence of direct or indirect fertilizer subsidies), adequate and timely fertilizer availability in remote areas, and guaranteed fertilizer quality and weights. Even if a government can achieve these goals, it generally does so at a very heavy cost to the national treasury. The economic returns to such investment may be much higher elsewhere, such as in agricultural research, which will not generally be undertaken by the private sector in developing countries. Furthermore, economic payoffs to investment in agricultural research have been demonstrated worldwide to be very high (Arndt, Dalrymple and Ruttan, 1977).

#### Need for Fertilizer Monitoring System

Despite every sincere effort by the policymakers (those who formulate fertilizer-related public policies) to encourage and facilitate healthy competition in the fertilizer market at all levels, however, it may not be possible to prevent monopolies or some sort of collusion, especially in remote locations. Such monopolistic elements tend to adversely affect fertilizer price, availability, and quality.

When the fertilizer supply approximately matches fertilizer demand, the invisible hand of the free market system does promote greater efficiency and cost effectiveness. However, when fertilizer is relatively scarce or where the infrastructure and communication system are not well developed

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1. This is true in most agriculture-dominated developing countries. In some cases, these concerns have been explicitly recognized in national fertilizer legislation or quality control laws. For example, the purpose of Fertilizer (Control) Order of India (which was issued in 1957 and is still in force) is to ensure (1) fair price, (2) quality, and (3) equitable distribution of fertilizers (Sikder, 1982).

(which is the case in most low-income countries), the private sector may take advantage of the market situation and get involved in activities that may not best serve the farming community at large. This is especially true when a large number of small farmers are involved in both remote and not-so-remote areas.

Naturally, the farmer and the consumer will ultimately suffer. Conceivably, fertilizer use and hence food production can decline in response to (1) high retail fertilizer prices, in the absence of any realistic parity with crop prices, (2) lack of adequate fertilizer supply, or (3) less than guaranteed fertilizer quality. Under such circumstances government's fear that the private sector may not act in the best national interest may be justifiable.

In order to ensure that such a situation does not arise and that private fertilizer dealers do not take undue economic advantage of farmers by charging unreasonably high prices, by creating artificial fertilizer scarcities, or by selling adulterated products, there is a need to monitor the fertilizer marketing system. The fertilizer marketing system needs to be continuously monitored to detect the early warning signals of any impending crisis or irregularities in the smooth functioning of the marketing system. Such information should be regularly made available to the policy-makers and concerned government organizations in order for them to design appropriate policies and take appropriate corrective actions.

#### Objectives and Components of the Monitoring System

The primary aim of the proposed fertilizer monitoring system is to address the three major concerns of the government in the gradual process of privatizing the fertilizer marketing system in Bangladesh.<sup>2</sup> More specifically, the objectives of the monitoring system are these:

1. To monitor fertilizer prices paid by farmers to retail dealers and by retail dealers to wholesalers all over the country.

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2. A brief description of the fertilizer marketing system in Bangladesh is given in the Appendix.

2. To monitor fertilizer availability to the farmers and to the retail dealers in different parts of the country.
3. To monitor fertilizer quality and weight to ensure that they correspond to the prescribed grade, quality, and weight within a predetermined margin.

These objectives can be accomplished through systematically conducted monthly sample surveys. These surveys are expected to provide evidence of competitiveness in the fertilizer market. In this context, the monitoring system would aid the policymakers in their efforts to ensure reasonable and stable fertilizer prices, adequate and stable fertilizer supply, and quality fertilizer in terms of guaranteed analysis and weight. Furthermore, the monitoring system should provide evidence of potential collusion among fertilizer dealers or hoarding of fertilizer; it should also provide baseline data for fertilizer market research, planning, and decision-making. Consequently, such a monitoring system would not only safeguard the interests of the farmers and honest dealers but would also serve the national interest.

The proposed monitoring system would consist of three different, but interrelated, components. These are (1) monthly farm-level fertilizer price and availability survey, (2) monthly dealer-level fertilizer price and availability survey, and (3) monthly fertilizer quality survey. The results obtained from these three surveys would be expected to reflect the performance of the fertilizer marketing system.<sup>3</sup>

### Farm-Level Fertilizer Price and Availability Survey

#### Objectives

Broadly, the purpose of a farm-level fertilizer price and availability survey is to monitor actual fertilizer prices paid by farmers and

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3. As has been articulated by Casley and Lury (1981), monitoring and evaluation of a given project are two distinct but related activities. Evaluation deals primarily with assessing the overall impact of the project, whereas monitoring deals with assessing the progress of the project over time against a set of predetermined criteria.

their ability to obtain the right kind of fertilizer at the appropriate time and in adequate quantities.

Fertilizer prices, in absolute and relative terms, are important both politically and economically since they influence food production, farmers' incomes, and consumer welfare. Moreover, input/output prices play a fundamental role in agricultural development through their influence on input use, resource allocation, income levels, income distribution, and capital formation. The farm-level fertilizer price survey would provide "early warning signals" of a potential or sudden rise in fertilizer prices, as well as point out what further research is needed to determine the possible causes of price escalation.<sup>4</sup>

Factors that influence fertilizer prices at the farm level include the following:

1. Ex-factory price.
2. Ex-port price.
3. Fertilizer subsidy (direct or indirect).
4. Level of officially administered price.
5. Degree of enforcement of administered price.
6. Marketing costs and margins.
7. Location of farm in relation to supply source (remote versus nonremote).
8. The number of dealers and the degree of competition among them.
9. Fertilizer availability (fertilizer supply in relation to its demand).
10. Size of fertilizer bag (25 kg versus 50 kg).
11. Quality of fertilizer bag (jute versus polypropylene).
12. Amount of purchase at one time (quantity discounts).
13. Method of payment (cash versus credit purchase).
14. Time of the year (peak versus nonpeak and off-season price discounts).

In most of the developing countries, one of the primary constraints to expanded fertilizer use is lack of fertilizer at the right price, place, and time and in the right quantity. This appears to be especially true in

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4. If fertilizer prices were fixed by the government, they would be used as criteria to compare actual fertilizer prices. On the other hand, if fertilizer prices were market-determined, additional variables including rate of inflation, price level and variability across the country, freight cost, and price paid by the dealer, would be used to determine fertilizer price behavior.

remote areas of Bangladesh. Farmers in remote areas are at a double disadvantage compared with those in nonremote areas: They not only have paid a higher fertilizer price (5-7 TK/md higher than the official price), but they also have had to travel farther to obtain fertilizer (Moots, 1982). In peak fertilizer demand months, however, spot shortages are rather common in both remote and nonremote areas, even when fertilizer supply is adequate at the national level.

Factors that influence the availability of fertilizer at the farm level include the following:

1. National/regional/local supply in relation to national/regional/local demand for fertilizer.
2. Number of fertilizer dealers in the areas.
3. Profitability in fertilizer retailing to the dealers.
4. Transportation costs, transport modes, and distance of farmers from dealers and of dealers from their supply sources.
5. Capital/credit situation with respect to both farmers and dealers.
6. Price speculation.
7. Seasonality of fertilizer demand.
8. Lack of fertilizer infrastructure, including storage and transportation facilities.

### Scope and Coverage

A "Farmer Fertilizer Price Survey" was initiated under the BADC/IFDC fertilizer marketing and consultancy services agreement in October 1980. It focused primarily on fertilizer prices paid by farmers.<sup>5</sup> The price information generated by the survey has been found very useful by policymakers for monitoring the prices paid under the New Marketing System (NMS) as contrasted to those under the Old Marketing System (OMS). It was also useful in determining fertilizer prices paid by farmers in both price-regulated and

5. With the exception of May, June, July, and August 1981, the monthly price survey has been conducted continuously since October 1980. However, the scope of the survey has been expanded over time to include other relevant issues. Since the fertilizer price survey has been going on for over three years, it was considered appropriate to improve rather than replace the existing survey.

price-deregulated areas of Bangladesh.<sup>6</sup> Ten districts are currently being covered by the fertilizer price survey (Figure 1). These include:

1. Dhaka	}	Dhaka Division	1982/83 Fertilizer price regulated
2. Tangail			
3. Rajshahi	}	Rajshahi Division	1982/83 Fertilizer price regulated
4. Pabna			
5. Bogra			
6. Kushtia	}	Khulna Division	1982/83 Fertilizer price regulated
7. Chittagong			
8. Noakhali	}	Chittagong Division	1982/83 Fertilizer price deregulated
9. Comilla			
10. Sylhet			

The survey covered all the major fertilizers including urea; triple superphosphate (TSP), both powdered and granular; diammonium phosphate (DAP); and muriate of potash (MOP). The information generated by the fertilizer price survey has been found useful by policymakers and others involved in the fertilizer sector in Bangladesh. However, in order to properly monitor the performance of the fertilizer marketing system in Bangladesh, especially in response to gradual privatization, the following recommendations should be considered:

1. The coverage of the farm-level fertilizer price and availability survey should be extended to all the districts of Bangladesh.
2. Since powdered TSP (PTSP) has been replaced by granular TSP (GTSP), the former can be dropped from the survey. However, all other fertilizers that are currently being sold or might be sold in Bangladesh in the future should be included in the survey.
3. The primary focus of the survey should be to monitor fertilizer prices paid by farmers and the availability of appropriate fertilizers at the right time and in adequate amounts. Since fertilizer and crop price parity influences fertilizer use at the farm level, it is advisable to also monitor crop prices received by farmers.

<sup>6</sup> Retail fertilizer prices were deregulated in Chittagong Division, effective April 1, 1982. The fertilizer price deregulation has now been extended to all other divisions of Bangladesh, effective April 1, 1983. However, the fertilizer prices at the primary distribution point (PDP) level are still fixed by the government.

