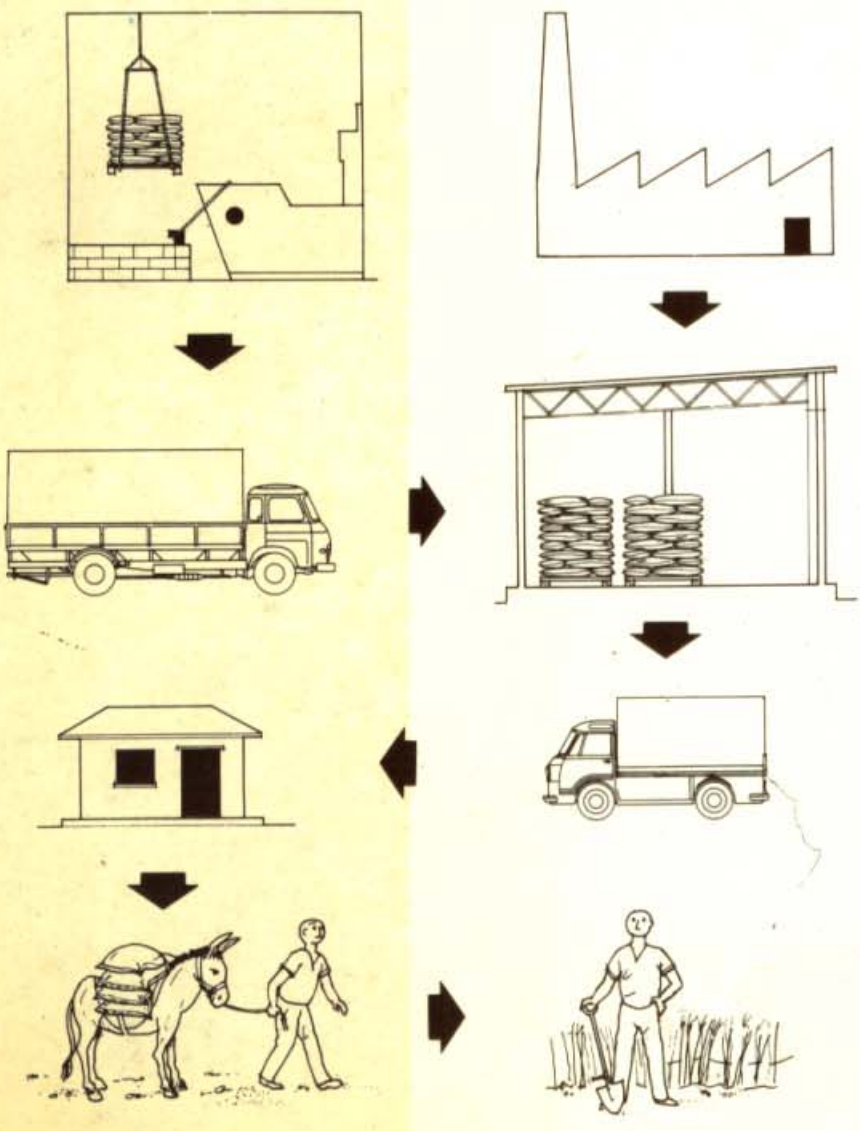
Manual on fertilizer distribution

FAO
FERTILIZER
AND PLANT
NUTRITION
BULLETIN

8



FOOD
AND
AGRICULTURE
ORGANIZATION
OF THE
UNITED NATIONS

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FAO
Fertilizer and Plant Nutrition Service
Land and Water Development Division

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1 FERTILIZERS AND THEIR USE

1.1 Introduction

A sufficient degree of confidence should exist between fertilizer salesmen and their farmer customers if national use of fertilizers is to develop. This requires of the seller or distributor, first, that he has a basic knowledge of the products he sells and, second, that he is certain that they can satisfy technically sound fertilizer recommendations.

Fertilizer, however important it may be, is only one of the inputs which can increase crop yields and farm incomes. Fertilizers must be used together with better seed, correct use of plant protection products, proper equipment and increased recycling of organic materials. Although this manual deals only with fertilizers, attention to their integration within a range of improved techniques is a basic underlying principle throughout.

The distributor who fully understands his role in the fertilizer marketing system will render service to agricultural production in general, to his farmer customers and to himself.

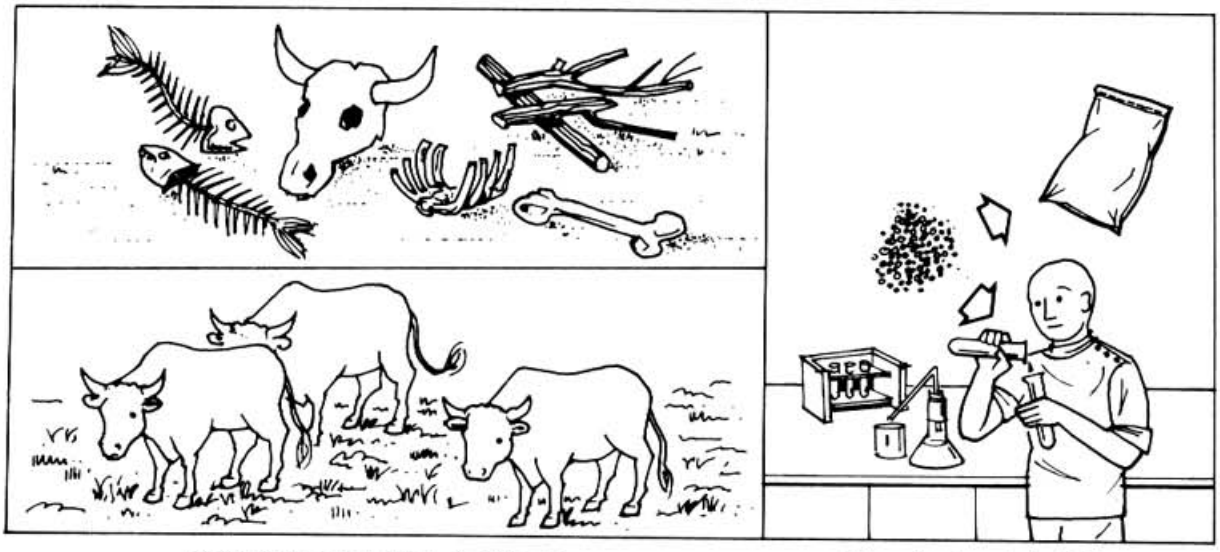
1.2 What is a Fertilizer?

A fertilizer is a substance which is used to provide one or more nutrient elements needed by plants. It may be either a naturally occurring or an industrially manufactured product. In both cases the nutrient elements are alike and have the same effect on plant growth.

Fertilizers may be solid, liquid or gaseous. Solid fertilizers are generally supplied packed in 50 kg bags.

It was mentioned above that fertilizers contain nutrient elements which are needed by plants in different quantities. These elements are divided into three categories according to the quantities needed by plants: primary or major nutrients, secondary nutrients, and micronutrients or trace elements, as shown in Table 1.

Figure 1
Naturally occurring and manufactured fertilizers



Naturally occurring fertilizers **Manufactured fertilizers**

Figure 2
Solid, liquid and gaseous fertilizers

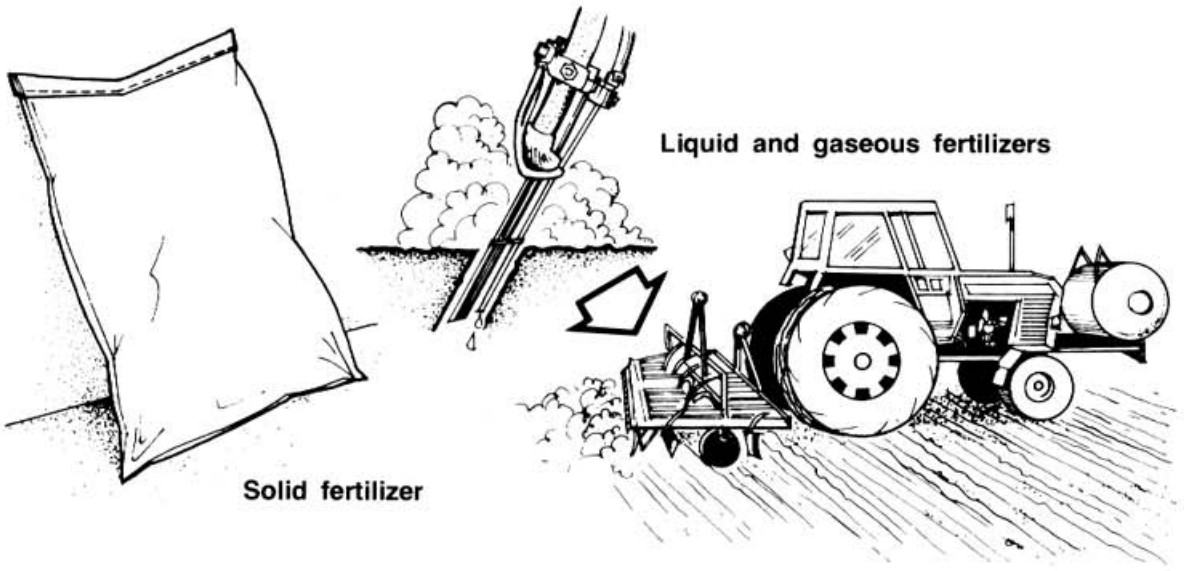


Table 1
Primary nutrients, secondary nutrients, micronutrients or trace elements and their chemical symbols

Primary or major nutrients	
Nitrogen	N
Phosphorus	P
Potassium	K
Secondary nutrients	
Calcium	Ca
Magnesium	Mg
Sulphur	S
Micronutrients or trace elements	
Iron	Fe
Zinc	Zn
Manganese	Mn
Copper	Cu
Boron	B
Molybdenum	Mo
Chlorine	Cl

1.3 Use of Fertilizers

The application of nutrient elements to a given crop to obtain good yields depends on the inherent fertility of the soil, which varies both with its formation over the years and with the use to which it has been put.

Soil fertility diminishes with each cropping season that adequate fertilizer application is not made because plants take up nutrient elements from the soil, particularly the major nutrients N, P and K. It is not necessary to apply all nutrient elements to the soil but only those that are taken up in the largest quantity, provided that the others are present in the soil to an adequate amount.

If nutrient elements which are not present in adequate quantity are not applied to the soil, then the crop yield is limited by deficiency of these nutrients, i.e. the yield will attain only that level which is permitted by the most deficient

Figure 3
Factors in plant nutrition

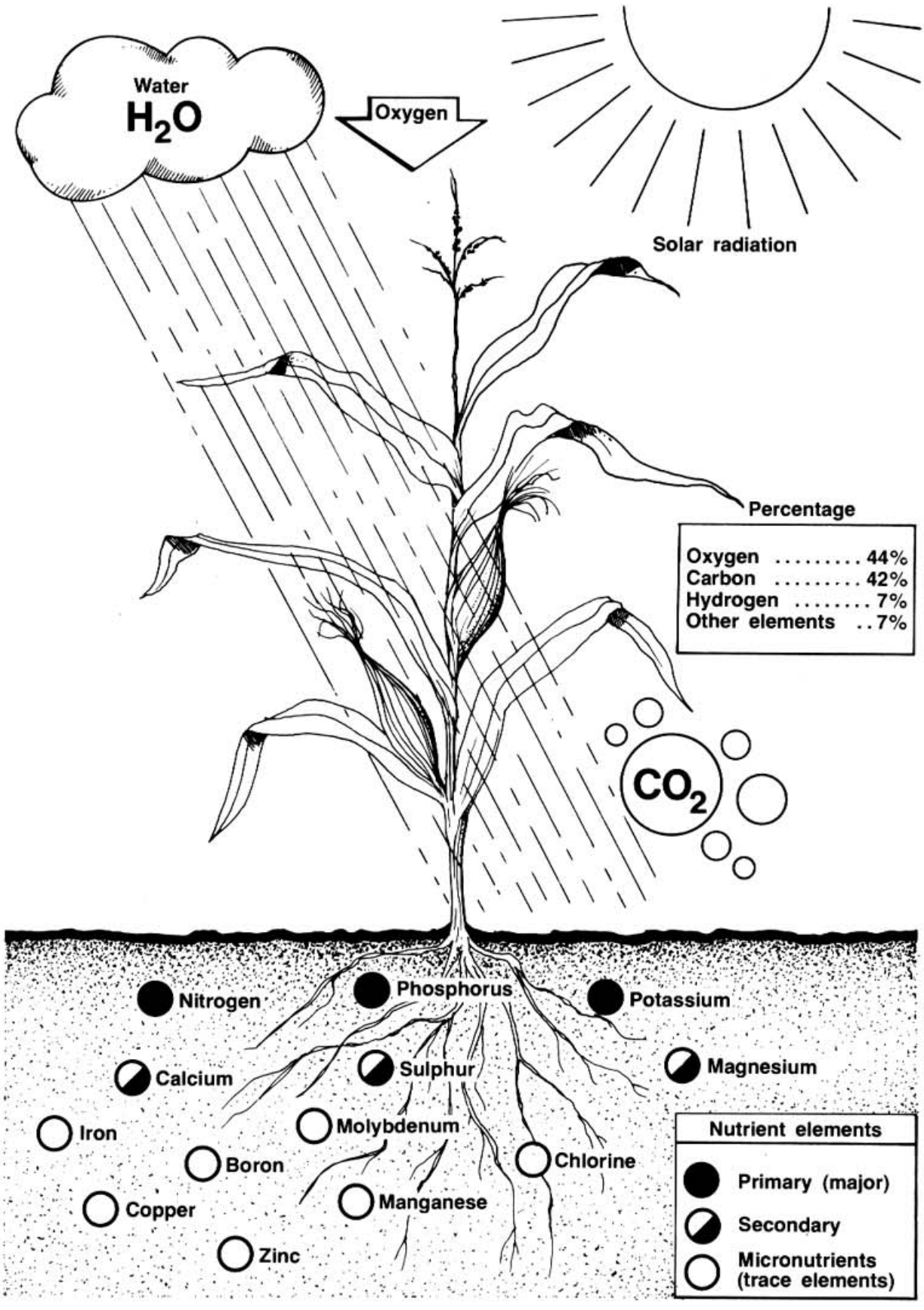
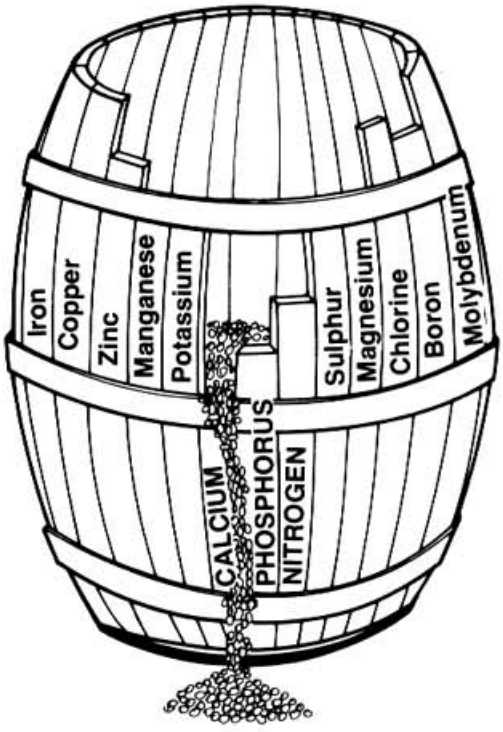


Figure 4
Yields according to the fertility of the soil



nutrient. This may be most easily understood by considering Figure 4.