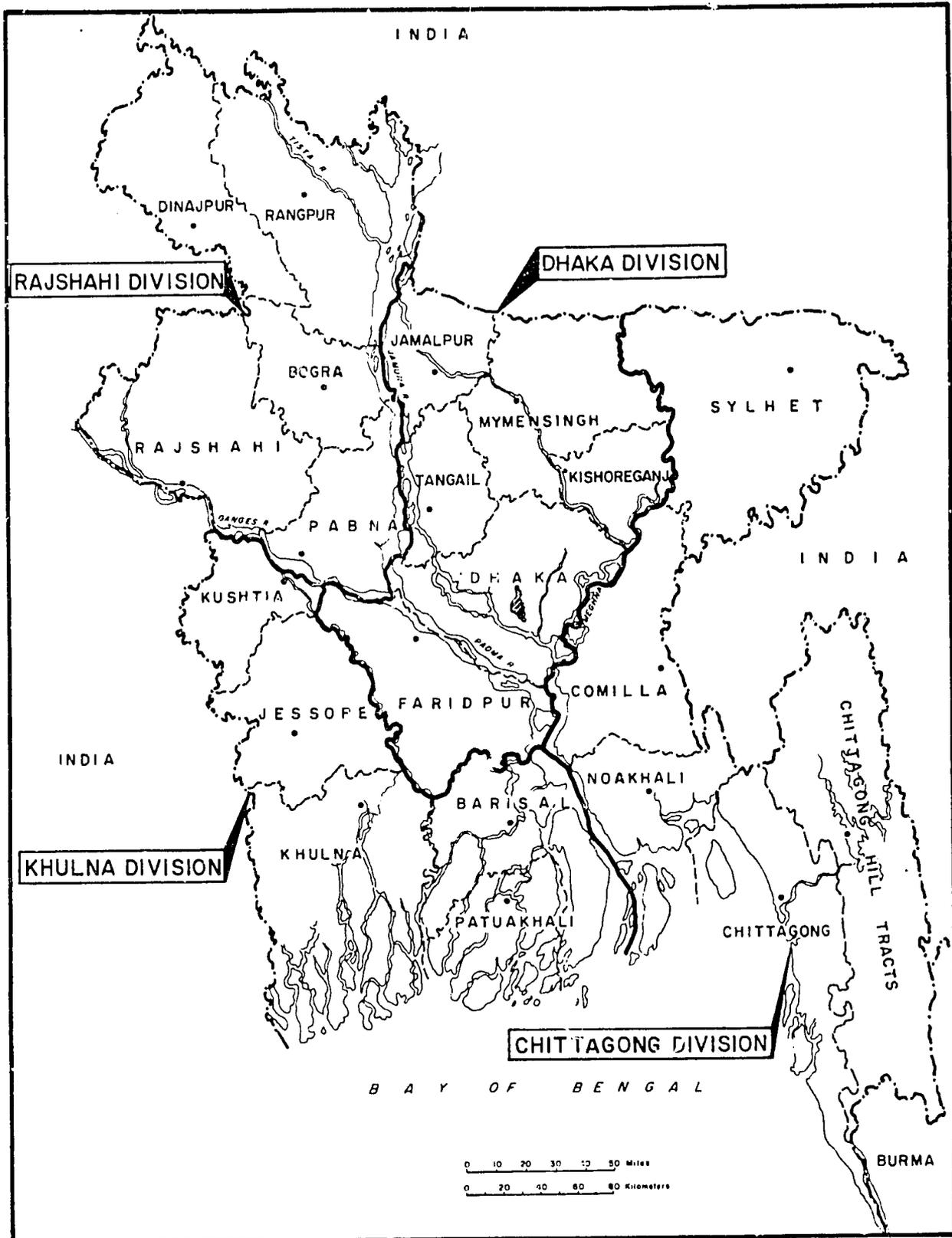


Figure 1. Bangladesh BADC Marketing Divisions (Hill and Benton, 1980).

4. Since the availability of cash limits farmers' ability to buy fertilizer and may also influence the price paid (cash purchase of fertilizer is generally less expensive than purchase on credit), the survey should include information on method of payment, availability of credit, and credit terms.
5. Needed resources should be made available by the government to maintain continuity and consistency in the information generated by a survey, over time and space.

#### Survey Sample and Questionnaire

In the ongoing fertilizer price survey, each district is further divided into seven strata, each stratum representing a separate market category. These market categories are based on the distance between the dealer's shop and his existing supply source, such as primary distribution point (PDP) or thana sales center (TSC). They serve as indicators of fertilizer accessibility to the dealer and hence to the farmer. These market categories and their locations in each of the 10 districts were determined jointly by BADC/IFDC staff.<sup>7</sup> The existing seven market categories follow:

1. 5 miles from PDP - Remote : 5/PDP/R
2. 10 miles from PDP - Remote : 10/PDP/R
3. 12-15 miles from PDP - Remote : 12-15/PDP/R
4. 15-20 miles from PDP - Nonremote : 15-20/PDP/NR
5. Within 5 miles from PDP - Nonremote : 5/PDP/NR
6. Served by TSC and 5 miles from TSC : 5/TSC
7. Served by TSC and 10 miles from TSC : 10/TSC

The sampling unit is the farmer who has made a purchase of fertilizer on the date of survey. The information is collected immediately after fertilizer purchases by using a structured questionnaire in interviews with randomly selected farmers. The surveyor has no control of the sampling unit and the number of sampling units to be interviewed on a particular day or month. The number of sampling units depends on the season, location, and market category.

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7. The market categories have varying degrees of remoteness. The primary distinction between remote and nonremote market categories is their relative accessibility to the fertilizer supply source. The transport system in remote market categories is not well established, and dealers may have to depend upon multiple transport modes.

Furthermore, the farmer may buy just one type of fertilizer or more than one since his needs depend on the season, crop cycle, and the cropping pattern in a particular market category or district.

As part of the reforms envisaged under the NMS, the TSCs would be either converted to PDPs or closed, except in special cases. Consequently, there is a need to replace the two TSC-related fertilizer market categories with two new PDP-related categories. It is recommended that these include (1) 20-25 miles from PDP - Remote: 20-25/PDP/R and (2) 25-30 miles from PDP - Nonremote: 25-30/PDP/NR. In order to maintain consistency and continuity in the survey, the potential new market locations should be identified, and the changeover should occur at the same time for all the districts.<sup>8</sup> This shift could be accomplished most appropriately when the survey is extended to the remaining 10 districts of Bangladesh. The market locations and the sampling units in each district should be selected as follows.

First--Prepare a list of all the PDPs in each district.

Second--Prepare a list of all the dealers, their locations, and distance from each PDP.

Third--Stratify each district into seven fertilizer market categories.

Fourth--Prepare a list of all the market locations in each of the market categories. The market locations falling in a particular market category may or may not be contiguous to each other.

Fifth--Randomly select one market location from each stratum (seven market categories) so that each location in a particular stratum has an equal chance of being selected.

Sixth--Develop an economic profile for each market location that could be updated once a year. Such a profile would not only provide the needed baseline background information but would also be particularly useful

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8. In order to maintain continuity in fertilizer price data and obtain a large enough sample of farmers at different locations in various parts of the country, it was decided not to drop the two TSC-related categories but rather to replace them with two new PDP-related categories. Alternatively, the addition of only one PDP-related nonremote category may be desirable so that out of a total of six market categories three would be remote and the other three would be nonremote market categories. This would reduce the cost of the survey without any loss in relevant information.

in explaining the performance and behavior of each market category over time.<sup>9</sup>

Seventh--Collect information from each market twice a month by randomly selecting 2 days when the market is open. Regular 2-week intervals should not be the criteria for selecting interview days.

Eighth--For each randomly selected day of the month for a particular market location, randomly select a sample of five farmers from those who purchase fertilizer on the day of the interview.

The upper limit on the sample size would be determined primarily by financial and staff considerations. As a general rule, the sample size (the number of farmers interviewed every month) for each market category should not be less than 20 in order to draw inferences for farmers in each market category. The monthly sample size for each market location should be approximately equal to 10. This implies that the sample size for each market category during a particular month would be approximately 200.

An arbitrary increase in sample size, beyond what is considered necessary to produce reliable estimates for drawing inferences, does raise the cost of the survey but does not necessarily result in a higher level of accuracy. However, every effort should be made to minimize errors and maintain quality control on data through proper training and supervision of field staff.

The development of a good questionnaire for sample surveys is extremely important in order to obtain good quality data and to reduce data errors. The questionnaire should meet the following criteria:

1. It should be short and focus primarily on survey objectives.
2. The questions should be precise and unambiguous.
3. It should contain the proper identification and conversions.
4. It must not be changed frequently.
5. The questionnaire must be precoded.

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9. Examples of variables that could be included in an economic profile are cropping pattern, level and type of irrigation, use of high-yielding crop varieties, level of fertilizer use, mode of fertilizer transportation, storage and transport facilities, population density, and level of education. Such information should be collected from secondary sources for the lowest administrative unit within which the randomly selected market is located.

The one currently being used for the fertilizer price survey has been well developed and tested over time. However, (1) its scope needs to be reduced in order to focus more sharply on the primary purpose of this survey, i.e., fertilizer price and availability and (2) it should be modified to incorporate a precoded questionnaire format. The data from precoded forms can be easily transferred for computer processing. Furthermore, it reduces the chances of error in collecting and transcribing data.

#### Implementation and Data Collection

The ongoing fertilizer price survey appears to be working very well. This survey is being implemented by staff members both at BADC Headquarters and in the field. Each enumerator is responsible for surveying two districts (a total of 14 separate market locations, with 7 in each district) twice a month. Properly trained enumerators are randomly supervised by the senior staff in their data collection efforts. The data from the questionnaire are transcribed into a tabular form by the enumerators. Both completed questionnaires and tables are then sent by mail to Headquarters.

Since the existing system appears to be working well, there is no need to make any major changes in its implementation. However, the field staff needs to be at least doubled if the survey is expanded to cover all the districts in Bangladesh. Additional enumerators are also needed to substitute for those who may be unable to conduct the survey for various reasons. On the other hand, there is no need to proportionately double the staff at Headquarters. The enumerator should be asked to complete the questionnaire at the time of the interview. Furthermore, in order to ensure that the questionnaire is not lost in the mail, the enumerator should prepare duplicates, one set to be sent by mail and the other set to be personally collected by the supervisor. Finally, the enumerators must use black ink in recording observations and transcribing the data. This improves legibility (especially for photocopies) and reduces chances of error in data processing for further analysis.

#### Data Processing and Analysis

Currently, all the data are processed at Headquarters with the help of desk calculators. Every month the data are prepared in a tabular form for monthly reports. However, very little analysis, if any, is performed on the

survey data as a regular monthly activity. The following recommendations need to be considered for further improvements.

First--The staff at Headquarters should be expanded in order to handle the increased workload of the survey as well as the proposed analysis (the type of analysis is discussed in subsequent sections).

Second--Headquarters staff should have access to centralized computation facilities. Otherwise, the staff should be provided with its own computer for monthly data processing and analysis.

Third--All of the original monthly data should be stored separately on a magnetic tape or disc (depending on the system, cost of storage, frequency of use of data, and space considerations). These data tapes/discs need to be updated as a new set of data becomes available.

Fourth--All the raw data should be appropriately edited and checked for consistency.

Fifth--An adequate number of hand-held or desk-top calculators (preferably with printers) should also be provided, particularly to the field staff.

### Dealer-Level Fertilizer Price and Availability Survey

#### Objectives

Broadly, the purpose of the survey on the price and availability of fertilizer at the dealer level is to monitor the actual prices paid by dealers and their ability to obtain the right kind of fertilizers at the appropriate time and in adequate quantities.

In the absence of an administered pricing policy, the fertilizer prices paid by dealers serve as a basis for determining the fertilizer prices the dealers charge farmers or, in other words, prices paid by farmers. Consequently, the information generated through the dealer-level price survey will not only serve as a basis for monitoring the performance of the fertilizer market, but it will also serve as a basis for estimating fertilizer marketing margins between the dealer and the farmer. In addition, the survey will provide early warning signals, at the dealer and wholesaler levels, of any irregularities with respect to fertilizer prices and fertilizer availability.

As discussed earlier, fertilizer availability at the farm level can be a major constraint to expanded fertilizer use. The availability of fertilizer to farmers depends in turn on the availability of fertilizer to dealers from wholesalers, which is influenced by many factors. The survey would generate monthly information on the availability of fertilizer to dealers as well as their fertilizer inventory. The indications of fertilizer scarcity would first appear at the wholesaler/dealer level and later be reflected at the dealer/farmer level. Under these circumstances, the government authorities could take appropriate actions to improve the fertilizer supply situation before the dealers start taking an undue economic advantage of fertilizer scarcity by charging higher prices to the farmers.

#### Scope and Coverage

The scope and coverage of the fertilizer price and availability survey at the dealer level should be the same as that at the farm level. The major difference between these two surveys is the sampling units. In this survey, dealers at the retail level are the ultimate sampling units. It is recommended that the survey cover the whole country, i.e., all the districts. Furthermore, all the fertilizers bought/sold by the sample dealers should be included in the survey.

Since the primary objective of the survey is to monitor fertilizer prices paid by dealers and fertilizer availability from wholesalers, it is important to aim the survey at the important factors that impinge on the price and availability of fertilizer to dealers. Particular attention should be paid to method of payment, availability of credit, and credit terms. More specifically, the survey should address the following issues:

1. Fertilizer price paid by the dealer to his supplier (wholesaler or distributor).
2. Amount and time of fertilizer purchase.
3. The number of subdealers and the amount of fertilizer sold to them.
4. The prices charged the subdealers and farmers.
5. Freight charges from the supply point (wholesaler) to his shop.
6. Current stock of fertilizer and storage capacity.
7. Any problems related to obtaining desired type and quantity of fertilizer.
8. Preferred method of payment by the farmers and credit terms.

9. Technical knowledge of the dealer with respect to fertilizer use.
10. The dealer's ability to transmit technical knowledge about fertilizer to the farmer.

#### Survey Sample and Questionnaire

The methodological issues raised earlier in the farm-level survey with respect to sampling and questionnaire structure also apply in the case of the dealer survey. Again, all the districts would be covered. Each district would be stratified into seven market categories. The specific market location in each stratum would be selected randomly. Up to this point the procedure, the market categories, and the market locations for the dealer survey would be the same as those for the farm survey. Restricting both surveys to the same market locations would not only reduce the possibility of data errors (through cross-checks, consistency checks, and better supervision) but also increase the usefulness of the survey data for monitoring purposes and for further economic analysis.

The major difference in sampling between the farm survey and dealer survey lies in the sampling units. In this case, active full-time dealers who sell fertilizer to farmers will be the ultimate sampling units. In each market location the number of active dealers is normally limited to less than five. If this is the case, all the dealers need to be surveyed once each month. However, if the number of dealers exceeds five, then only five dealers should be selected randomly out of all active dealers in that market location. This implies a total sample size of no more than 700 dealers or 100 dealers in each market category. Again, one should keep in mind that a large sample does not necessarily mean greater accuracy.

The questionnaire for the dealer survey should be precoded, short, concise, and unambiguous. It should be pretested before initiating the actual dealer survey. It should focus on the questions that were raised earlier, i.e., fertilizer price and availability.

#### Implementation and Data Collection

Currently the fertilizer prices at PDP or at TSC levels are fixed and are the same all over the country. Dealers acquire fertilizer from either the PDP or the TSC. Consequently, at this stage there is no need to implement the dealer survey, at least from the point of view of fertilizer

price. However, the dealer survey needs to be implemented as soon as the fertilizer prices are deregulated at the PDP level or prices paid by the dealer to the wholesaler are deregulated.

The dealer survey would be implemented by staff both at Headquarters and in the field. Each enumerator would be responsible for surveying dealers in four districts (28 market locations) a month. One day would be adequate to cover one market location. Each dealer would be surveyed once a month, with a randomly selected day for interviewing. One person could take the overall responsibility for both farm and dealer surveys at the Headquarters level. However, there would be a separate staff for editing, processing, and analyzing the dealer survey data up to a certain point. Again, all the raw data sets should be duplicated and sent to Headquarters both through the mail and through the supervisor.

#### Data Processing and Analysis

At the Headquarters level there would be two separate units that would work in close cooperation with each other, and both would be under the supervision of one person. Both units would share the computation facilities and the staff responsible for overall computation and analysis. The staff involved in data processing and analysis should be well trained for their respective responsibilities. Again, other issues discussed earlier for the farm survey should also be kept in mind for the dealer survey, such as duplicate tapes/discs, data quality control, and adequate data processing facilities.

### Fertilizer Quality Survey

#### Objectives

The overall objective of a fertilizer quality survey is to continuously monitor fertilizer quality (chemical and physical), measurements, and weight, especially at the dealer/farmer level, after it has been determined that fertilizer quality is in fact a serious problem.

There is no fertilizer quality control legislation in Bangladesh. Consequently, the fertilizer dealers can and often do engage in various fraudulent activities. Some of these irregularities occur even at the

domestic fertilizer factory or ports. For example, according to an IFDC survey, more than one-half of the 250 fertilizer bags selected for testing were found underweight by more than the  $\pm 0.1$  kg/bag weight tolerance allowed (Moots, 1982). This underweight could be due to faulty balances at the bagging plants, or it could be due to loss in transit caused by hooks or pilferage. In any case, the farmer pays full price even for the underweight bags. Dealers merely pass on their losses to the farmers when fertilizer is sold in full bags.

Another important feature of the fertilizer market in Bangladesh is that a large share of fertilizer is sold in loose bags to the farmers. According to the IFDC survey, on the average, 64% of the total fertilizer quantity sold at the retail level was in loose bags (Moots, 1982). The detailed results, based on a survey of 1,000 active dealers in Bangladesh, are summarized below:

<u>Market Category</u>	<u>Average % of Total Retail Fertilizer Sales</u>	
	<u>Full Bags</u>	<u>Loose Bags</u>
High use easy access	39	61
High use remote	40	60
Low use easy access	33	67
Low use remote	32	68
Overall Average	36	64

Generally, it is small farmers who buy fertilizer in loose bags. They buy in this manner for at least three reasons: (1) they need only a small quantity, (2) they do not have enough cash to buy a full bag even if they need it, and (3) they are unable to secure adequate credit to buy fertilizer.

Dealers claim that they lose up to 2 kg/50-kg bag of fertilizer in loose bag sales. This, of course, appears slightly exaggerated. Even if this were the case, dealers would pass this loss on to farmers. Loose bag sales of fertilizer have at least four disadvantages for the farmer: (1) underweight, (2) higher price per unit of fertilizer, (3) loss of bag (which dealers sell at TK 2-6/bag, depending on the bag size and quality), and (4) adulteration and poor physical characteristics of fertilizer.

A large-scale involvement of the private sector at all levels of the fertilizer marketing system could further aggravate the problem of quality control. The recent experience in trying to develop a market for pesticides in the private sector of Bangladesh and the evidence from many other developing countries testify to that.<sup>10</sup> Thailand, with a major involvement of the private sector in fertilizer marketing, is a case in point. Fertilizer quality problems may be serious, especially under the following conditions:

1. There is an absolute fertilizer marketing monopoly, public or private.
2. There is general scarcity of fertilizer.
3. Fertilizer is bought and sold in loose bags.
4. Fertilizer prices and dealers' commissions are fixed by government.

The end results of fertilizer adulteration and/or underweight are high fertilizer cost and lower crop response to the fertilizer supposedly applied. Both of these factors lower fertilizer profitability and thus serve as a constraint to fertilizer adoption or expanded fertilizer use at the farm level.