In this Figure, each nutrient element is represented by one of the staves of a barrel. The shorter staves correspond to those nutrients that are not present in adequate quantity. The most marked deficiency is that of nitrogen (N), followed by phosphorus (P) and, third, potassium (K).

Without application of fertilizer containing these three nutrients, the crop yield would reach only the level allowed by the amount of nitrogen present in the soil, despite the presence of adequate quantities of the other nutrient elements.

In farm soils the most commonly insufficient nutrients are nitrogen (N), phosphorus (P) and potassium (K). To find out the recommended rates of application of each of these nutrients, one should consult an agricultural adviser and, with his assistance, take soil samples for analysis to provide a basis for his recommendations.

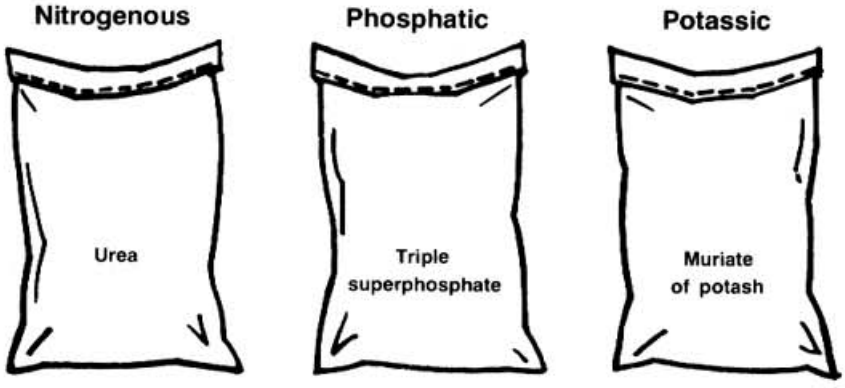
The three nutrients should be applied in a balanced ratio giving adequate proportions of nitrogen (N), phosphorus (P) and potassium (K) corresponding to the needs of each particular type of soil. Figure 5 illustrates the amounts needed on three types of soil.

The three columns of each group (i.e. each type of soil) represent the yield obtainable with appropriate fertilizer application. The white part of each column shows how much of the nutrient in question is lacking.

In the first group, it can be seen that only potassium is present in sufficient quantity and that there is some lack of phosphorus and of nitrogen. In the second group, all three nutrients are deficient and, in the third group, there is a deficiency only of nitrogen.

Figure 5
Soil type and nutrient supply

Figure 6
Straight fertilizers



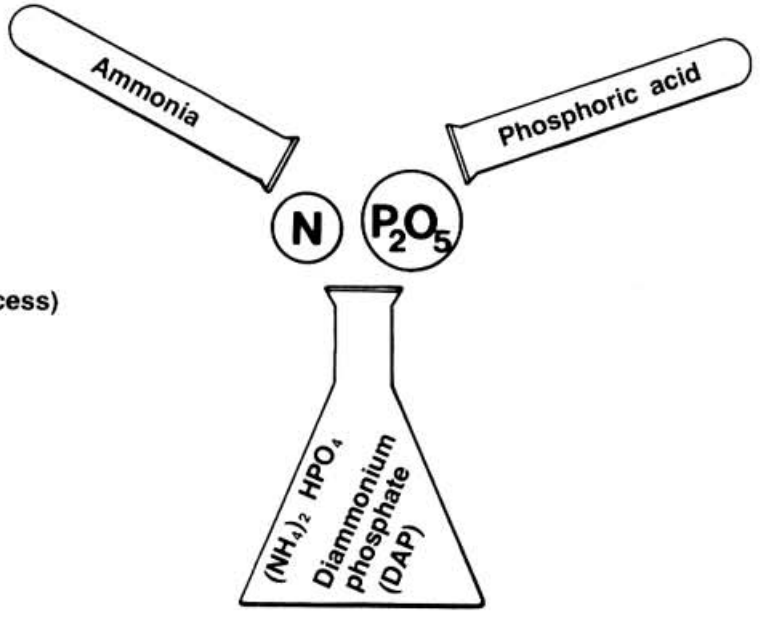
Given that nitrogen, phosphorus and potassium are the most commonly deficient nutrient elements in soils, these are the primary elements contained in commercial fertilizers. Fertilizers containing only one of these elements are called straight fertilizers and are as follows:

- nitrogenous fertilizers (N);
- phosphatic fertilizers (P);
- potassic fertilizers (K).

Fertilizers containing two or more primary nutrients are called compound fertilizers. They may be produced either by chemical combination during manufacture (complex fertilizers) or by physical mixing of straight or complex fertilizers.

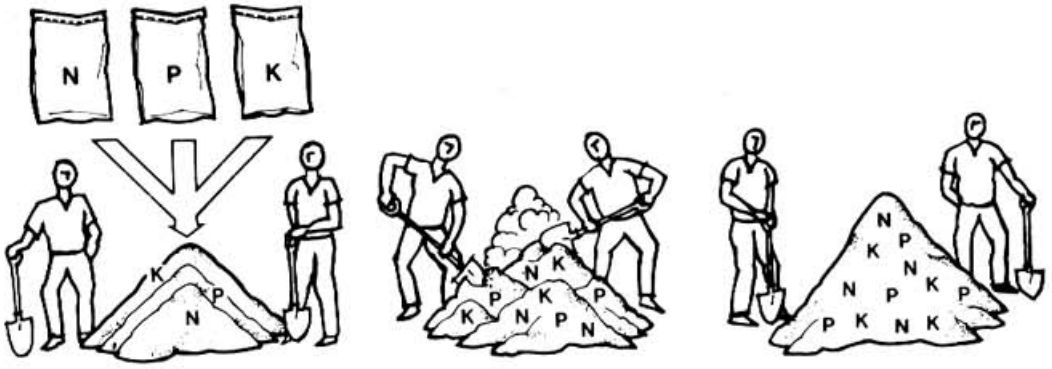
It was indicated above that the chemical symbol N corresponds to nitrogen, P to phosphorus and K to potassium. In practice P_2O_5 and K_2O are also used to designate the

Figure 7
Compound fertilizers



MIXED
Ammonium nitrate + triple super + muriate of potash = 9-18-9

Figure 8
Mixing by hand



latter two nutrients. To convert P_2O_5 to P, divide by 2 291, and K_2O to K, divide by 1 205.

It should be understood, moreover, that fertilizers do not only contain nutrient elements. They also contain inert materials which are indispensable for making the nutrient elements utilizable.

In most countries, fertilizers are marketed which contain, in every 100 kg of product, between 20 and 60 kg of nutrients, expressed normally as percentage (%) content or concentration. The remaining kilograms are the inert material. This means that a more concentrated fertilizer contains a greater quantity of nutrient per 100 kg of fertilizer.

Figure 9
Chemical symbols for nutrients

NITROGEN = N
(N)

PHOSPHATE = P_2O_5
(P)

POTASH = K_2O
(K)

Figure 10
Nutrient concentration and inert materials

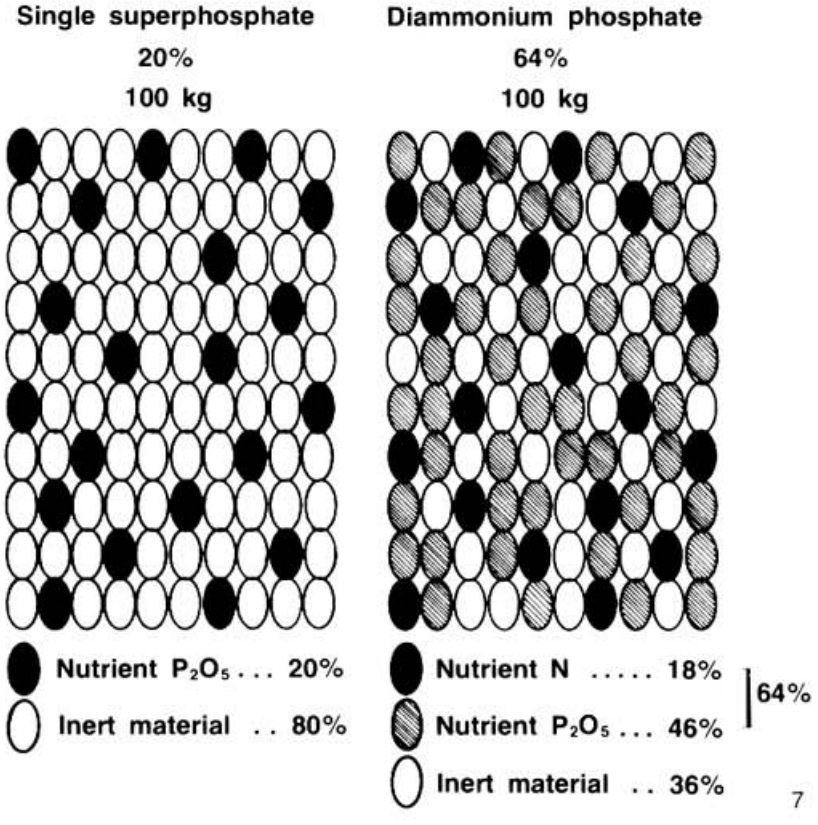


Table 2
Number of bags of different types of fertilizers to supply 100 kg of nutrients

Nutrient	Fertilizer	Approximate number of 50-kg bags
100 kg N	Urea 45%	4½
	Ammonium nitrate 33.5%	6
	Ammonium sulphate 21%	9½
100 kg P_2O_5	Single superphosphate 20%	10
	Triple superphosphate 46%	4½
100 kg K_2O	Muriate of potash 60%	3½
	Sulphate of potash 50%	4

Table 3
Most widely used fertilizers with their nutrient content

Fertilizer	Nutrient content (%)		
	N	P_2O_5	K_2O
Nitrogenous fertilizers			
Urea	45	—	—
Calcium ammonium nitrate (CAN)	26	—	—
Ammonium sulphate (AS)	21	—	—
Phosphatic fertilizers			
Single superphosphate (SSP)	—	20	—
Triple superphosphate (TSP)	—	46	—
Potassic fertilizers			
Muriate of potash (MOP)	—	—	60
Sulphate of potash (SOP)	—	—	50
Sulphate of potash magnesia (also contains 18% MgO)	—	—	22
Typical compound fertilizers			
17-17-17	17	17	17
12-24-12	12	24	12
20-20-0	20	20	0

Likewise, it should be understood that a highly concentrated fertilizer may cost more per ton than a lower grade fertilizer but may, in fact, be a better buy because less is needed and so there are fewer bags to fill, to transport, to handle and to store. Table 2 gives an example of the approximate numbers of 50 kg bags of different types of fertilizers needed to supply 100 kg of nutrients.

On each fertilizer bag information is given on the name of the product, its nutrient content, weight, and the name of the manufacturer, importer or distributor, as shown in Figure 11.

Figure 11
Information given on a fertilizer bag

1.4 The Most Commonly Used Fertilizers

Amongst the whole range of fertilizers currently available, the most widely used are those listed in Table 3. Each of these can be identified by characteristics of the product: e.g. powder, granular, or crystalline, as shown in Figure 12.