#### Scope and Coverage

Fertilizer quality and weight are the responsibility of the manufacturer, importer, and dealer. The primary purpose of a fertilizer quality survey is to monitor the chemical and physical characteristics of fertilizers to ensure that they conform to the prescribed characteristics, including packaging and labeling. The chemical characteristics mainly refer to the minimum guaranteed analysis, including N, available  $P_2O_5$ , and  $K_2O$ . The physical characteristics, on the other hand, refer to particle size, moisture content, and weight of all nutrients.

The quality survey should cover all the districts of Bangladesh and the fertilizers currently sold or those that might be sold in the future in Bangladesh. The primary focus of the survey, however, is not only to regularly monitor fertilizer quality but also to report the results to

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10. India, where the public, private, and cooperative sectors play important roles in fertilizer marketing, has recognized the need for effective fertilizer quality control legislation. According to Motsara and Singh (1983) there are 5,000 fertilizer inspectors and 36 fertilizer testing laboratories in different states in India, with a total capacity of analyzing 57,000 fertilizer samples per annum.

the government agency responsible for enforcing the quality control legislation.<sup>11</sup>

#### Survey Sample and Questionnaire

The sampling units in a quality survey would be randomly taken samples from randomly selected fertilizer bags and the measuring scales used by dealers for loose bag sales. Again, for purposes of a quality survey, it would be appropriate to adopt the same seven fertilizer market categories in each of the districts.

In each of these fertilizer market strata, a complete list of all the dealers and wholesalers should be prepared and regularly updated. These dealers should also be stratified by volume of their fertilizer business. A total of 140 dealers/wholesalers (1 dealer/wholesaler from each of the 7 market categories from each of the 20 districts) should be randomly selected from all the dealers. Currently there are about 22,000 active and approximately 49,000 registered fertilizer dealers in Bangladesh (Moots, 1982).

The staff for the quality survey should inspect the store, premises, bags, and measuring scales and take representative random samples of all the fertilizers sold by that dealer. The representative fertilizer samples should be properly taken according to prescribed standards along with appropriate identifications. The results should be recorded in structured precoded questionnaires with appropriate identification. The staff would have to be thoroughly trained with respect to the technical aspects of quality control and fertilizer sampling.

#### Implementation and Data Collection

The fertilizer quality survey would be implemented from both Headquarters and the field. Each survey staff member would be responsible for

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11. Over time it may be desirable to reduce the scope of the fertilizer quality survey itself and put more emphasis on the enforcement of fertilizer quality control legislation. The enforcement, however, would require continuous monitoring of fertilizer quality. A step-by-step illustration for implementing fertilizer quality control legislation is discussed by Mootsara and Singh (1983). In this context, Bangladesh may benefit from India's experience in the area of fertilizer quality control and may find it appropriate to visit India's Central Fertilizers Quality Control and Training Institute before developing and implementing fertilizer quality control legislation.

4 districts, with 7 market categories in each district (a total of 28 market locations). One randomly selected dealer would be monitored from each market on a randomly selected day. The frequency of conducting the fertilizer quality survey would depend upon the seriousness of the quality problem. The field staff would be properly trained and regularly supervised.

All the data would be sent to Headquarters for further processing, and all the fertilizer samples would be sent to soil/fertilizer testing laboratories for chemical analysis. Each sample would be sent to at least two separate laboratories. The results of analysis would be sent directly to both the field staff and Headquarters.

Since there is no fertilizer quality control legislation in Bangladesh, it is strongly recommended that uniform fertilizer quality control legislation be developed, enacted, and enforced by the appropriate authorities in government.

#### Data Processing and Analysis

All the data processing activities should be properly coordinated with the data processing section of the farmer and dealer surveys. The chemical analysis of fertilizer samples would be performed at the fertilizer/soil testing laboratories. Consequently, appropriate arrangements should be made with the Bangladesh Agricultural Research Institute (BARI) for needed fertilizer analysis on a reimbursable cost basis. Currently, there exist at least four soil testing laboratories with facilities to analyze fertilizer samples. The results of these chemical analyses would be processed at Headquarters along with the rest of the data.<sup>12</sup>

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12. Despite the existence of physical facilities to analyze fertilizer samples, the enforcement of fertilizer quality control legislation in most developing countries is often hindered by long delays in obtaining laboratory reports. Many countries still do not have adequate facilities for accurate chemical analysis of fertilizer samples. In order to reduce the "backlog" and expedite the enforcement process, it is proposed that the chemical analysis phase be carried out in two stages: (1) the representative fertilizer samples should be analyzed by using quick fertilizer testing methods or kits, such as those that are being used by the Central Fertilizers Quality Control and Training Institute of India, and (2) only those fertilizer samples that have been found to be adulterated by the quick check method should be sent to the laboratories for detailed chemical analysis. The quick testing methods may not be as accurate as detailed chemical analysis of fertilizer samples in a well-equipped laboratory, but they are normally adequate.

### Indicators for Monitoring Fertilizer Prices

After the primary price survey data have been collected, transcribed, edited, checked, and tabulated, they should then be transformed into useful information relevant for monitoring the performance of the fertilizer marketing system and for formulating appropriate corrective actions, including modifications in government fertilizer policy. Such a transformation would involve statistical and economic analyses to generate appropriate economic indicators for monitoring fertilizer prices.

At least eight independent but related indicators for monitoring fertilizer prices over time and across different parts of Bangladesh are proposed. These economic indicators are absolute average price levels, fertilizer/crop price parity, fertilizer retail marketing margins, composite fertilizer price, temporal price comparison, percentage change in average prices over time, monthly average growth in prices, and monthly fertilizer price index. Each of these indicators is discussed briefly in turn.

#### Absolute Average Price Levels

The fertilizer price surveys are designed to collect fertilizer prices paid by farmers, crop prices received by farmers, and fertilizer prices paid by dealers. In each market location (a total of at least 140 locations), the fertilizer prices will be collected for urea, TSP, MOP, and DAP, and crop prices will be collected for rice, wheat, and jute. Other fertilizers and crop prices can also be included in the survey over time, depending upon their relative importance.

Let us assume that

$i = 1, \dots, M$ , i.e., seven fertilizer market categories

$j = 1, \dots, N$ , i.e., 20 districts

$k = 1, \dots, K$ , i.e., number of farmers/dealers surveyed in each market

$l = 1, \dots, L$ , i.e., number of fertilizer types

$r = 1, \dots, R$ , i.e., number of food/cash crops

$t = 1, \dots, T$ , i.e., 12 months in a year

and

$P_{ijkl}^F(t)$  = Price paid by  $k$ th farmer for  $l$ th fertilizer in  $i$ th market category of  $j$ th district in month  $t$  in TK/md or TK/mt

$P_{ijkl}^D(t)$  = Price paid by  $k$ th dealer for  $l$ th fertilizer in  $i$ th market category of  $j$ th district in month  $t$  in TK/md or TK/mt

$P_{ijk_r}^C(t)$  = Price received by kth farmer for rth crop in ith market category of jth district in month t in TK/md or TK/mt

$Q_{ijkl}^F(t)$  = Quantity purchased by kth farmer of lth fertilizer in ith market category of jth district in month t in seers and md or kg and mt

The fertilizer prices that are currently being reported in the "monthly price survey report" refer to weighted average price paid by farmers for lth fertilizer in ith fertilizer market category of all the districts in month t in TK/md. This price is reported separately for price-regulated (six districts) and price-deregulated (four districts) districts. Since fertilizer price has now been deregulated (effective April 1, 1983) all over the country, there is no need for dividing the districts into regulated and deregulated areas for collecting and reporting fertilizer prices. The current weighted average fertilizer price is being computed as follows:

$$\bar{P}_{il}^{WF}(t) = \frac{\sum_{j=1}^N \sum_{k=1}^K Q_{ijkl}^F(t) \cdot P_{ijkl}^F(t)}{\sum_{j=1}^N \sum_{k=1}^K Q_{ijkl}^F(t)}, \quad (1)$$

where  $\bar{P}_{il}^{WF}(t)$  is the weighted average price paid for lth fertilizer (urea, PTSP, GTSP, and MOP) in ith fertilizer market category (seven in all) in all the districts combined. In order to maintain consistency and continuity in reported price series, it is desirable to continue to compute and report these weighted average prices, just as they are being done now. However, major additions and/or modifications, both in price analysis and price reporting, are proposed as follows.

First--The price averages should also be computed as simple arithmetic averages. There are at least three reasons to calculate simple price averages.

1. The weighted price averages have an inherent downward bias and do not truly reflect the "going market" or "modal" price. One large purchase at a lower price (due to quantity price discounts) can offset the impact of a large number of small purchases at higher prices. Since price weights are generally not the same, weighted average price may not be the same as simple average price.

2. A large number of small farmers generally buy small quantities of fertilizer in loose bags, either because of small requirements or lack of financial resources. Consequently, for policy and equity considerations, it becomes extremely important to monitor, compute, and report the simple average prices, which more accurately reflect the prices paid by these farmers. This is important primarily because of these factors:
  - (a) Relatively large number of small farmers.
  - (b) Relatively large contribution made by small farmers to agricultural production (not necessarily, however, to marketable surplus).
  - (c) Relatively lower level of risk-bearing ability since most of the small farmers are not far from the poverty level.
  - (d) Relatively limited credit available to small farmers from both institutional and commercial credit organizations.
3. Crop procurement prices are generally fixed at the same level all across the country, irrespective of the amount of crop sold. The retail or farm-gate crop prices are generally reported as simple average prices.

In the proposed surveys fertilizer prices paid by dealers and crop prices received by farmers will be collected, computed, and reported as both weighted and simple arithmetic averages. In order to maintain consistency across different price series and derived price relationships, it is necessary to compute and report fertilizer prices paid by farmers also as simple averages. The simple average fertilizer prices can be calculated as follows:

$$\bar{P}_{ijl}^F(t) = \frac{\sum_{k=1}^K P_{ijkl}^F(t)}{K}, \text{ and} \quad (2)$$

$$\bar{P}_{il}^F(t) = \frac{\sum_{j=1}^N \sum_{k=1}^K P_{ijkl}^F(t)}{\sum_{j=1}^N K_j}, \quad (3)$$

where  $\bar{P}_{ijl}^F(t)$  is average price paid for  $l$ th fertilizer in  $i$ th market category of  $j$ th district in month  $t$  and  $\bar{P}_{il}^F(t)$  is average price paid for  $l$ th fertilizer in  $i$ th market category in all the districts ( $j=1, \dots, N$ ) combined. Furthermore, all the analyses suggested in the subsequent price indicators

should be performed on both weighted and simple price averages rather than weighted price averages alone.

Second--It may also be desirable to stratify the sample either by farm size (as has been done by Sidhu, Baanante, and Ahsan [1982]) or by the quantity (e.g., less than one bag and equal to or more than one bag) of a particular type of fertilizer purchased and then estimate weighted and simple price averages for each stratum. This approach would make it easier to determine whether the small farmers who generally buy a small quantity of fertilizer pay higher prices, on the average, than the large farmers who generally buy a large quantity. The correlation coefficient between quantity purchased and price paid by the sample farmers would also provide statistical evidence for the relationship between fertilizer price paid and quantity purchased.

Third--The price survey should be extended to include fertilizer prices paid by dealers and crop prices received by farmers. All the prices should be computed and reported as weighted and simple average prices for each market location and for each market category, just as in the case of fertilizer prices paid by farmers. Consequently, price survey data processing and analysis should also be extended to include crop price analysis as soon as possible. However, the dealer price survey should be initiated only after the prices paid by fertilizer dealers are decontrolled. The average fertilizer and crop prices can be computed by applying equations (1), (2), and (3) to the dealer fertilizer price and crop price survey data.

Fourth--Currently the fertilizer price averages are reported for fertilizer products in TK/md. These prices should also be computed and reported in terms of fertilizer nutrients. The needed conversions can be performed as follows:

$$P_N(t) = P_U(t)/A_U \quad (4)$$

$$P_{P_2O_5}(t) = P_{TSP}(t)/A_T \quad (5)$$

$$P_{K_2O}(t) = P_{MOP}(t)/A_M \quad (6)$$

$$P_{N+P_2O_5}(t) = P_{DAP}(t)/A_D \quad (7)$$

where  $P_N$ ,  $P_{P_2O_5}$ ,  $P_{K_2O}$ , and  $P_{N+P_2O_5}$  are fertilizer nutrient prices;  $P_U$ ,  $P_{TSP}$ ,  $P_{MOP}$ , and  $P_{DAP}$  are fertilizer product (urea, TSP, MOP, and DAP, respectively) prices;  $A_U$ ,  $A_T$ ,  $A_M$ , and  $A_D$  refer to "nutrient factor" in the respective fertilizer products. On the average, the nutrient contents are 46% N in urea, 46%  $P_2O_5$  in TSP, 60%  $K_2O$  in MOP, and 18% N + 46%  $P_2O_5$  in DAP.

Fifth--Currently all the prices are reported in TK/md since md is the popular measuring unit used by farmers. However, approximately 2 years ago the long ton (equal to 27.22 md or 2,240 lb) was replaced by the metric ton (equal to 26.80 md or 2,205 lb) as the weight measuring unit. The crop procurement and fertilizer prices are fixed in terms of TK/mt. Consequently, the fertilizer and crop prices should also be computed and reported in TK/mt, along with TK/md. Such a conversion can be performed as follows.

$$P(\text{TK/mt}) = 26.80 P(\text{TK/md}) = 0.9844 P(\text{TK/lt}). \quad (8)$$

These conversions should be performed for all the price variables, including the fertilizer prices paid by farmers, the fertilizer prices paid by dealers, and crop prices received by farmers.

Sixth--The current format for computing and reporting average fertilizer prices paid by farmers should be expanded along the lines suggested in Table 1. This one table provides an overall telescopic comparison of average fertilizer prices for each market location, each market category, each district, and the nation as a whole. Such a format should be developed for fertilizer prices paid by farmers for each fertilizer type, fertilizer prices paid by dealers for each fertilizer type, and crop prices received by farmers for each crop. Similar formats could also be used for reporting fertilizer prices for products as well as nutrients or prices reported in TK/md or TK/mt.

#### Fertilizer/Crop Price Parity

A farmer's decision to use fertilizer and the economic return to fertilizer use are determined not only by the absolute price paid for fertilizer but to a large extent by fertilizer/crop price parity. The fertilizer/crop price parity here refers to the ratio between fertilizer price paid by the farmer and crop price received by the farmer. The fertilizer/crop price

parity, expressed in either fertilizer product or fertilizer nutrient terms, can be calculated as below:

$$P_{ijkl}(t) = P_{ijkl}^F(t)/P_{ijkr}^C(t) \quad (9)$$

where  $p_{ijkl}(t)$  refers to the ratio between the price of  $l$ th fertilizer and  $r$ th crop. These ratios should also be calculated by using average prices for each market location, each market category, and each district along the lines presented in Table 1. The crop prices, on the other hand, should be the prices actually received by the farmer, which may be equal to or higher than the procurement prices fixed by the government.

In estimating farm-level and regional or national fertilizer demand functions, one of the major explanatory (independent) variables is fertilizer/crop price ratio (assumes price homogeneity), which is sometimes also referred to as real fertilizer price. Fertilizer price elasticity in this context refers to percentage change in fertilizer demand in response to a 1% change in fertilizer/crop price parity or real fertilizer price. The fertilizer/crop price parity could change in response to changes in either the numerator (fertilizer price) or the denominator (crop price) or both. The relative economic impact of a given percentage change in price ratio of individual farm groups or the economy, however, would depend on (1) whether the change was due to a change in fertilizer price or a change in crop price and (2) relative magnitude of independent fertilizer demand elasticities with respect to fertilizer price and crop price.

For example, for very small or marginal subsistence farmers without any marketable surplus, the short-term relative economic impact of a given change in fertilizer price may be more important than a corresponding change in crop prices. On the other hand, a given increase in fertilizer price may have a relatively larger economic impact on the small farmer with negligible marketable surplus than on the large farmer with large marketable surplus. However, the relative economic impact depends on various economic parameters and needs empirical verification. A continuous monitoring of fertilizer/crop price parity and source of change in price parity at the farm level would indicate a change in relative economic benefits from fertilizer use, if no change in average crop response to fertilizer use is assumed.

Table 1. Suggested Format for Computing and Reporting Average Fertilizer or Crop Prices for Each Market Location as Indicators for Monitoring Prices in Bangladesh

Market Category	Districts			Average	
	$\frac{1}{- - - - -}$	$\dots$	$\frac{j}{-(Tk/md \text{ or } Tk/mt)}$		$\dots$
1					$\bar{P}_1$
.			.		.
.			.		.
.			.		.
i		$\dots$	$\bar{P}_{ij}$	$\dots$	$\bar{P}_i$
.		(Average price in one market located in			.
.		ith market category of jth district)			.
.			.		.
M			.		$\bar{P}_M$
			.		
			.		
Average	$\bar{P}_1$		$\bar{P}_j$		$\bar{P}_N$
					National Average Price

### Fertilizer Retail Marketing Margin

The fertilizer retail marketing margin can be defined as the difference between fertilizer price paid by the farmer and fertilizer price paid by the dealer. The difference between these two prices is due to marketing costs borne by the dealer and to his profit margin. In other words, the average marketing margin for a particular market location can be calculated as

$$m_{ijl}(t) = \bar{p}_{ijl}^D(t) - \bar{p}_{ijl}^F(t) \quad (10)$$

where  $m_{ijl}(t)$  is the marketing margin (TK/md or TK/mt) for  $l$ th fertilizer in  $i$ th market category of  $j$ th district. These results should also be presented in tables similar to Table 1.

A continuous monitoring of the fertilizer marketing margins would be useful to determine the underlying reasons for an increase in marketing margins or higher marketing margins in some market locations than in others (e.g., higher transportation costs). This monitoring would also be helpful in determining unfair market practices such as hoarding, monopoly pricing, collusion among dealers, or simply higher profit margin due to fertilizer scarcity.

The information on fertilizer marketing margins would indicate to the government whether the existing marketing margins are legitimate or whether the dealers are merely taking an undue economic advantage of farmers. One could extend the same methodology and logic to obtain the marketing margins between the fertilizer price paid by the dealer to the wholesaler and the fertilizer price paid by the wholesaler to the fertilizer distributor.

### Composite Fertilizer Price

The retail prices for different types of fertilizers are generally different unless, of course, these are fixed by the government at the same level (for example, current PDP prices of urea and DAP in Bangladesh are the same). As fertilizer use expands and farmers become more aware of the need for balanced fertilizers, the number of fertilizer types and grades sold in a country will expand. Under these circumstances there will be several average fertilizer price series, one for each fertilizer. Furthermore, several different types of fertilizers, (i.e, N,  $P_2O_5$ ,  $K_2O$ , and S) are used

by the farmers on each crop in question, and the fertilizer product mix also varies across crops.

Under these circumstances, in order to compare fertilizer/crop price ratios over time and across different crops and to calculate farm-level or even macro-level cost:benefit ratios, it would be desirable to develop a composite fertilizer price, i.e., one fertilizer price for every crop, month, or even year. The composite fertilizer price can be calculated as follows:

$$\bar{P}_j^F(t) = \frac{\sum_{l=1}^L Q_{jl}^F(t) \bar{P}_{jl}^F(t)}{\sum_{l=1}^L Q_{jl}^F(t)}, \quad (11)$$

where  $\bar{P}_j^F(t)$  is the average composite fertilizer price in  $j$ th district,  $Q_{jl}^F(t)$  is the consumption of  $l$ th fertilizer in  $j$ th district, and  $\bar{P}_{jl}^F(t)$  is the average price for  $l$ th fertilizer in  $j$ th district. In other words, the average composite fertilizer price is calculated by dividing the total value of all the fertilizers used in  $j$ th district by the total quantity of those fertilizers.