Figure 12
Characteristics of fertilizer products

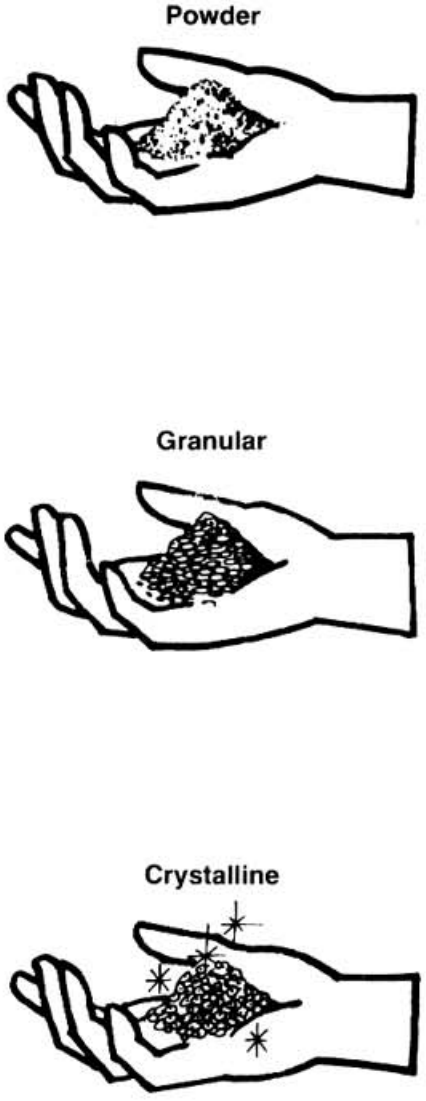
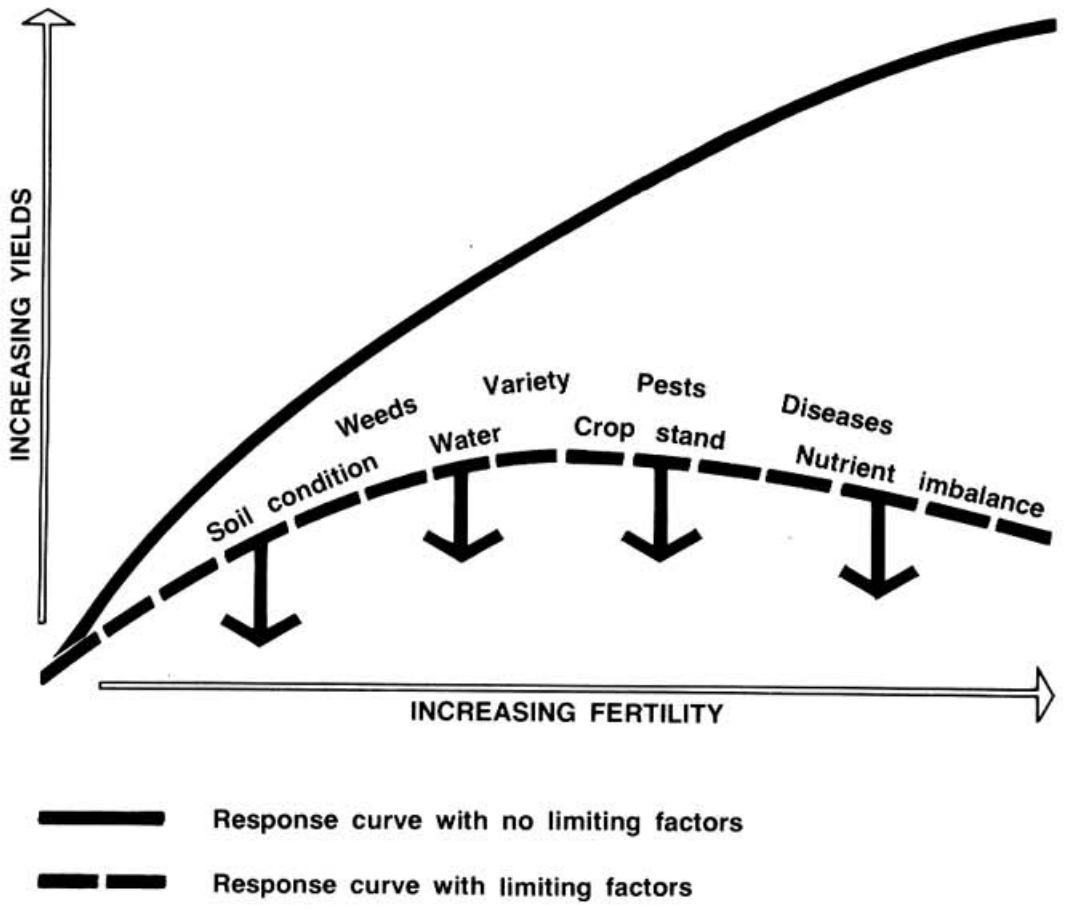


Figure 13
Response to fertilizer
with and without limiting factors



1.5 Fertilizer Recommendations

Fertilizer recommendations vary considerably with soil, crop, climate and the farmer's cultural practices. If all these factors are optimum, then maximum rates may be used; but, if they are average or below average, then the rates should generally be lower because deficiencies in other factors cannot be corrected just by using fertilizer.

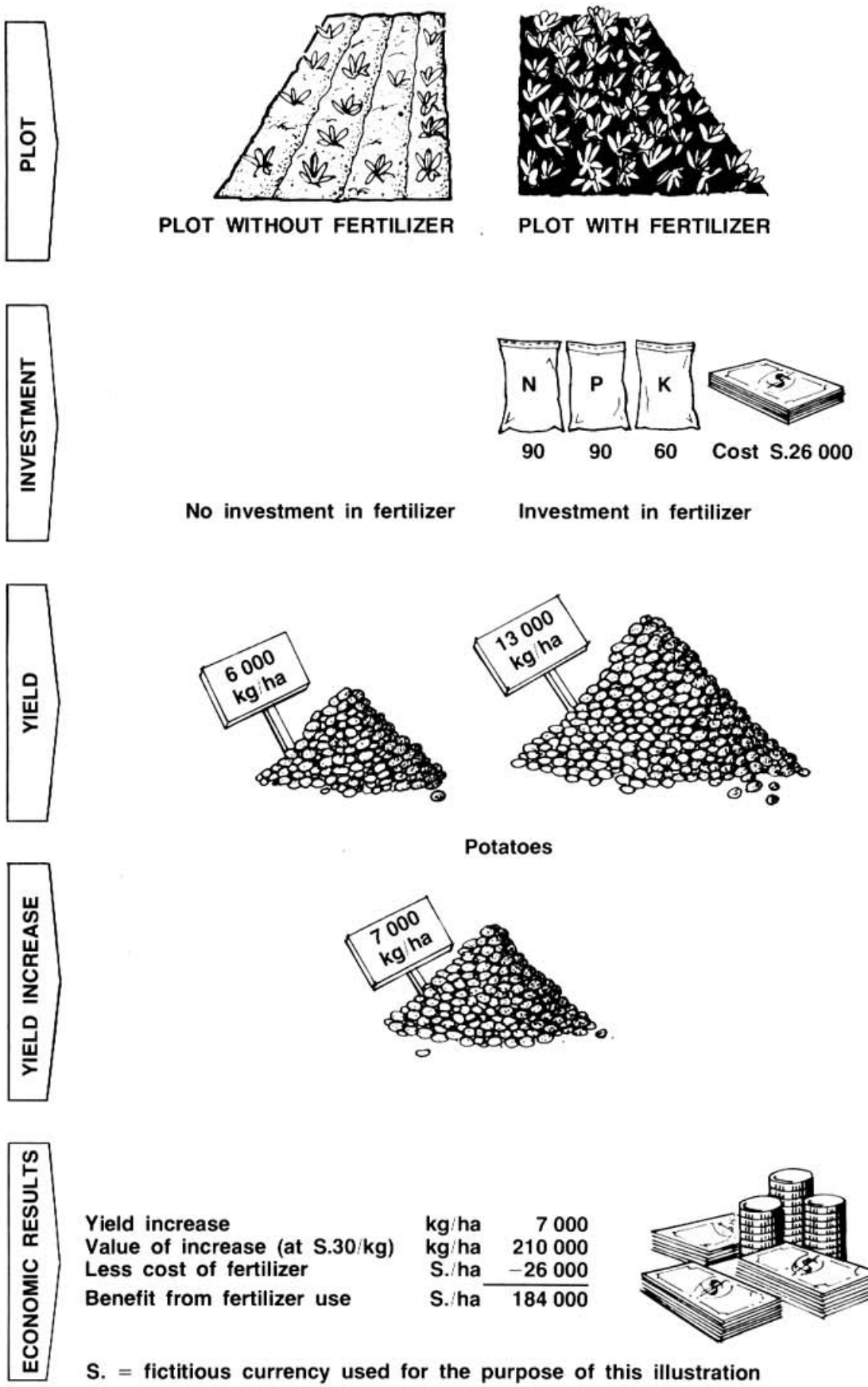
Figure 13 illustrates the response of a crop to fertilizer with and without limiting factors.

A fertilizer recommendation depends not only on the cost of the fertilizers to be used but also on the value of the expected increase in yield and on the financial resources of the farmer, whether he is paying the full cost or only part of it.

The most precise method of establishing the correct fertilizer recommendation for a specific crop in a given area is by conducting trials and demonstrations. These involve applying increasing quantities of nitrogen, phosphate and potash to small plots and measuring the yield from each plot. The yield from a particular plot receiving fertilizer minus the yield from a plot without fertilizer gives the response of the crop to that fertilizer application.

A typical example of a simple fertilizer demonstration and the economic result obtained is shown in Figure 14.

Figure 14
Economic results from plots with and without fertilizer



Yield increase	kg/ha	7 000
Value of increase (at S.30/kg)	kg/ha	210 000
Less cost of fertilizer	S./ha	−26 000
Benefit from fertilizer use	S./ha	184 000

S. = fictitious currency used for the purpose of this illustration

If the farmer has no results of trials available, he can seek technical advice from the nearest advisory office of the Ministry of Agriculture, who could take samples of his soil, send them to the laboratory for analysis and interpret the results of the analysis.

In using fertilizers it is important to bear in mind that each nutrient must be correctly applied at the right time. Generally, N is given in split dressings, P and K as a single application. The Ministry of Agriculture advisers can dispel doubts as to the most appropriate form and timing of fertilizer application for specific crops and local conditions.

As fertilizer recommendations are expressed in kg N, P_2O_5 and K_2O per hectare, the distributor needs to know how to convert the recommendations from kg of nutrient to kg of commercial fertilizer. These conversions can easily be done by simple calculations using the Rule of Three.

For example, a fertilizer recommendation of 100 kg N, 90 kg P_2O_5 and 60 kg K_2O, commonly expressed as 100-90-60, can be converted in the following manner:

Example of conversion from nutrients to fertilizer products and vice versa

If you want to apply: 100 kg N
90 kg P_2O_5
60 kg K_2O = 100-90-60

using ammonium nitrate (AN) 33.5% N
triple superphosphate (TSP) 46% P_2O_5
muriate of potash (MOP) 60% K_2O

determine the: **1st application 50-90-60**

As 100 kg of ammonium 50-90-60 contain
33.5 kg N, to obtain 50 kg N
do the following calculation:
100 kg AN contain 33.5 kg N
x kg AN contain 50 kg N

As it is necessary to act in a practical manner toward the farmer, the distributor should express his recommendation in terms of bags:

$\frac{100 \times 50}{33.5} = \frac{5\,000}{33.5}$ = 145.25 kg AN which are virtually 150 kg or 3 bags of 50 kg

Follow the same procedures for phosphate and potash:

100 kg TSP contain 46 kg P_2O_5
x kg TSP contain 90 kg P_2O_5

$\frac{100 \times 90}{46} = \frac{9\,000}{46}$ = 195.65 kg TSP which are virtually 200 kg or 4 bags of 50 kg

100 kg MOP contain 60 kg K_2O
x kg MOP contain 60 kg K_20

$\frac{100 \times 60}{60} = \frac{6\,000}{60}$ = 100 kg MOP or 2 bags of 50 kg

Thus the farmer should use for his 1st application a mixture of:

150 kg or 3 bags of ammonium nitrate
200 kg or 4 bags of triple superphosphate
100 kg or 2 bags of muriate of potash
Total: 450 kg or 9 bags of the mixture

For the 2nd application

Apply the remaining 50 kg N as ammonium nitrate, i.e., 150 kg or 3 bags of ammonium nitrate.

Result: To fertilize 1 hectare according to the recommendation 100-90-60, the farmer should buy:

6 bags AN
4 bags TSP
2 bags MOP
Total: 12 bags

If the preceding recommendation 100-90-60 has to be given in terms of:

ammonium nitrate 35.5%
diammonium phosphate 18-46-0
muriate of potash 60%

the calculation takes the following form:

1st application: 50-90-60

100 kg DAP contain 46 kg P_2O_5
x kg DAP contain 90 kg P_2O_5

$$\frac{100 \times 90}{46} = \frac{9\,000}{46} = 195.65$$ which are virtually 200 kg or 4 bags

but DAP contains also 18% N

100 kg DAP contain 18 kg N
200 kg DAP contain x

$$\frac{200 \times 18}{100} = \frac{3\,600}{100} = 36$$ kg N of the 50 kg N for the 1st application are applied in the diammonium phosphate.

Thus a further 50 − 36 = 14 kg N need to be applied as AN

$$\frac{14 \times 100}{33.5} = \frac{1\,400}{33.5} = 41.79$$ kg which may be rounded up to 50 kg or 1 bag.

For potash, the application is:

$$\frac{100 \times 60}{60} = 100 \text{ kg or } 2 \text{ bags of MOP.}$$

The 1st application needs a mixture of:

50 kg or 1 bag of ammonium nitrate
200 kg or 4 bags of diammonium phosphate
100 kg or 2 bags of muriate of potash
Total: 350 kg or 7 bags of the mixture.

For the 2nd application, there remain more or less 50 kg N as ammonium nitrate

$$\frac{100 \times 50}{33.5} = \frac{5\,000}{33.5} = 149.25 \text{ kg which are virtually 150 kg or 3 bags of AN.}$$

Result: To fertilize 1 hectare according to the recommendation 100-90-60, the farmer should buy:

4 bags AN
4 bags DAP
2 bags MOP
Total: 10 bags

To save the distributor wasting much time repeating these calculations many times per day, Conversion Tables have been drawn up which allow rapid calculation of the quantity of fertilizers needed to comply with a recommendation expressed in kg nutrients per hectare.

THE WAY TO USE THESE TABLES CAN BE SEEN IN TERMS OF THE RECOMMENDATIONS FOR 100-90-60, SHOWN IN TABLES 4, 5 AND 6, RESPECTIVELY.

Begin by referring to Table 4 from nitrogen (N) to nitrogenous fertilizers (kg/ha). This table shows that, to apply 100 kg N, one needs 222 kg urea or 299 kg ammonium nitrate or 476 kg ammonium sulphate or 556 kg diammonium phosphate, and so on.

For the 90 kg P_2O_5, refer to Table 5 from P_2O_5 to phosphatic fertilizers (kg/ha). This table shows that, for the desired quantity of P_2O_5, one needs 450 kg single superphosphate or 196 kg triple superphosphate or 196 kg diammonium phosphate, and so on.

For the 60 kg K_2O, refer to Table 6 from K_2O to potassic fertilizers (kg/ha). This table shows that, to apply 60 kg K_2O, one needs 100 kg muriate of potash or 120 kg sulphate of potash or 300 kg sulphate of potash magnesia, and so on.

Certain countries and manufacturers express P and K in their elemental form instead of the oxides P_2O_5 and K_2O. The conversion factor from P_2O_5 to P is $P_2O_5/2.291 = P$, and from K_2O to K it is $K_2O/1.205 = K$. The figures indicated in the columns of Tables 4, 5 and 6 would then need to be interpreted accordingly.

Table 4
Conversion table from nitrogen (N) to nitrogenous fertilizers
(Kilograms nitrogenous fertilizers per hectare)

Recommendation (kg N/ha)	Urea	AN	AS	DAP	15-15-15	12-24-12	20-20-0
10	22	30	48	56	67	83	50
20	44	60	95	111	133	167	100
30	67	90	143	167	200	250	150
40	89	119	190	222	267	333	200
50	111	149	238	278	333	417	250
60	133	179	286	333	400	500	300
70	156	209	333	389	467	583	350
80	178	239	381	444	533	667	400
90	200	269	429	500	600	750	450
100	222	299	476	556	667	833	500
110	244	328	524	611	733	917	550
120	267	358	571	667	800	1 000	600
130	289	388	619	722	867	1 083	650
140	311	418	667	778	933	1 167	700
150	333	448	714	833	1 000	1 250	750
160	356	478	762	889	1 067	1 333	800
170	378	507	810	944	1 133	1 417	850
180	400	537	857	1 000	1 200	1 500	900
190	422	567	905	1 056	1 267	1 583	950
200	444	597	952	1 111	1 333	1 667	1 000

Table 5
Conversion table from phosphate (P_2O_5) to phosphatic fertilizers
(Kilograms phosphatic fertilizers per hectare)

Recommendation (kg P_2O_5/ha)	SSP	TSP	DAP	15-15-15	12-24-12	20-20-0
10	50	22	22	67	42	50
20	100	43	43	133	83	100
30	150	65	65	200	125	150
40	200	87	87	267	167	200
50	250	109	109	333	208	250
60	300	130	130	400	250	300
70	350	152	152	467	292	350
80	400	174	174	533	334	400
90	450	196	196	600	376	450
100	500	217	217	667	418	500
110	550	239	239	733	460	550
120	600	261	261	800	502	600
130	650	283	283	867	544	650
140	700	304	304	933	586	700
150	750	326	326	1 000	628	750
160	800	348	348	1 067	670	800
170	850	370	370	1 133	712	850
180	900	391	391	1 200	754	900
190	950	413	413	1 267	796	950
200	1 000	435	435	1 333	838	1 000

Table 6
Conversion table from potash (K_2O) to potassic fertilizers
(Kilograms potassic fertilizers per hectare)

Recommendation (kg K_2O/ha)	MOP	SOP	Sulphate of potash magnesia	15-15-15	12-24-12
10	17	20	50	67	83
20	33	40	100	133	167
30	50	60	150	200	250
40	67	80	200	267	333
50	83	100	250	333	417
60	100	120	300	400	500
70	117	140	350	467	583
80	133	160	400	533	667
90	150	180	450	600	750
100	167	200	500	667	833
110	183	220	550	733	917
120	200	240	600	800	1 000
130	217	260	650	867	1 083
140	233	280	700	933	1 167
150	250	300	750	1 000	1 250
160	267	320	800	1 067	1 333
170	283	340	850	1 133	1 417
180	300	360	900	1 200	1 500
190	317	380	950	1 267	1 583
200	333	400	1 000	1 333	1 667

Exercises on fertilizers and their use

1 Name the fertilizers you sell and the nutrients contained in each.

2 In 100 kg of fertilizer, what quantities of nutrients do the following products contain?

Urea
Ammonium nitrate
Triple superphosphate
Single superphosphate
Diammonium phosphate
Muriate of potash

3 A farmer applied fertilizers costing S. 16 000 to one hectare of potatoes (S = Sol, a fictitious currency for which a real currency may be substituted). From this hectare receiving fertilizer he obtained a yield of 4 000 kg greater than that from a hectare not receiving fertilizer. How much will the farmer have gained by applying fertilizer to his potatoes if he sells them at S. 30/kg?

4 How are fertilizer recommendations expressed?

5 How much ammonium nitrate is needed to supply 100 kg N?

How much single superphosphate is needed to supply 80 kg P_2O_5?

How much muriate of potash is needed to supply 40 kg K_2O?

6 Using the conversion tables for the recommendation of 120-90-50, calculate how much fertilizer you should sell from your shop to a farmer who cultivates 2 hectares.

2 HOW TO MAKE SALES FORECASTS

2.1 Introduction

For a distributor to be able to estimate reasonably accurately the amount of fertilizers he can sell, he should know well the geographical limits of his point of sale, the agricultural producers' associations and the individual farmers it includes, and their possible needs having regard to the prevailing climatic and technical conditions. The answers to the questions: what? when? how much? where? and to whom? allow him to make this forecast and to make his own purchases opportunely.

It must be stressed that good forecasting will improve the service to the customer through adequate and timely stocking which in turn will lead to an increase in fertilizer consumption and so to a greater profit for the dealer.

There are different ways of making sales forecasts. Some are based on available statistics and others on the knowledge and experience of the dealer in his area.

2.2 The Most Important Methods of Sales Forecasting

2.2.1 Previous fertilizer consumption

Knowledge of fertilizer consumption in preceding years at local, regional and national levels is the starting point from which to make sales forecasts.

Analysis and interpretation of statistical consumption data at these three levels help in determining the pattern and trend of fertilizer demand.

Statistics of local consumption relate to fertilizer sales in preceding years from one specific point of sale. Table 7 gives an example of fertilizer sales in 1977 and 1978 from a village-level point of sale.

Regional consumption statistics relate to fertilizer sales in preceding years from all points of sale in the region. An example

Table 7
Local fertilizer consumption (sales) in terms of product and of nutrients (in metric tons)

Product	1977	1978	Difference + or −
Ammonium nitrate	589	592	+ 3
Single superphosphate	16	17	+ 1
Triple superphosphate	168	169	+ 1
Muriate of potash	36	37	+ 1
TOTAL	809	815	+ 6
N	197	198	+ 1
P_2O_5	80	81	+ 1
K_2O	21	22	+ 1
TOTAL	298	301	+ 3

showing figures from 1975 to 1978 is given in Table 8.

National fertilizer consumption statistics relate to sales from all points of sale in the whole country. Table 9 shows consumption during 11 years (1968-1978 inclusive) in the country which has been taken as an example.

Table 8
Regional fertilizer consumption over ten years in terms of nutrients
(in metric tons)

Nutrient	1975	1976	1977	1978
N	1 767	1 917	1 987	1 923
P_2O_5	476	729	1 129	1 170
K_2O	144	319	514	563
TOTAL	2 387	2 965	3 630	3 656

2.2.2 Potential fertilizer consumption

Another method which plays an important role in sales forecasting is to calculate the amount of fertilizers that could be used if every hectare and every crop cultivated at local, regional and national levels were to receive the current NPK recommendations.

In the country that was used for the example above, potential annual consumption of fertilizer nutrients has been calculated approximately by various institutions, with the result shown in Table 10.

By comparing Tables 9 and 10 it can be seen (Table 11) that there is a considerable difference between actual and potential consumption, a difference which can slowly be reduced by appropriate sales promotion.

Table 9
National fertilizer consumption 1968-78 in terms of nutrients
(in thousands of metric tons)

Nutrient	Three-year average				Year			
	1968-70	1970-72	1972-74	1974-76	1975	1976	1977	1978
N	62.9	76.5	75.3	84.8	83.8	100.3	109.4	104.4
P_2O_5	9.0	9.4	12.0	13.6	11.7	17.1	21.7	22.7
K_2O	5.4	5.6	6.8	9.5	9.5	11.5	12.7	13.4
TOTAL	77.3	91.5	94.1	107.9	105.0	128.9	143.8	140.5

Table 10
*Potential national fertilizer consumption in terms of nutrients**
(in metric tons)

N	P_2O_5	K_2O	Total
220 000	140 000	82 000	442 000

* Same country as Table 9

2.2.3 Extension of cultivated area

Various governmental programmes are designed to improve the land and to increase the cultivated area. These comprise:

i. irrigation projects;

ii. improvement of the irrigation system to allow, in some cases, two crop harvests per year;

iii. bringing new land into cultivation.

It is very important for the distributor to be aware of such developments for they have a direct influence on the dynamics of fertilizer sales. Further, the farmers who benefit from these developments are often trained in advance so as to ensure that the schemes are effective and they therefore constitute important new users of fertilizers.

In addition, the introduction of new technologies using improved seed and plant protection methods often permits the use of larger quantities of fertilizers, which means larger sales.

Figure 15 shows how actions designed to extend the cultivated area and the use of new technologies can influence fertilizer sales.

Table 11
Difference between potential and actual fertilizer consumption in 1978 in terms of nutrients (in metric tons)*

Consumption	N	P_2O_5	K_2O	Total NPK
Potential consumption	220 000	140 000	82 000	442 000
Actual consumption (1978)	104 400	22 700	13 400	140 500
Difference	115 600	117 300	68 600	301 500

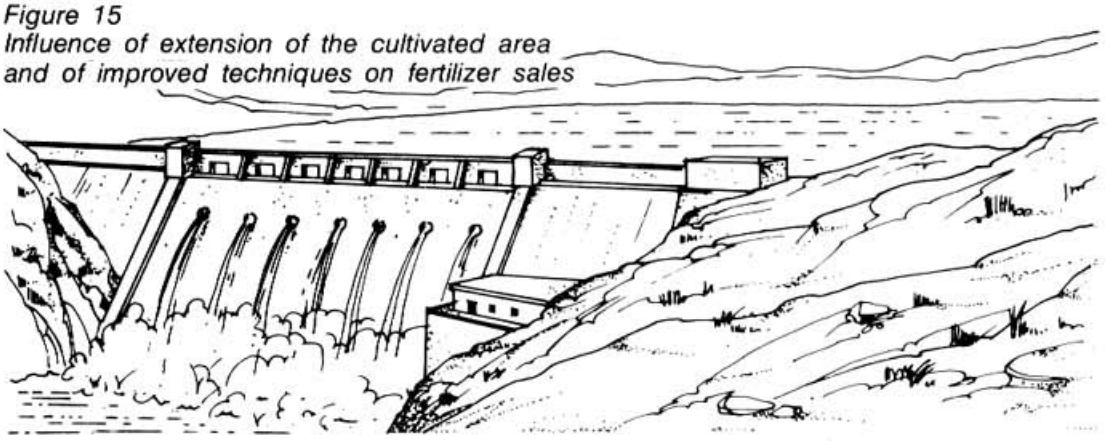
* Same country as Tables 9 and 10

Table 12
*Type and number of farms in the country**

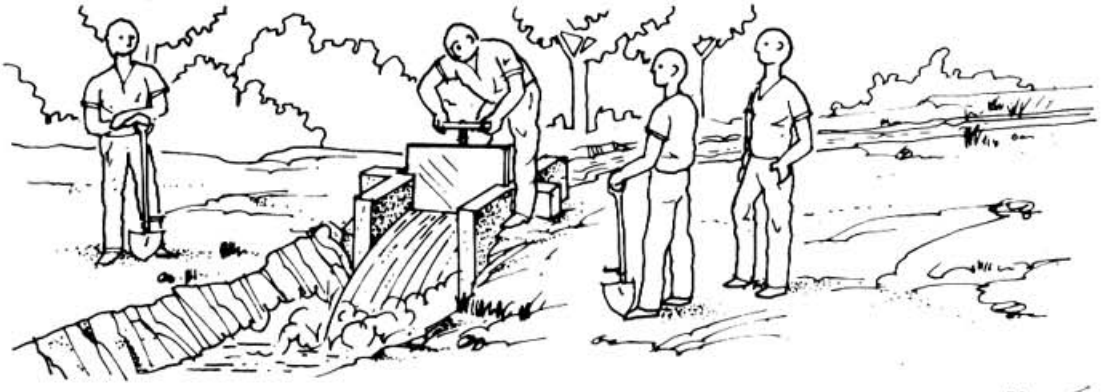
Type of farm	Number of farms (number)	(%)	Cultivated area (ha)	(%)
Production cooperatives	1 553	0.1	980 115	31.6
Individual farms (3 ha and over)	484 419	34.8	1 179 140	38.0
Individual farms (less than 3 ha)	904 905	65.1	943 745	30.4
TOTAL	1 390 877	100.0	3 103 000	100.0