The quantity of each fertilizer consumed is used as the appropriate weight. The fertilizer consumption data generally may not be available by district. In that case, district level fertilizer sales data can be used as an approximation of consumption. The same logic can be extended to compute average composite fertilizer price at the national level. Because of the lack of appropriate fertilizer consumption data for each farmer, market location, and market category, and because it is desirable to keep the data processing within manageable limits, it will not be necessary to compute average composite fertilizer price by market location or market category. However, the district or national average composite fertilizer price can be used to compute fertilizer/crop price parity by using appropriate corresponding crop price.

#### Temporal Price Comparisons

Fertilizer and crop prices do change over time in response to various factors, including general inflation and government price policy. Consequently, it is highly desirable to monitor and compare average monthly prices with the corresponding average prices for the previous months. With

such information, one does not have to search for previous monthly reports in order to obtain a perspective on average prices over time in a time-series framework. Each monthly report, however, should cover not more than 1 year's comparative monthly price data.

All the three survey price series should be reported, i.e., fertilizer prices paid by farmers, fertilizer prices paid by dealers, and crop prices received by farmers. In addition to weighted and simple average monthly prices in absolute terms, fertilizer/crop price parity, fertilizer retail marketing margins, and composite fertilizer price should also be included in the monthly report. However, the average monthly price indicators should be reported only for each district, each market category, and the country as a whole. The proposed monthly time-series data should be presented both in tabular and graphic forms.

#### Percentage Change in Average Prices

In addition to comparing the absolute values of various monthly price variables, it is very important to compute the monthly percentage change in a particular price variable over the previous month. The monthly percentage change can be computed as follows:

$$g(t) = \left[ \frac{P(t) - P(t-1)}{P(t-1)} \right] 100, \text{ or} \quad (12)$$

$$g(t) = \left[ \frac{P(t)}{P(t-1)} - 1 \right] 100, \text{ or} \quad (13)$$

$$g(t) = \left[ \frac{\Delta P(t)}{P(t-1)} \right] 100, \quad (14)$$

where  $g(t)$  is the percentage change in price in a particular month over the previous month. The percentage change in monthly prices should be calculated and reported for both fertilizer and crop price averages at the market category, district, and national levels.

#### Average Monthly Growth in Prices

At the end of each year, it would be very useful to obtain a proper perspective on price trends by computing the monthly average compound growth rate for all the price time series in question. The average compound growth can be computed by using one of two approaches. First,

$$g = \left[ \left[ \frac{P(T)}{P(t)} \right]^{1/n} - 1 \right] 100, \quad (15)$$

where  $P(T)$  is price in the terminal month,  $P(t)$  is the price in the initial month,  $n$  is the number of months and is equal to  $(T-t)$ , and  $g$  is the average monthly compound growth rate in prices and is expressed in percent. The growth rate computed by this approach is very sensitive to the price levels in both initial and terminal months. Consequently, it is very important that these months reflect normal economic and weather conditions. However, the impact of abnormal months can be minimized by using 3- or 5-month averages in determining growth rate.

Second, the average growth rate can also be calculated by estimating a regression equation by using the least-squares method. In this method, the least-squares estimate of the growth rate is calculated by regressing the values of an appropriate price variable in the relevant period over time by using the following logarithmic form:

$$\text{Log } P_t = a + bt + u_t, \text{ and} \quad (16)$$

$$g = (\text{antilog } b) - 1. \quad (17)$$

where  $P_t$  is the price variable,  $t$  is time,  $u_t$  is the error term,  $a$  is the intercept,  $b$  is the slope coefficient with  $b = \log(1 + g)$ , and  $g$  is the least-squares estimate of the growth rate. The advantage of this approach is that all the values in price time series are used to estimate the average growth rate. Consequently, the magnitude of the growth rate is not as sensitive to the selection of initial and terminal prices. However, this approach requires more time, appropriate training, and access to appropriate computation facilities.

#### Monthly Fertilizer Price Index

Price indexes are very popular indicators for monitoring price changes over time. Specifically, a price index is used to measure price changes at a particular point in time (month or year) relative to a benchmark, the base period. The most common price index is Laspeyres index, which is computed as follows:

$$I = \left[ \frac{\sum_{l=1}^L Q_{o1} P_{11}}{\sum_{l=1}^L Q_{o1} P_{o1}} \right] 100, \quad (18)$$

where I is the weighted average fertilizer price index,  $Q_{o1}$  is the quantity of lth fertilizer sold in the base (o) period,  $P_{o1}$  is the price of lth fertilizer in base (o) period, and  $P_{11}$  is the price of lth fertilizer in current (1) period. The Laspeyres index is computed by using base period quantities as weights. Other price indexes include Paasche Index and Fisher's Ideal Index, which use slightly different quantity weighting schemes.

In constructing monthly price indexes, it is important to be careful in selecting (1) the base period, which should preferably be an average of 3-5 periods; (2) the components of the index, which should include all the important fertilizers; and (3) the quantity weights, which could also be an average of 3-5 periods. Since the monthly survey price data are already available for about 2 years, it may also be desirable to compute an annual fertilizer price index.

The price index should be calculated for both the fertilizer prices paid by farmers and crop prices received by farmers. Furthermore, the ratio of these two indexes (fertilizer price index and crop price index) would indicate a relative change over time in fertilizer and crop prices. Since it will not be possible to accurately estimate quantity weights by each market category, the price indexes should be calculated for district and national average prices only.

#### Indicators for Monitoring Fertilizer Availability

The primary function of an efficient fertilizer marketing system is to deliver the right type of fertilizer, in adequate quantities, at the appropriate time and place, and at reasonable prices, especially when there is no fertilizer oversupply in the market. BADC has made remarkable progress toward achieving these goals in the last 5 years. However, much remains to be done especially in light of the expanding demand for fertilizer at the national level.

The proposed farm-level and dealer-level surveys would monitor the availability of fertilizer in terms of right time and right place. They would be conducted every month in at least 140 randomly selected market locations in all the districts of Bangladesh. In addition, these surveys are designed to monitor the following four fertilizer availability indicators. These are (1) fertilizer quantity, (2) fertilizer type, (3) fertilizer stock, and (4) number of fertilizer dealers.

#### Fertilizer Quantity

The fertilizer availability indicator would ascertain whether adequate amounts of fertilizer are available in the market to farmers as well as dealers. Spot shortages of fertilizer during peak seasonal demand months would always, of course, be there. However, any effort on the part of dealers or wholesalers to hoard fertilizer or create artificial fertilizer scarcity would be exposed by the proposed fertilizer monitoring system.

#### Fertilizer Type

The types of fertilizers available to Bangladesh farmers would be determined by the organizations involved in fertilizer manufacture and fertilizer imports. However, these fertilizers must be agronomically and economically appropriate for soils and crops grown in Bangladesh. This indicator (which is closely related to the quantity indicator) would ascertain whether the farmers are able to obtain appropriate types of fertilizers, especially those that are included in fertilizer recommendations. For example, at the time of topdressing rice, farmers need urea. No amount of TSP would substitute for urea since they contain different plant nutrients.

#### Fertilizer Stock

The stock of each fertilizer would also be estimated for randomly selected fertilizer dealers in a particular market location. This indicator would provide a quantitative measure of fertilizer availability at the retail level and would also indicate the seasonal pattern for fertilizer demand in each of the market locations. However, these fertilizer stock estimates (unless appropriately correlated with aggregate district or national level

stocks) would not provide an estimate of total fertilizer stocks in the country during a particular month.

#### Number of Dealers

The amounts and types of fertilizer available to the farmers are directly related to the number of fertilizer dealers in a particular market location and the competition among them (assuming there is no collusion). The number of fertilizer dealers in each market location would be monitored each month as an indicator of farmers' access to fertilizer. Generally when the number of fertilizer dealers in a particular market location increases, the potential benefits to farmers also increase as a direct result of competition among various dealers.

#### Indicators for Monitoring Fertilizer Quality

As was discussed earlier, guaranteed chemical analysis, physical characteristics, and weight are the responsibility of the manufacturer, importer, and distributor. There is some evidence, however, that farmers in Bangladesh do not always receive what is written on the bag in terms of quality and weight. The fertilizer quality survey in 140 market locations is designed to monitor at least four fertilizer quality indicators. These are chemical analysis, physical characteristics, weight and measurements, and bag quality.

#### Chemical Analysis

The fertilizer specifications will be developed in the proposed fertilizer quality control legislation. Through chemical analysis the randomly selected representative fertilizer samples will be monitored to determine whether they meet the specifications within a prescribed tolerance limit. This would include primarily the nutrient content in terms of both total and soluble contents by weight. Appropriate chemical analysis is very important since a large share of fertilizer in Bangladesh is sold in loose bags.

#### Physical Characteristics

The physical characteristics of fertilizer are primarily the moisture content, the particle size (i.e., the size of prills or granules), and

general physical appearance, including caking. Again, the chemical and physical analyses of randomly selected representative fertilizer samples will determine whether the fertilizer meets the guaranteed specifications within an acceptable (prespecified) margin of error. Additional moisture adds to the weight and hence means a direct loss to the farmer when fertilizer is bought loose. Caking makes it very difficult to apply fertilizer evenly across the field, and unevenly applied fertilizer may result in lower crop response.

### Weight and Measurements

The quality survey will monitor the weight of fertilizer bags as well as the accuracy of weight measurements used in loose bag sales. The available evidence indicates that about one-half of the bags are underweight. There is no reason why a farmer should pay a full price for underweight bags; instead, whoever is found to be responsible for underweights should bear the financial loss.

### Bag Quality

Bag quality here refers to several factors, including quality of the outer covering of the bag, thickness of inner lining, quality of stitching, and the use of hooks on bags. Any of these problems could lead either to loss of fertilizer or deterioration of fertilizer quality. Each of these factors will be monitored at the randomly selected dealer's store in each of the 140 market locations.

### Organization and Staff for the Monitoring System

The organization and staff requirements for monitoring fertilizer price and availability and fertilizer quality are discussed in the context of Bangladesh. The adequate number of staff members would, of course, vary depending upon the country and its annual fertilizer consumption. In order to facilitate the actual implementation, the fertilizer monitoring system should be organized under one ministry, preferably Ministry of Agriculture, at the national level.

### Monitoring Fertilizer Price and Availability

The organization and staff needs (excluding technical assistance) for monitoring fertilizer price and availability at the farm and dealer levels are shown in Figure 2. The farm-level price survey, which has been conducted in Bangladesh for the past 3 years, would be expanded in terms of coverage and economic analysis. Consequently, the existing staff would be expanded to accommodate the increased workload in the field as well as at Headquarters. This should be accomplished as soon as possible. On the other hand, the dealer survey would be initiated only after PDP-level fertilizer prices were deregulated.

### Monitoring Fertilizer Quality

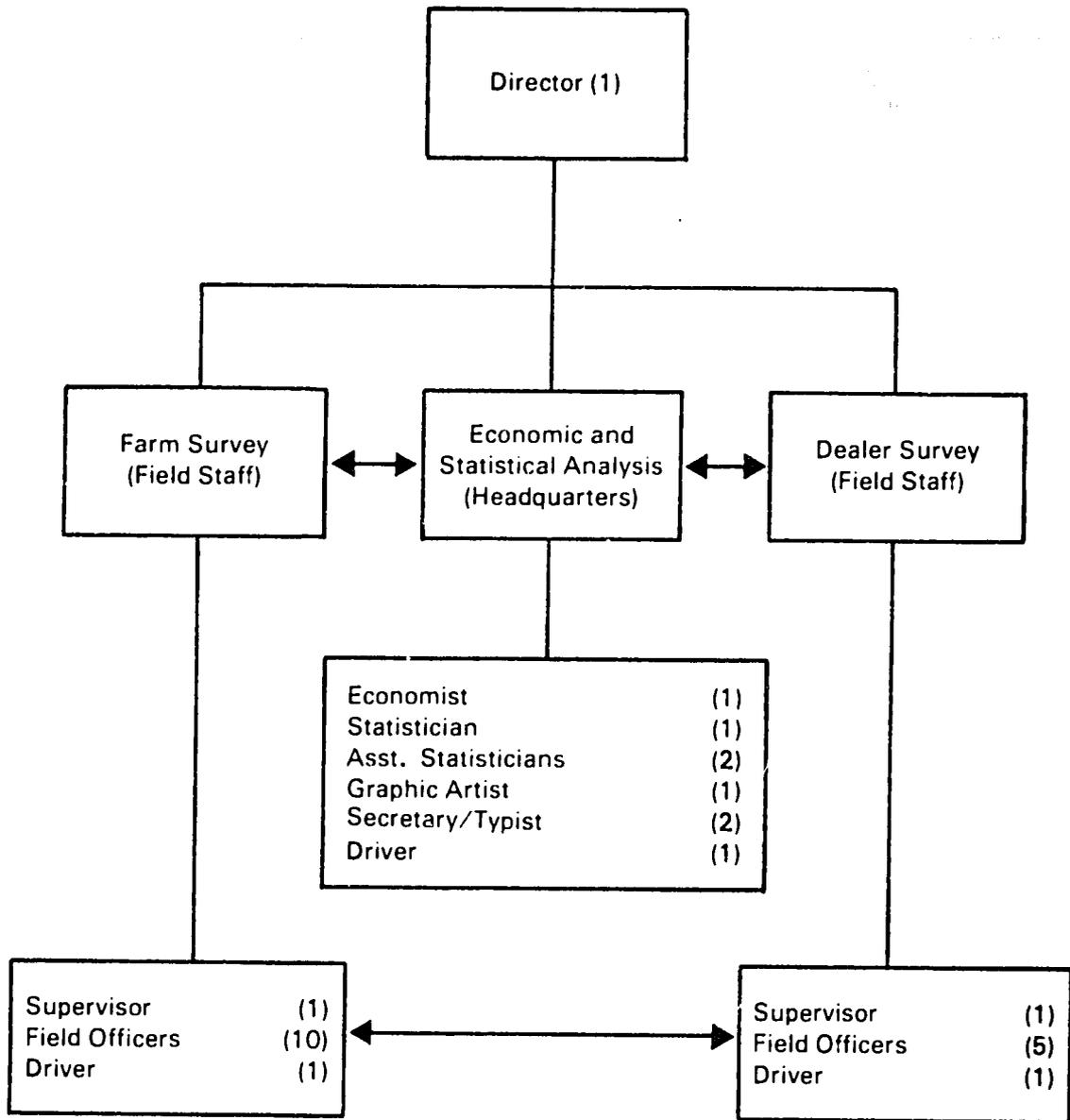
The organization and staff needs (excluding technical assistance) for monitoring fertilizer quality are shown in Figure 3. The actual implementation of the quality survey may be delayed until the enactment of fertilizer quality control legislation. However, the development of this legislation should be undertaken as soon as possible.

### Analysis and Reporting of Monitoring Information

After the survey data have been collected, they should be checked, edited, processed, and analyzed at Headquarters. This would require adequate data processing and computation facilities. In order to process large volumes of data and to generate needed price, availability, and quality indicators, it is proposed that the staff have access to computation facilities, preferably an in-house computer. This would facilitate the generation of timely and accurate information for monitoring purposes. All the key results should be published once a month in "Economic Indicators for Fertilizer Policy Analysis," along with appropriate economic analysis, key conclusions, and suggestions for actions.

### Monitoring System as an Aid to Policymakers

Monitoring is an integral part of an effective and responsible fertilizer policy design and implementation. Monitoring here refers to

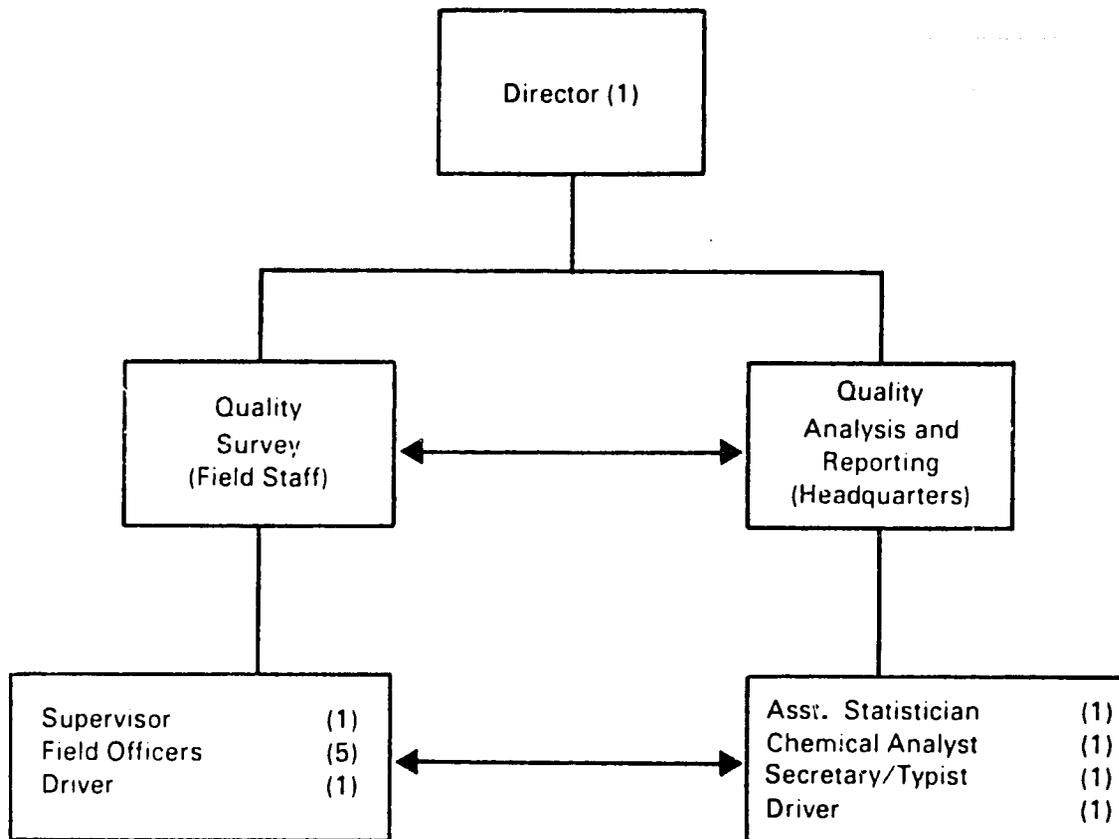


Number of staff members at Headquarters = 9

Number of staff members in the field = 19

Total = 28

**Figure 2. Organization and Staff for Monitoring Fertilizer Price and Availability in Bangladesh.**



Number of staff members at Headquarters = 5

Number of staff members in the field = 7

Total = 12

**Figure 3. Organization and Staff for Monitoring Fertilizer Quality in Bangladesh.**

generation of appropriate information in order to adequately assess the performance of the fertilizer marketing system in Bangladesh and thus to keep the government decisionmakers fully informed so that they are able to take appropriate and timely actions. The appropriate information must be timely, accurate, concise, complete, and relevant to the stated objective.<sup>13</sup>

The monitoring system would assist the policymakers both in seeking solutions for short-term implementation problems and in making long-range plans and fertilizer-related policy decisions. Furthermore, monitoring can prevent many potential problems. For example, if fertilizer dealers are aware of the monitoring system, that knowledge may prevent them from engaging in any illegal or unfair market activities.

An effective monitoring system can also be highly cost effective from a social point of view as long as it provides the appropriate early warning signals to the policymakers. For example, the total annual operational cost of implementing the proposed fertilizer monitoring system is expected to be very small (less than 0.5% of the value of annual fertilizer consumption in Bangladesh), and the relative cost is expected to decline as fertilizer use expands.