* Same country as Tables 9, 10 and 11

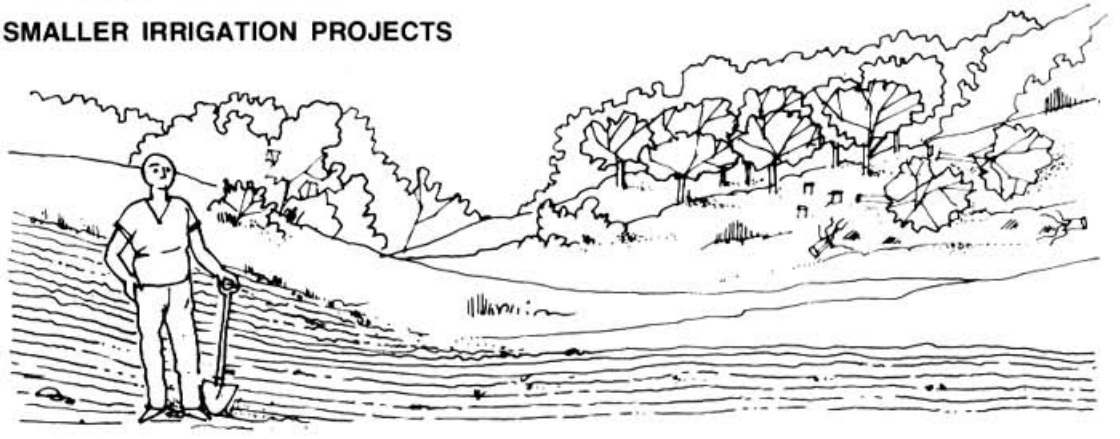
Figure 15
Influence of extension of the cultivated area and of improved techniques on fertilizer sales



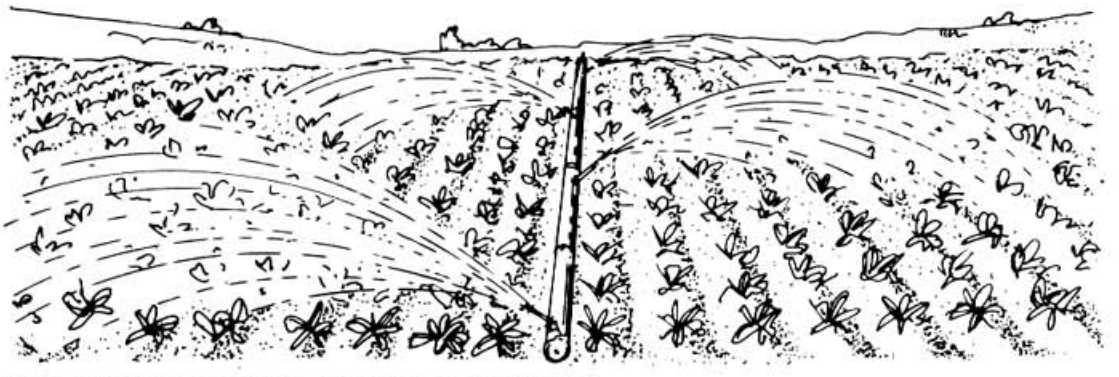
MAJOR IRRIGATION PROJECTS



SMALLER IRRIGATION PROJECTS



BRINGING NEW LAND INTO CULTIVATION IN HILL AND FOREST AREAS



IMPROVEMENT OF THE IRRIGATION SYSTEM

2.2.4 Farm size

Another aspect of great importance for sales forecasting is the size of individual farms, which varies considerably, as can be seen from Table 12 in the country which has been chosen as an example.

In general, the distributor cannot hope to sell much fertilizer to the very small farms or to individuals growing only food for their own consumption and obtaining the major part of their income from work done outside their holding. Moreover, even if there is no general indication that small farmers are using less fertilizer per hectare than larger farmers, the total amount of fertilizer sold will increase with the size of the farm.

This is important to the salesman for it takes much less time to sell a large quantity to a single customer than to sell the same amount to a large number of small farmers, as shown in Figure 16.

Even so, with good sales programming it can still be worth dealing with small customers, particularly if they can buy collectively, as is discussed in the next chapter.

2.2.5 Geographical location of farms

The geographical location of farms is another factor the distributor should take into account in sales forecasting.

Let us take as an example a fertilizer country comprising three regions: the coastal plain, the hills and the forest.

The coastal plain is the region which uses most fertilizers because of the high proportion of large commercial farming enterprises and the better infrastructure, transport facilities, etc.

In the hills, where there is the greatest concentration of small farms of less than 3 hectares growing food for their own consumption and greater difficulties with climate and infrastructure, the land receives much less fertilizer, even though the largest part of the cultivated area is located here.

In the forest region there are extensive areas not receiving any fertilizer, because of the low density of population and lack of infrastructure for communications and services.

These problems can be resolved, however, if the distributor becomes sufficiently knowledgeable to be able to concern himself with the fertilizer demand which is likely to increase substantially and rapidly in these regions.

The effects on fertilizer sales of geographical location and regional characteristics of the coastal plain, the hills and the forest are shown in Figure 17.

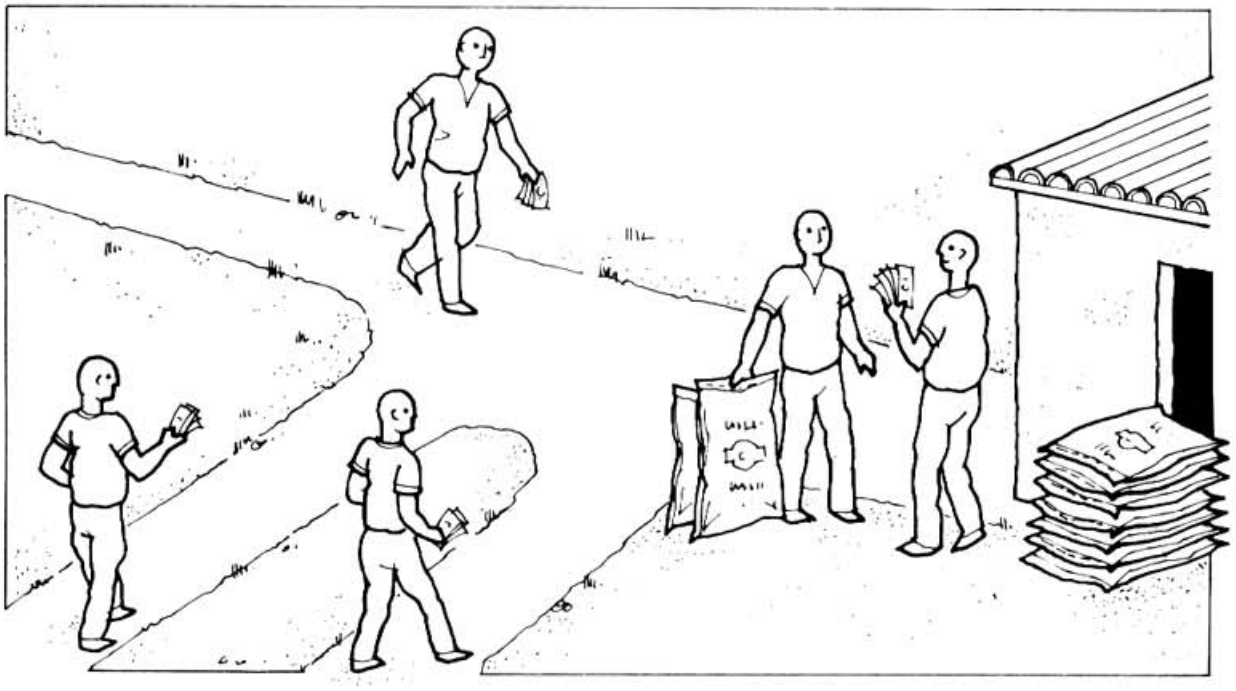
2.2.6 Results of trials and demonstrations

The results of trials and demonstrations constitute an effective means of sales forecasting. This has been proved by a large number of trials and demonstrations conducted in recent years.

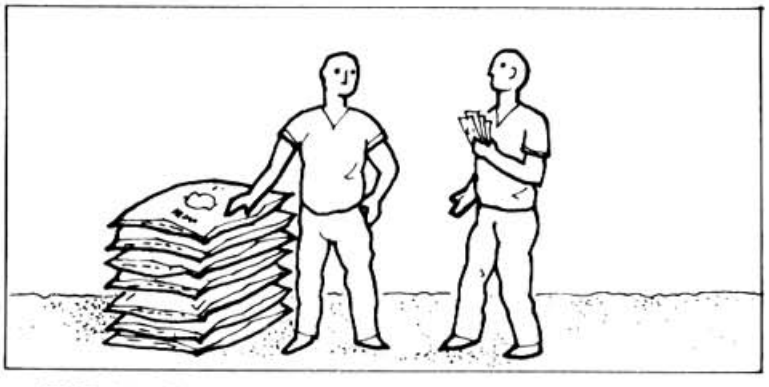
When these were first started, only a few farmers participated. But when the first results became known, a large number of farmers wanted to put them into practice. As a result there was a large increase in fertilizer sales, as shown in Figure 18.

So the distributor should be permanently in touch with the Extension Staff of the Ministry of Agriculture in order to know in good time about such trials and demonstrations so that he can judge their possible effect on his sales.

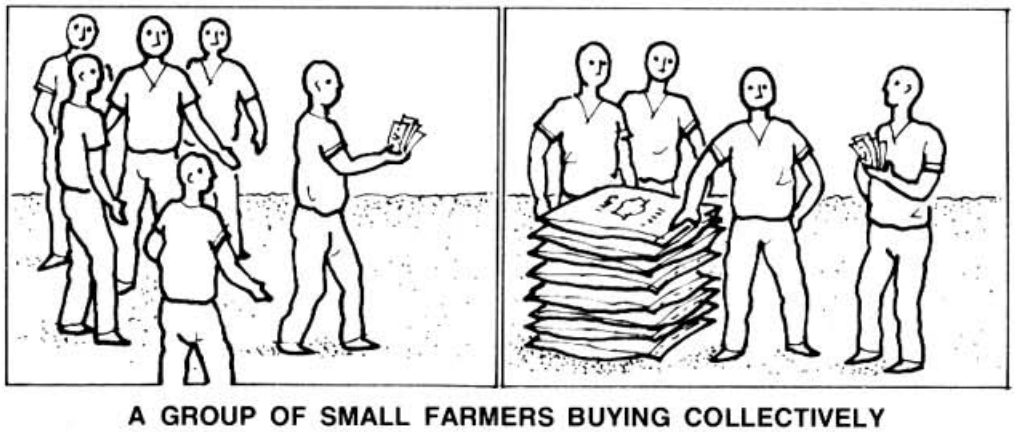
Figure 16
Individual and group sales



A LARGE NUMBER OF SMALL FARMERS BUYING INDIVIDUALLY

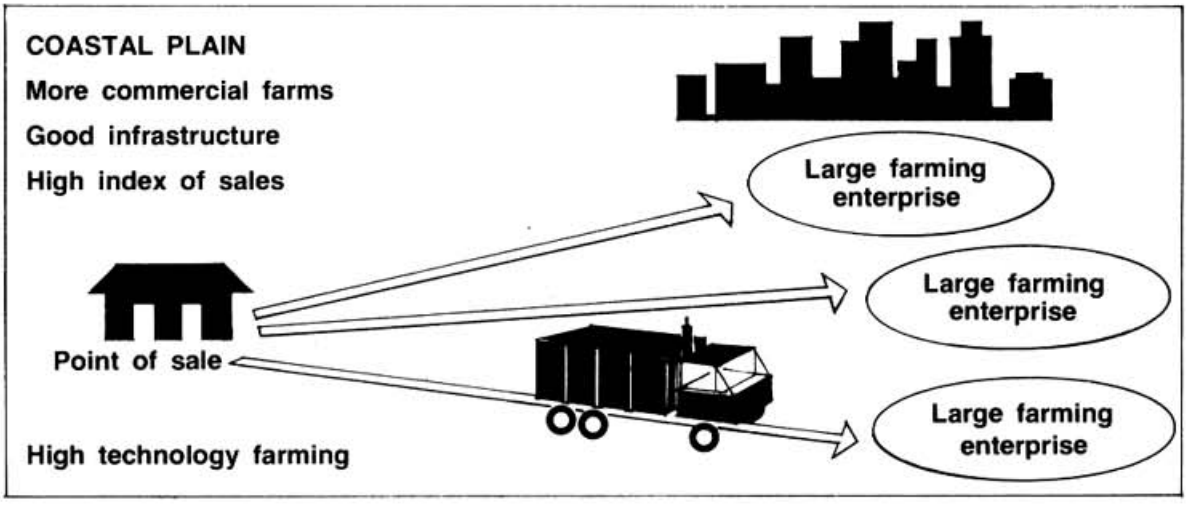


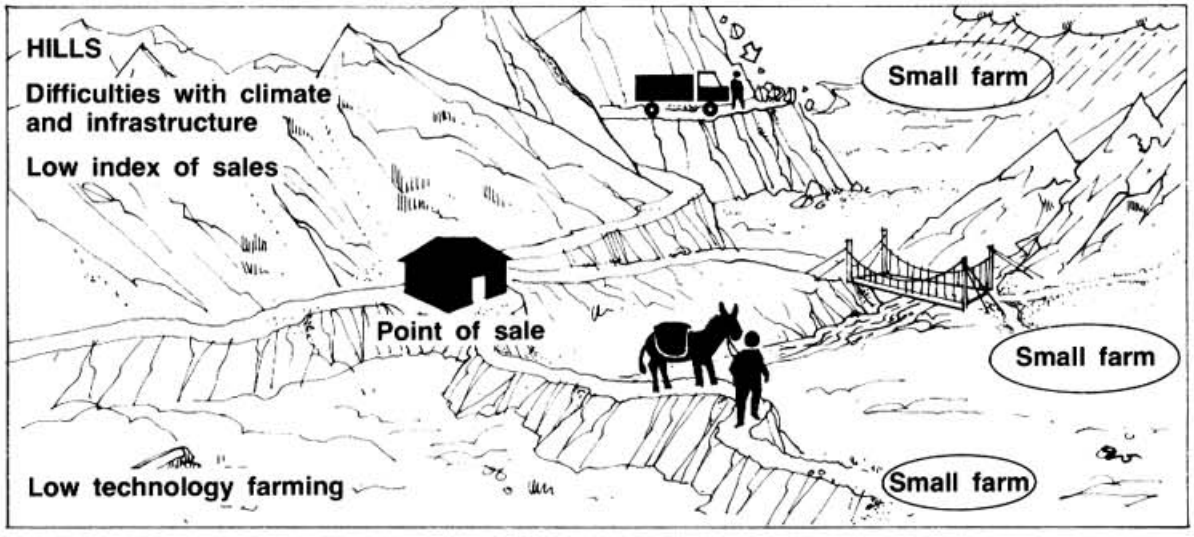
ONE LARGE FARMER BUYING A LARGE QUANTITY



A GROUP OF SMALL FARMERS BUYING COLLECTIVELY

Figure 17
Effects of geographical situation
and regional characteristics on fertilizer sales





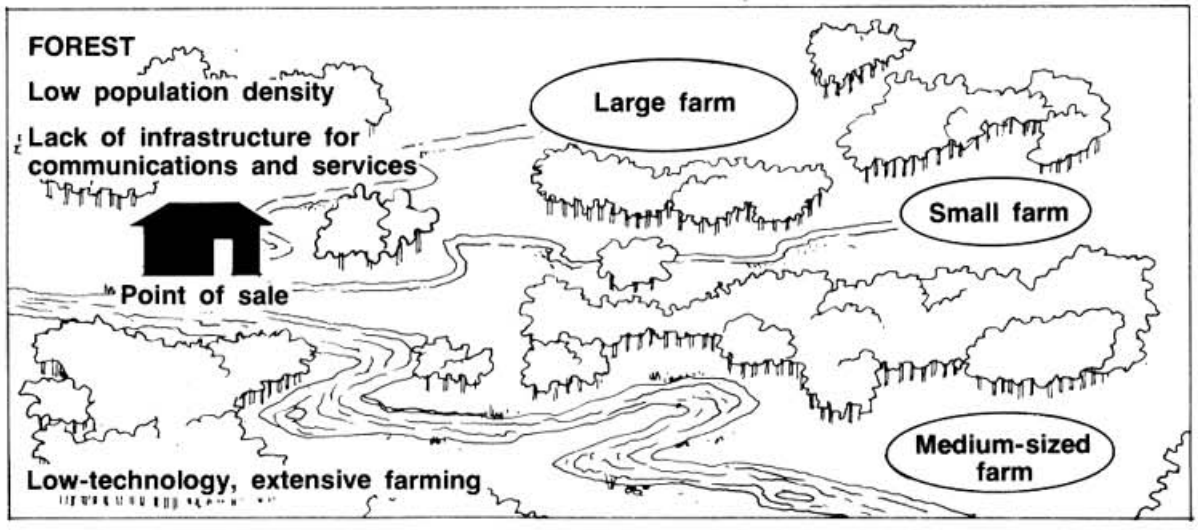
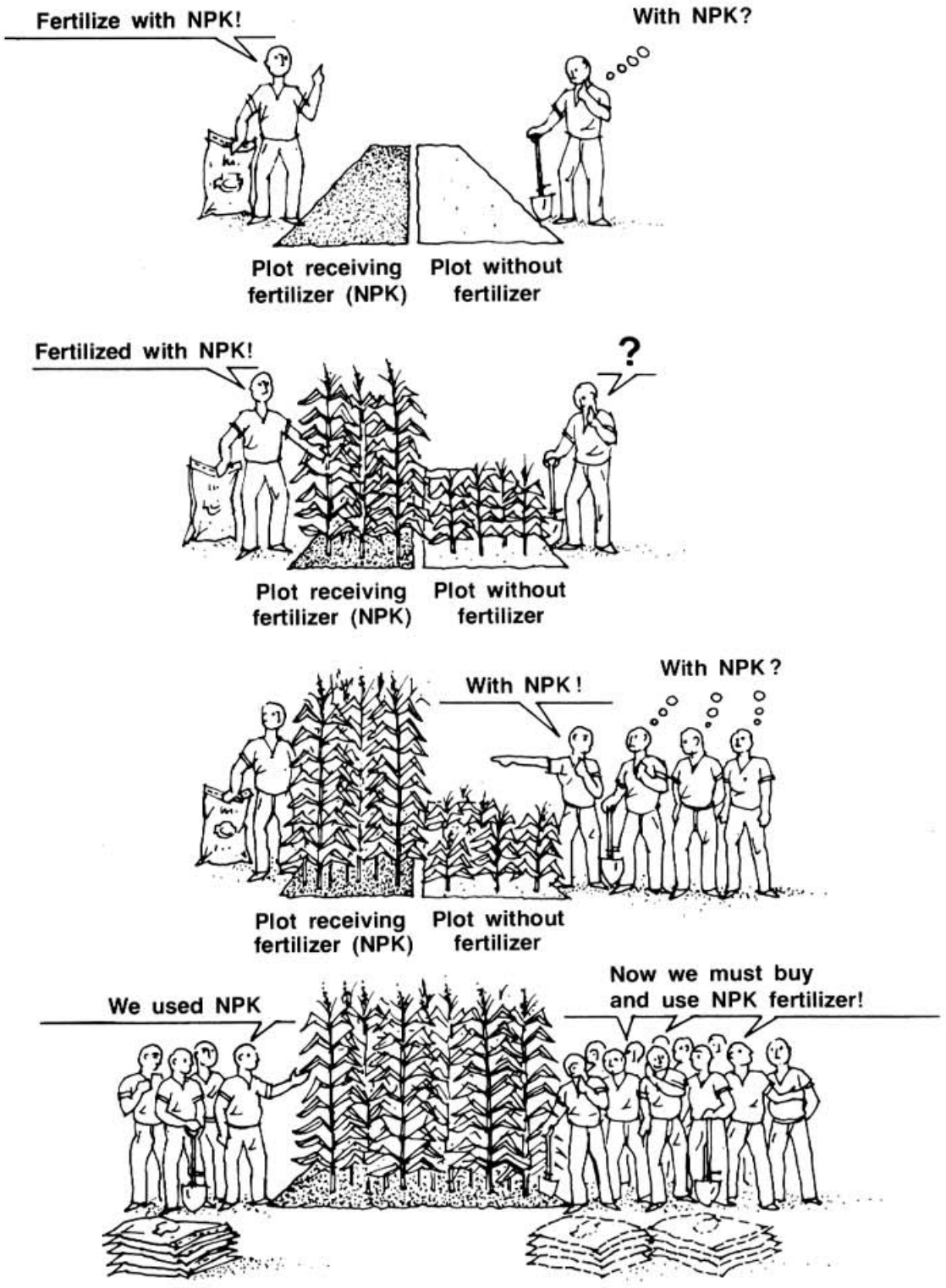


Figure 18
Increase in fertilizer sales following trials and demonstrations



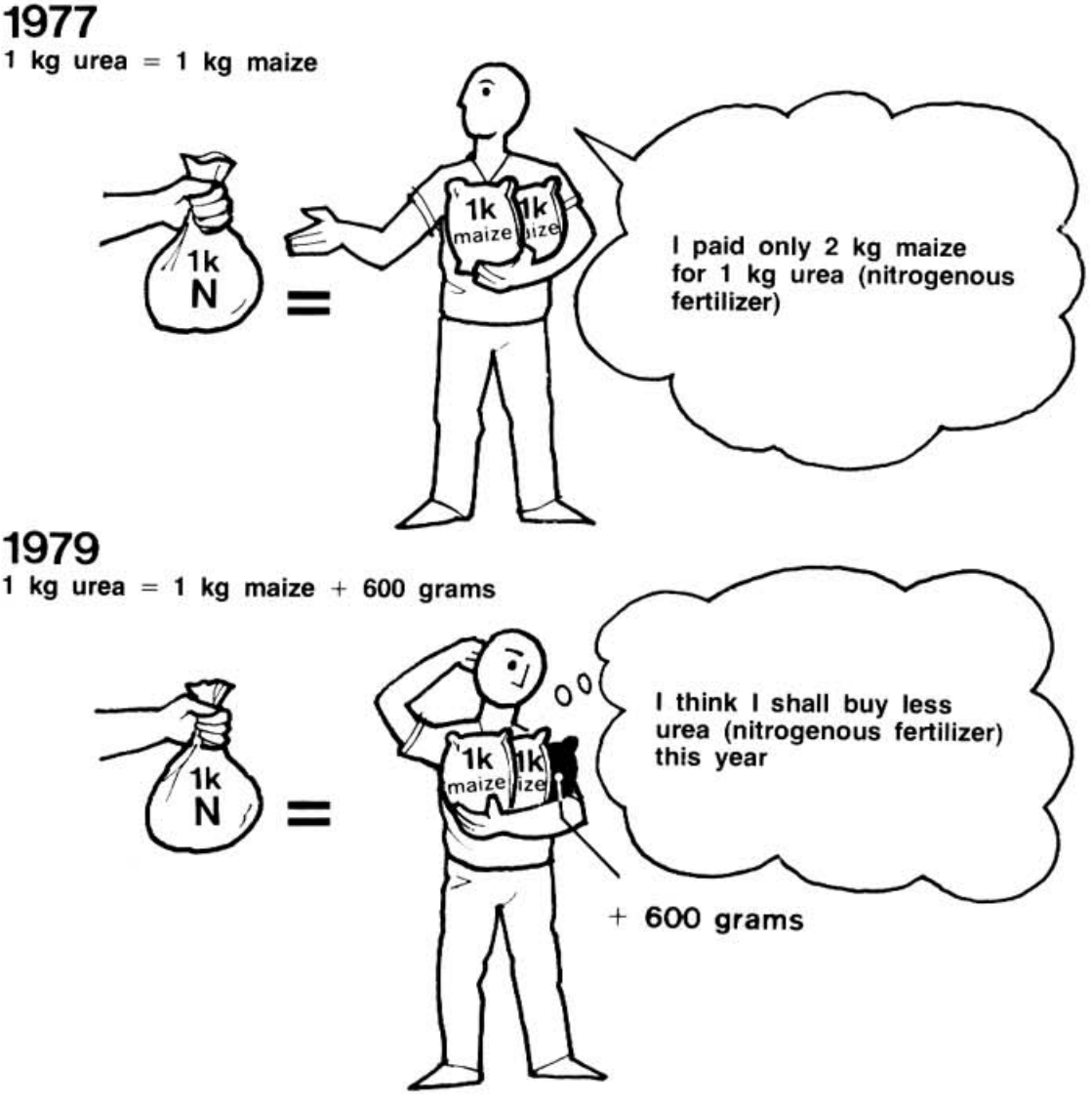
2.2.7 Ratio between fertilizer prices and agricultural product prices

Another factor of great importance in sales forecasting is the ratio between fertilizer prices and the prices of agricultural products. There is a tendency to use less fertilizer when the fertilizer price rises and agricultural product prices fall or remain unchanged.

Figure 19 shows the number of kilograms of maize the farmer has had to pay for 1 kilogram of urea (nitrogenous fertilizer) in recent years. At the beginning of 1977, 2 kg maize were sufficient to pay for 1 kg urea, but by the beginning of 1979 2.6 kg maize were needed to pay for the same amount of urea.

This same comparison can be made for all crops and for P_2O_5 and K_2O too. These comparisons provide a good indication of the economic motivation for fertilizer use. They result in a larger or smaller sale of fertilizers.

Figure 19
Number of kilograms of maize to pay for 1 kg of urea (nitrogenous fertilizer) in 1977 and 1979



2.2.8 Variations in fertilizer prices

Fertilizer sales are related to price stability. That is to say, there is a tendency to buy more before a price rise and to buy less each time prices go up. This upsets the sales programme and can cause a drop in sales at certain periods, unless the distributor has taken due precautions in advance.

The three curves in Figure 20 show the monthly variations in sales of fertilizers at the national level in 1976, 1977 and 1978 and their relationship to changes in price.

In 1976, the price did not change during the whole year.

In 1977, prices changed in February and July, reducing sales in those two months.

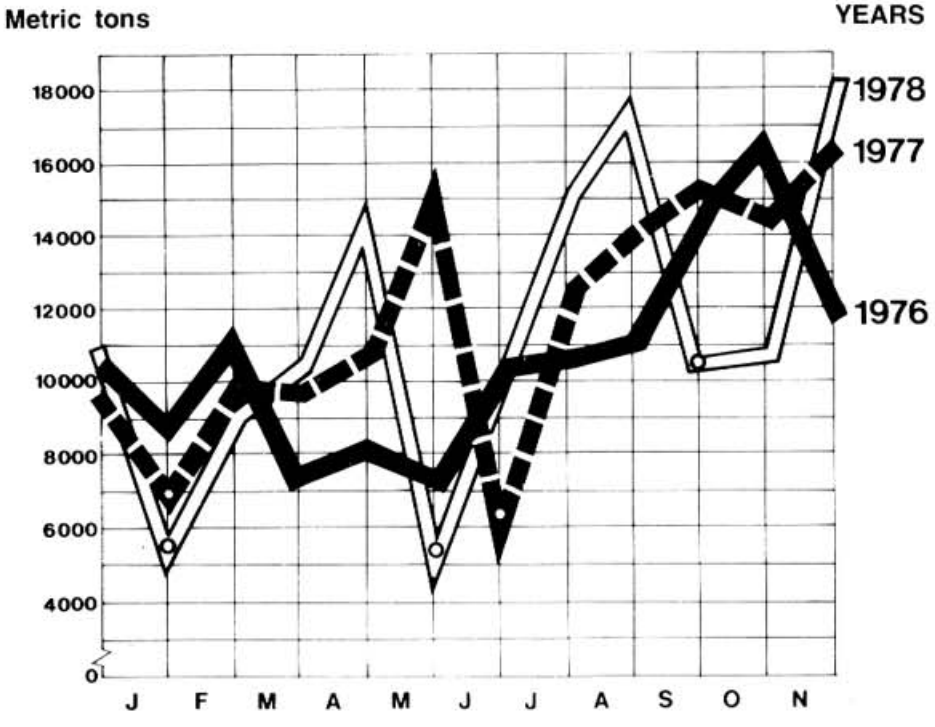
In 1978, prices changed in January, June and October, affecting sales in February, June and November. In the same year, sales of fertilizers for rice dropped on account of the drought which affected the coastal region in December 1977 and February 1978.