Simply setting up a fertilizer monitoring system, however, does not necessarily mean that it will accomplish all the desired goals. In order for the monitoring system to be effective and successful, it must meet certain criteria. It must articulate "goals" of the monitoring system and "criteria" against which the performance of the marketing system will be assessed. It must be operational and manageable within the existing infrastructural and the human, financial, and organizational constraints. The system must be objective, without any intended bias in data collection, analysis, and reporting. It must have low initial cost and not be unduly expensive to operate. The system must generate information that is timely and accurate. It must obtain continuous and constructive feedback from the policymakers with respect to further improvements, needed modifications, and urgent corrective actions. The policymakers must have the authority to penalize those who violate the prescribed rules of the system through both administrative and legal actions.

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13. Needed information and economic analysis in the context of fertilizer policy formulation in developing countries are discussed in detail in Mudahar (1978).

Once the fertilizer monitoring system uncovers any irregularities in fertilizer pricing, availability, or quality, it is extremely important that urgent and stern action be taken to rectify the problem. Timing is extremely important. Lack of an appropriate action under these circumstances may further stimulate such activities on the part of dealers until things are out of control. However, it is also very important for the government authorities not to unnecessarily interfere in the smooth operations of the private sector in the fertilizer marketing system. It is important to provide the needed flexibility to the private sector in order to innovate, promote, and improve fertilizer marketing efficiency so that it succeeds in delivering quality fertilizer to all parts of the country and at reasonable prices.

In addition to the fertilizer price, availability, and quality indicators proposed earlier, the monitoring system should also collect information on other relevant national (and even international) fertilizer-related economic variables. Some of these variables include:

1. National fertilizer price with and without fertilizer price subsidy.
2. Fertilizer price subsidy.
3. c.i.f. price for imported fertilizers.
4. Ex-factory price (with and without fertilizer subsidy) for domestically produced fertilizers.
5. Fertilizer transportation costs and transportation modes.
6. Fertilizer consumption.
7. Fertilizer production.
8. Fertilizer imports/exports.
9. Fertilizer stocks.
10. Average fertilizer distribution costs.

Information on these variables, along with information generated through fertilizer surveys, should provide the necessary information base to the decisionmakers for formulating and implementing fertilizer policy. In the case of Bangladesh, much of this information is already being collected by BADC and published in the monthly BADC newsletter.

If the proposed fertilizer monitoring system is to succeed, at least three basic fertilizer activities must be undertaken by the government at the national level. These are (1) development of accurate fertilizer supply and demand forecasts, (2) maintenance of fertilizer security through

adequate buffer stocks and appropriate import planning, and (3) establishment of nationwide control and management of fertilizer inventories. Lack of adequate fertilizer at the national and farm levels can be a serious constraint to expanded fertilizer use. Accurate forecasts for fertilizer supply, demand, import needs; adequate stock of fertilizer in buffer stocks; and regular inventory control can be of great help to policymakers in ensuring smooth operations of the fertilizer market. The fertilizer monitoring system, along with these activities, can aid the policymakers and lead to an efficient and equitable fertilizer use, which is essential to achieve the stated national goal of food self-sufficiency in Bangladesh and in other developing countries of the world.

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APPENDIX

FERTILIZER MARKETING SYSTEM IN BANGLADESH

Introduction

The Bangladesh Government has been introducing major reforms in the fertilizer marketing system since 1978. Some of these reforms include an expanded role of the private sector, fertilizer price decontrol, creation of additional fertilizer storage facilities, streamlining fertilizer procurement through imports, and improving fertilizer marketing and distribution systems.

The overall objectives of these and other proposed reforms in the existing fertilizer marketing system in Bangladesh are (1) an improvement in economic efficiency in fertilizer marketing from supply source to the farmer, (2) an improvement in economic efficiency in fertilizer use by farmers, (3) increased availability of quality fertilizers to all classes of farmers in the country at competitive prices, and (4) an accelerated growth in balanced use of fertilizer. The achievement of these objectives is necessary, but that alone will not achieve the ultimate national goal of food self-sufficiency in the shortest possible time.

Evolution of the Fertilizer Marketing System

Fertilizer was introduced in Bangladesh around 1951. The market for fertilizer has expanded from merely 3,000 long tons of product in 1951/52 to 73,000 long tons of product in 1962/63 to almost 823,000 long tons of product in 1981/82. The expansion of fertilizer consumption in the last 5 years has been rather impressive. The fertilizer sector in Bangladesh is by no means a "static" sector. In the last 10 years the fertilizer marketing system in Bangladesh has experienced several major changes, and it appears to be adjusting rather well to these changes.<sup>14</sup>

<sup>14</sup> Further details on different aspects of the fertilizer marketing and distribution system are available in several IFDC publications, including Chuang, Hill, and Barnett (1978); Hill and Benton (1980); Clayton (1981); IFDC (1982); and Moots (1982).

### Phase I

The Bangladesh Agricultural Development Corporation (BADC) has been responsible for marketing agricultural inputs, including fertilizer, since 1962/63. The predecessor of BADC was the East Pakistan Agricultural Development Corporation (EPADC), which was established in 1961; the name was changed to BADC in 1971. BADC is a corporation which is wholly owned by the government. The primary features of this so-called Old Marketing System were these: (1) BADC, an "absolute public monopoly" was responsible for procuring and distributing fertilizer up to the level of thana sales center (TSC), beyond which the private dealers and cooperatives sold to farmers; (2) the private dealers, 15 in every union, were appointed by BADC, and each dealer was assigned to a fixed marketing territory; (3) the retail price at which a dealer could sell to a farmer was fixed; and (4) the dealer's commission was fixed by BADC, which provided rather limited incentive.

### Phase II

The New Marketing System was first introduced in Chittagong Division on December 1, 1978, and later expanded to the whole country (except Chittagong Hill Tracts) by July 1, 1980. The New Marketing System removed several drawbacks of the Old Marketing System; for example, (1) the role of BADC in fertilizer distribution was reduced to what is known as primary distribution points (PDPs) and viable TSCs only; (2) any number of private dealers can sell fertilizer by merely registering with BADC without any restrictions on number or market territory (except within the 5-mile border zone); (3) the retail price at which a dealer can sell fertilizer to a farmer is still fixed; and (4) the economic incentives to private dealers are provided through price flexibility at wholesaler level, quantity discounts, and credit facilities. The preliminary evaluations of the New Marketing System indicate that farmers' accessibility to fertilizer has generally increased except, of course, when there is national shortage in fertilizer supply.

### Phase III

The New Marketing System was further modified by deregulating retail fertilizer prices. The price deregulation was first introduced in

the Chittagong Division on April 1, 1982, and later extended to the whole country (except Chittagong Hill Tracts) on April 1, 1983. The concept of price deregulation in this context is rather limited. The PDP price is fixed by BADC and is the same across all PDPs for a particular fertilizer. However, the wholesalers or retail dealers are free to sell fertilizer at any price. The limited evidence available indicates that (1) prices in deregulated areas were slightly higher than those in the price-regulated areas and (2) availability of fertilizer in the pricederegulated areas was increased, particularly in the remote areas. However, there is a need for further detailed analysis on the economic impact of price deregulation before drawing any substantive conclusions.

#### Phase IV

Further reforms in the New Marketing System are largely a continuation of the process that was set into motion on December 1, 1978. The primary purpose of these reforms should be to reduce fertilizer marketing constraints, reduce fertilizer delivery costs, and increase availability of fertilizer in all areas and to all farmers. Further privatization of the existing New Marketing System should aid in the achievement of these objectives. In particular, (1) further development of private distributors should be encouraged at the national level, (2) BADC should continue to operate as a distributor but will have to compete with private distributors on equal footing, (3) the number of private dealers should be further increased with appropriate dealer-development programs, and (4) the fertilizer price should be deregulated further in the marketing system.

#### Promoting Competition in the Fertilizer Market

The underlying justification for an increased involvement of the private sector in the marketing system is to get away from absolute public monopoly and increase opportunities for greater competition at all levels. The competitive marketing system is expected to be in the best interests of individual farmers and society at large. The existing fertilizer marketing system with additional reforms will have the following economic attributes.

1. The number of buyers and sellers of fertilizer will be large. There are approximately 12 million farming households in Bangladesh, over 60%

of which use fertilizer.<sup>15</sup> On the other hand, there are over 22,000 active (and 49,000 registered) retail fertilizer dealers. The number of retail dealers is expected to increase rapidly under the expanded New Marketing System.

2. The fertilizers sold by retail dealers are homogeneous products. However, the distributors, wholesalers, and retail dealers are expected to differentiate the market on the basis of quality of service, location, and even such provisions as sale on credit.
3. Even though the per-unit cost of fertilizer (i.e., purchase price by BADC and/or private distributors) at the supply source is expected to be the same, the fertilizer prices at the retail level are determined by the prevailing market forces without any explicit or implicit government controls.
4. The proposed reforms are expected to further increase the freedom of entry into or exit from the fertilizer market by fertilizer distributors, wholesalers, and retail dealers, provided they satisfy certain minimum conditions. However, they will be allowed to sell fertilizer wherever they please in the country.
5. Perfect knowledge about supply demand, prices, and use on the part of farmers and dealers may not be obtained because of limitations on infrastructure, communication, market research, and training. However, during the implementation of additional reforms through the ongoing Fertilizer Distribution Project, some of these constraints are expected to be removed.

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15. According to Sidhu, Baanante, and Ahsan (1982), the percentage share of sample farmers using fertilizer was 68%, 62%, and 61% in Boro, Aus, and Aman seasons, respectively, during 1979/80. However, the percentage share of farmers actually using fertilizer increases with an increase in farm size. For example, during Aman 1980 season, the percentage share of sample farmers using fertilizer was 54%, 57%, 67%, and 72%, respectively, for farm size categories of less than 1.0 acre, between 1.0-2.5 acres, between 2.5-5.0 acres, and greater than 5.0 acres. On the other hand, fertilizer use per acre appears to have an inverse relationship with farm size.