In summary, sales during a particular year can differ markedly from those in preceding years as a result of fertilizer price increases.

2.2.9 Climatic factors

Factors such as flood, drought, frost and hail have a negative influence on fertilizer consumption because of the interruptions to farm work and the greater risk associated with investment in fertilizers.

Figure 20
Influence of price stability on fertilizer sales



O Fertilizer price rises: February and July 1977
January, June and October 1978

2.3 How to make a Sales Forecast for the Area Covered by a Single Point of Sale

2.3.1 Sales forecasting in a monopoly situation

To predict sales in his own geographical area, the distributor should use the methods explained in the first part of this Chapter, as demonstrated in the following example.

The point of sale concerned has sold in the past year 800 metric tons of commercial fertilizers containing 200 tons N, 80 tons P_2O_5 and 20 tons K_2O.

The cultivated area consists mainly of rice, maize and wheat, together with fallow. This information can usually be obtained from the Ministry of Agriculture. The figures for this specific example are shown in Table 13.

Table 13
Cultivated area covered by the point of sale

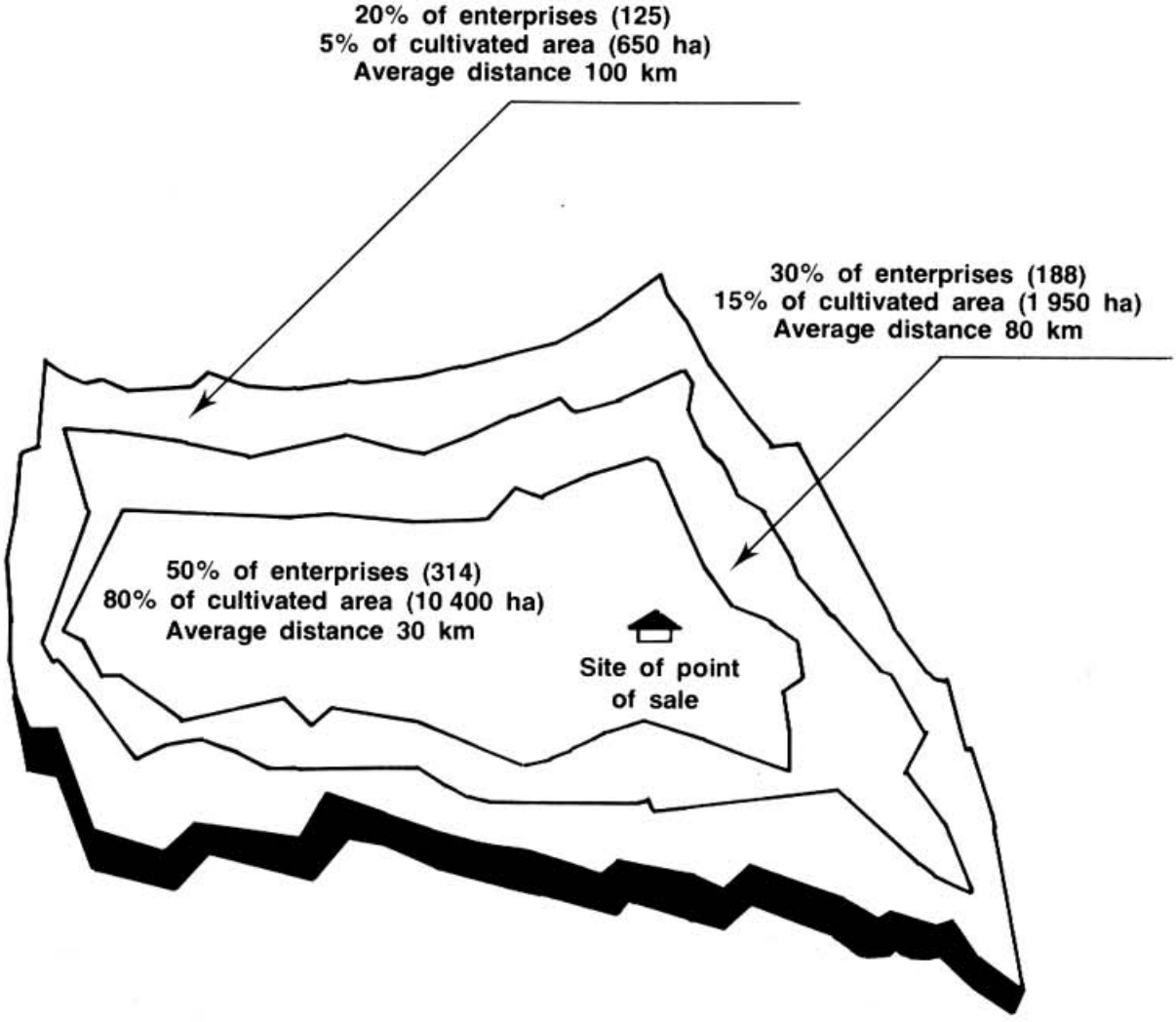
Crop	Area in hectares			
	Irrigated	Unirrigated	Total	Percent
Rice	2 000	5 000	5 000	27.8
Maize	3 000	1 000	4 000	22.2
Wheat	—	1 500	1 500	8.3
Others	500	2 000	2 500	13.9
Area under crops	5 500	7 500	13 000	72.2
Fallow	1 500	3 500	5 000	27.8
TOTAL	7 000	11 000	18 000	100.0

Table 14
Type and number of farms in the area covered by the point of sale

Type of farm	Number	Area under crops[1] (ha)	(%)
Village collective	1	1 500	11.5
Agricultural production cooperatives	11	5 400	41.5
Small farmers' groups	15	4 500	34.6
Individual small farms under 3 ha	600	1 600	12.4
TOTAL	627	13 000	100.0

[1] Excluding natural grassland and marginal land

Figure 21
Geographical distribution of farms in relation to point of sale



Rice is the most heavily fertilized crop. Some farmers apply fertilizer also to maize and some to wheat as well, while the other crops receive almost no fertilizer.

There are in the area 627 agricultural enterprises of varying size as shown in Table 14. One half of these occupying 80% of the cultivated area; they are situated at an average distance of 30 km from the point of sale and in every case there are roads which are passable throughout the year.

The 30% which occupy 15% of the cultivated area are situated at an average distance of 80 km from the point of sale. The remaining 20%, which occupy 5% of the cultivated area, are widely scattered beyond 100 km from the point of sale and are very difficult to reach whether for transport of agricultural inputs or the harvested crops.

The distribution of cultivated land and of the 627 agricultural enterprises is shown in Figure 21.

The timetable of sowing dates provides basic information from which to estimate when the largest sales of fertilizers can be expected. In the present example the yearly timetable is normally as shown in Table 15.

Table 15
Yearly timetable of sowing dates

Sept.- Dec.	Sowing of maize
Oct. - Dec.	Sowing of irrigated rice
Jan. - Feb.	Sowing of wheat
Jun. - Jul.	Sowing of unirrigated rice

For all these crops it is customary to apply all the phosphate and potash, and half the nitrogen, at the time of sowing, and the other half of the nitrogen about 2 months after sowing.

From the results of trials and demonstrations it is evident that the application rates for the 3 major nutrients lie in the ranges shown in Table 16.

Table 16
Application rates for the three major nutrients (in kg/ha)

Crop	N	P_2O_5	K_2O
Rice	90-140	100-130	60-80
Maize	70-100	80-100	40-50
Wheat	60- 80	60- 70	0-30

This means that, if one were to give every cultivated hectare the minimum fertilizer rate indicated, the potential annual consumption would be around 820 metric tons N, 910 tons P_2O_5 and 460 tons K_2O. Comparing these figures for potential consumption expressed in terms of N + P_2O_5 + K_2O with actual sales during the past year, one can see that there are substantial differences, as shown in Table 17.

But why is there this large difference between actual and potential consumption? Some farmers say they want to fertilize their land but do not know how to, others that they have no money and/or are unable to obtain credit, others that the distributor does not stock the fertilizers they want and have been accustomed to use and that they are unwilling to change, and others again say: "Why use fertilizer when the crop cannot be sold at a good price?"

Some of these typical reactions are right, at least partially, and in many cases the dealer can himself help to solve a part of the problems. This will result in higher sales than in previous years.

So far, we have not yet estimated the amount of fertilizers it will be possible to sell in the year to come. Before doing so, it is a good idea to set out all that is already known. This is shown in Figure 22.

With the aim of knowing the figures for possible sales in the coming year, it is estimated, in consultation with the Ministry of Agriculture Extension Staff, that sales in the past year amounted to 200 t N, 80 t P_2O_5 and 20 t K_2O distributed as shown in Table 18.

Also, in conjunction with the Ministry of Agriculture Extension Staff, the areas that received nitrogen were about 90 kg N/ha for rice, 70 kg N/ha for maize and 60 kg N/ha for wheat. These figures would correspond to about 35% of the rice area but only about 13% in the case of maize and about 4% for wheat.

Suppose that in the year ahead it might be possible to increase these proportions to 40% for rice, 15% for maize and 6% for wheat. Then, if the areas remain the same as in Table 13, nitrogen consumption would rise to a level calculated as shown in Table 19.

Table 17
Difference between actual and potential consumption of fertilizers in terms of nutrients (in metric tons)

Nutrient	Potential consumption	Actual consumption	Difference
N	820	200	620
P_2O_5	910	80	830
K_2O	460	20	440
TOTAL	2 190	300	1 890

Table 18
Example of estimated fertilizer sales per crop in past years (in metric tons)

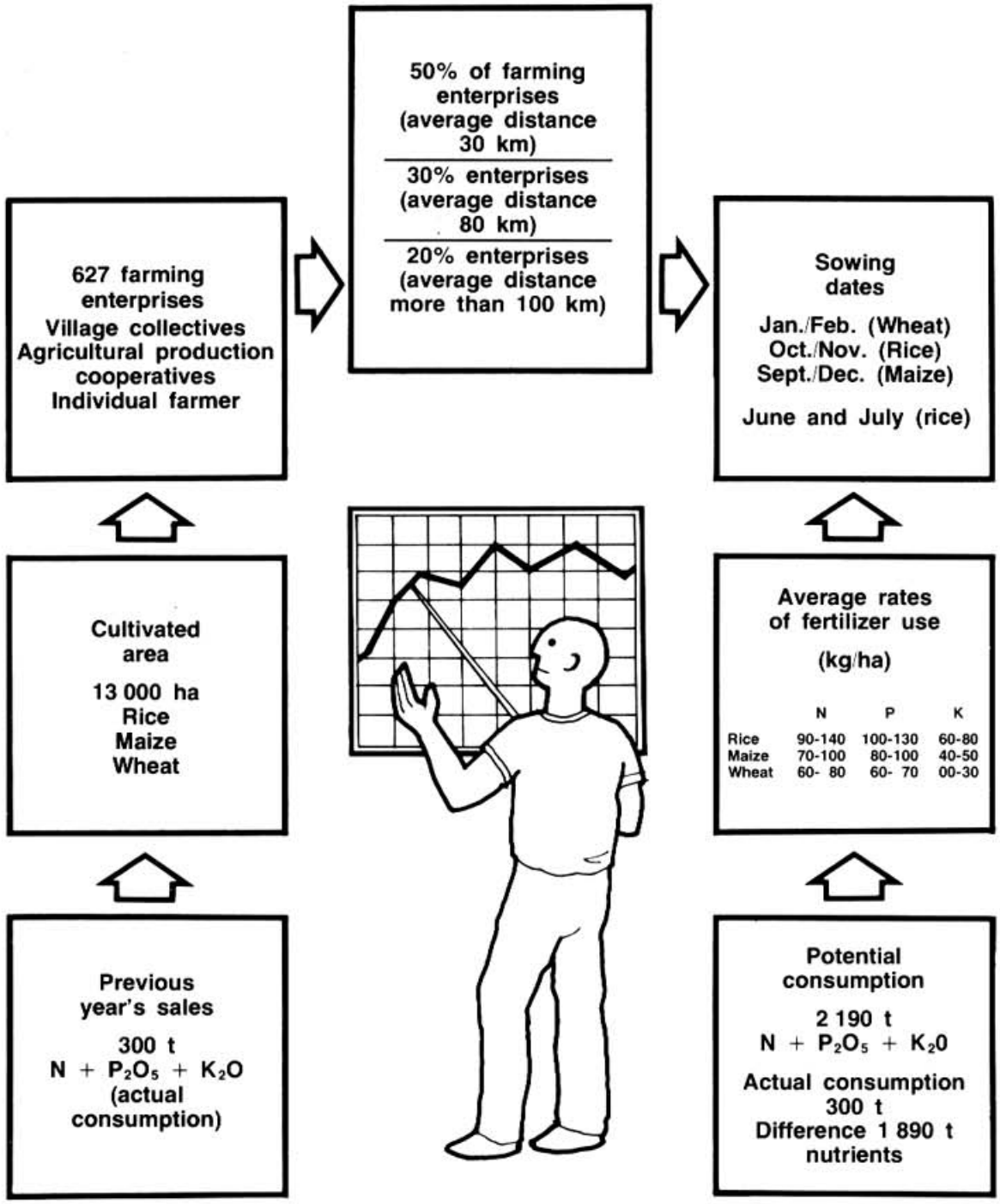
Crop	N	P_2O_5	K_2O	Total NPK
Rice: 80% of N and P, and 85% of K	160	64	17	241
Maize: 18% of N and P, and 14% of K	36	14	3	53
Wheat: 2% of N and P, and 17% of K	4	2	0	6
TOTAL	200	80	20	300

Table 19
Example of estimated nitrogen consumption per crop in future year (in metric tons)

Rice:	40% of 5 000 ha =	2 000 ha at 90 kg N/ha =	180 t N
Maize:	15% of 4 000 ha =	600 ha at 70 kg N/ha =	42 t N
Wheat:	6% of 1 500 ha =	90 ha at 60 kg N/ha =	5 t N
TOTAL			227 t N

This would mean an increase of 27 metric tons N or 13.5% above the previous year. Reference to the figures in Tables 8 and 9, for regional and national consumption, which show a much smaller rate of growth in past years (in the order of 2 to 3% per annum) might suggest that 13.5% is possibly too optimistic unless there are special factors operating in this particular area and/or year. This point should be considered in the light of all the data assembled in Figure 22 and should be discussed with the Ministry of Agriculture Extension Staff or other experts, who may have made their own independent forecasts for this or adjoining areas, or for the region as a whole.

Figure 22
Summary of data for sales forecast



Similar calculations should be done for P_2O_5 and K_2O. The results can be cross-checked by studying the trends in the ratios P_2O_5 : N and K_2O : N, which would not be expected to show any sudden discontinuity.

Let us now assume that the forecast, shown in Table 20, has been made and is considered acceptable and achievable.

These figures now have to be expressed in terms of the most

Table 20
Example of a forecast expressed in plant nutrients (in metric tons)

Crop	Total sales in past year			Increase			Estimated total sales in year ahead			
	N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O	Total
Rice	160	64	17	20	11	4	180	75	21	276
Maize	36	14	3	6	1	2	42	15	5	62
Wheat	4	2	0	1	1	0	5	3	0	8
TOTAL	200	80	20	27	13	6	227	93	26	—

commonly used fertilizers in the area, which are ammonium nitrate (33.5% N), triple superphosphate (46.5% P_2O_5) and muriate of potash (60% K_2O), and to be apportioned between the basal dressings, at sowing time, and the topdressings, as shown in Table 21.

Table 21
Example of a forecast expressed in fertilizer materials per crop and period of application (in metric tons)

Crop	Basal dressing			Top-dressing
	AN	TSP	MOP	AN
Rice	268	161	35	268
Maize	63	32	8	63
Wheat	8	7	0	8
TOTAL	339	200	43	339

Finally, these quantities, expressed in terms of commercial fertilizers, need to be apportioned between the months of the year according to the timetable of sowing dates, bearing in mind that they ought to be sold two weeks before application. Figure 23 shows the sales programme for the year ahead.

Although, in this example, it has been assumed that only the percentage area of each crop that receives fertilizers increases, and that the average rate of application to the area that receives fertilizer remains constant, in practice they will both increase. Indeed, it may well be advisable to consider fertilizer use separately on the different types of farming enterprises, particularly if average ratios of application differ widely between the different groups. The general principles, however, remain the same.

2.3.2 Sales forecasting in a competitive situation

Analysis of the total market can proceed along similar lines in a competitive situation, except that the dealer's sales area may not be so clearly defined and he may have more difficulty in drawing up statistics of past fertilizer consumption in his area. However, if he is reasonably confident in his estimated figures, he can calculate his percentage share of the market for N, P_2O_5 and K_2O separately, and for total N + P_2O_5 + K_2O for the future, depending on his own marketing strategy and the likely attitude of his competitors, he can make an estimate of the total market in the year ahead, as

shown in Section 2.3.1, and then either:

i. assume that his market share will remain the same as in the past year; or

ii. assume that the trend in his market share will continue (whether upwards or downwards); or

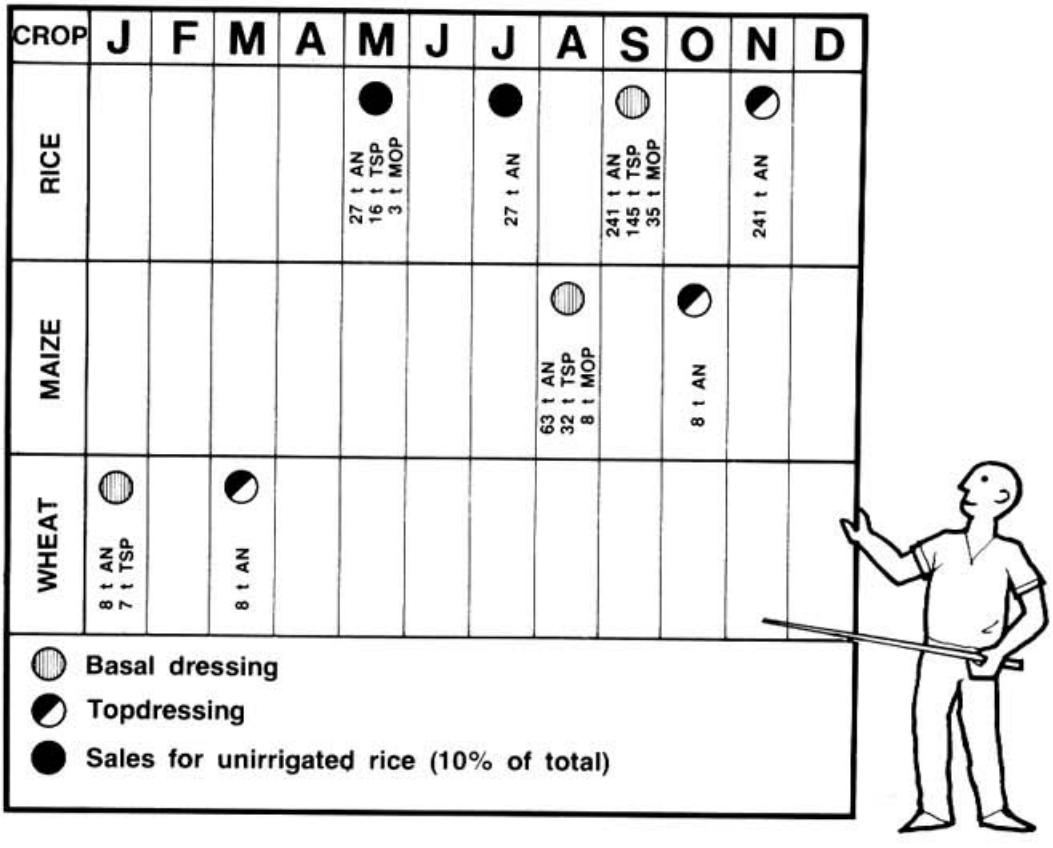
iii. assume that he will succeed in doing rather better than the trend.

This is clearly a matter of skill, experience and judgement.

Another method of sales forecasting, which should preferably be used in conjunction with the above, is simply to look at his own past sales over a period of years, of which he ought to have an accurate record.

First, he should consider the annual total sales for each nutrient and for each product separately and, either by drawing graphs or by using such mathematical methods as may be available to him, obtain trend curves for each in turn. These, if projected forward, will give in each case an estimate of what may be expected to happen in the year ahead provided everything continues as before and no new factors come in to influence either the total size of the market or his share of that market. The extent to which such a projection should be modified to take account of such factors is again a matter of skill and judgement. There are, for example, mathematical methods of curve-fitting which give greater weight to figures from more recent years than to those from the more distant past. Such methods, however, are beyond the scope of this Manual.

Figure 23
Fertilizer sales programme



Second, having established the annual trend for each nutrient and for each product, the dealer should go on to study the variations in monthly sales within the year. Here again there are mathematical methods available to help him, but the simplest approach is to express each month's sales as a percentage of the annual total. He may find that proportionate sales in the different months are consistent from year to year and conform to an expected pattern of use on the major crops in his area, of which an example is illustrated in Figure 23, or he may come to the conclusion that he is doing either better or worse than his competitors at particular times of the year or with particular products. His forecast for the months ahead will depend on the extent to which he expects to improve his position relative to his competitors.

The dealer should always be aware of new competitors entering the field (or old ones dropping out). This is true of both dealers and products. He should know whether his share of the market is increasing or decreasing, and he should know roughly how his share of the market is made up - i.e. whether it is the same for all classes of customers and types of products, or whether he has a larger or smaller share of the more profitable (or, in the future, likely to be more profitable) parts of the business.

Because of the many factors that may affect the market, whether it is a monopoly or a competitive situation, it is strongly recommended that every dealer should draw up a detailed monthly sales programme for the year ahead and monitor his progress month by month against that programme. Whenever he notices marked variations from the programme, he should try to analyse the reasons for the variation and he should either consider amending the forecasts for the remainder of the year or, where appropriate, take action to improve his sales.

It is also important that the dealer takes account of the position of his supplier, i.e.

- What to do about ordering fertilizers?
- When to buy?
- Where to buy?

Once the sales forecast has been completed with reasonable accuracy and forethought, the procedure for buying may be summarized in the following questions.

- How much time will the buying transaction take?
- How long will it take to organize transport?
- Over what distance must the fertilizers be transported?
- Are the roads passable throughout the year?
- Are the necessary fertilizers available?

These five questions and the three above are developed in the ensuing Chapters but it is already very important to take them into account because, if the distributor orders his fertilizers too late, he may lose much of his predicted sales. If, on the other hand, he buys his fertilizers too early and does not sell, he will have to store them longer, which means additional expense both for the storage and for the tying-up of his capital in fertilizers.

In summary, all aspects such as the sales forecasting discussed in this Chapter have a strong influence on the profitability of the business.

Exercises on how to make sales forecasts

1 Calculate your sales in the previous year(s) in terms of product and of nutrients.

2 What are the most important crops in your sales area and what is the area of each?

3 What action is being or could be taken to increase the cultivated zones in your sales area?

4 What types of agricultural enterprises are there in your area? List the approximate number of each type.

5 Try to sketch the geographical location of these enterprises in relation to your point of sale.

6 What are the latest fertilizer recommendations in $N - P_2O_5 - K_2O$ per hectare for the different crops in your area?

7 What is the timetable of sowing dates in your area?

8 Calculate potential fertilizer consumption in your area.

9 Calculate the difference between potential consumption and actual consumption in the past year.

10 Calculate the possible amounts of fertilizers that you can sell in the coming year.

3 MEANS OF PROMOTING FERTILIZER SALES AND IMPROVING SERVICE

3.1 Introduction

In the preceding Chapter an example was given of the possibility of increasing annual sales of fertilizers from a typical point of sale in the hill region by 218 metric tons $N + P_2O_5 + K_2O$. In the same way, every distributor has the possibility of increasing his sales to a greater or lesser extent, according to the conditions.

In general, most distributors can sell more than in the preceding year, especially when they succeed in establishing better relations with their customers.

That is why this Chapter deals, on the one hand, with the sales promotion that the distributor should effect in order to increase his sales by means of a series of actions and decisions and, on the other hand, with the service that he ought to provide to the farmers in his sales area.

3.2 Distribution Levels

Trade in fertilizers is an activity covering various distribution levels from the moment the product leaves the factory gate (for national production) or port (for imports) until it reaches the end user. A typical distribution system comprises the levels indicated in Figure 24.

As a result there is an interdependence between the various levels so that the supply and distribution of fertilizers from a particular level are dependent on those from other levels. In consequence, the retail distributor is not an independent agent within the system but is affected in his activities both by his suppliers and by his customers. In the same way, the wholesale distributors, as well as the retailers, are affected by the performance of local production and imports.

The geographical locations of fertilizer factories, major ports, and wholesale and retail distributors in a typical country are shown in Figure 25.

Figure 24
Distribution levels
and numbers of distributors at each level

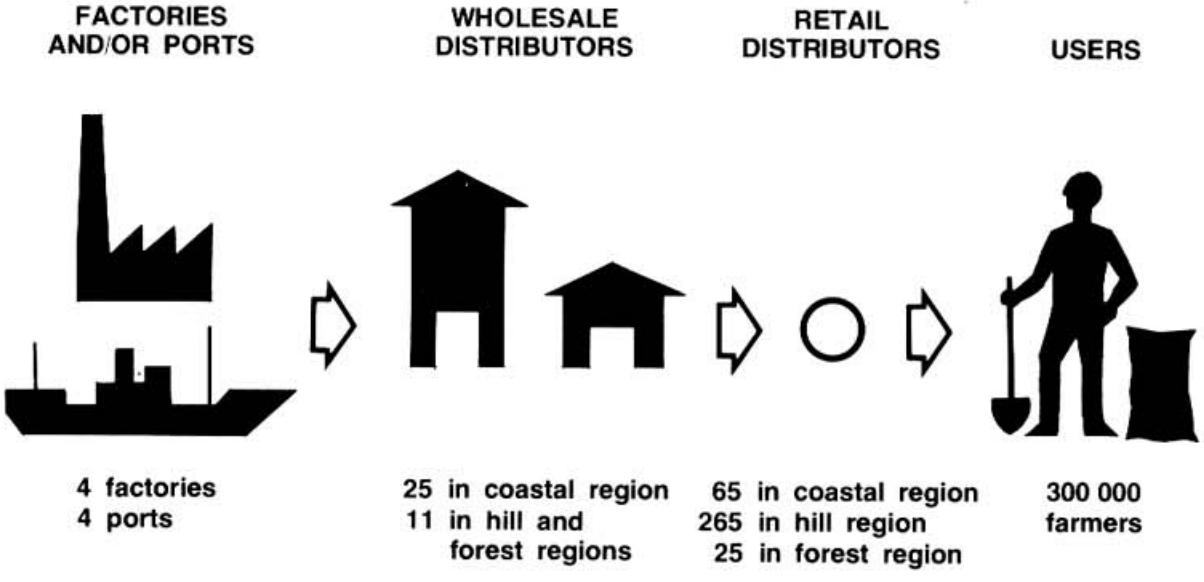


Figure 25
Geographical locations of fertilizer factories, ports and wholesale and retail distributors

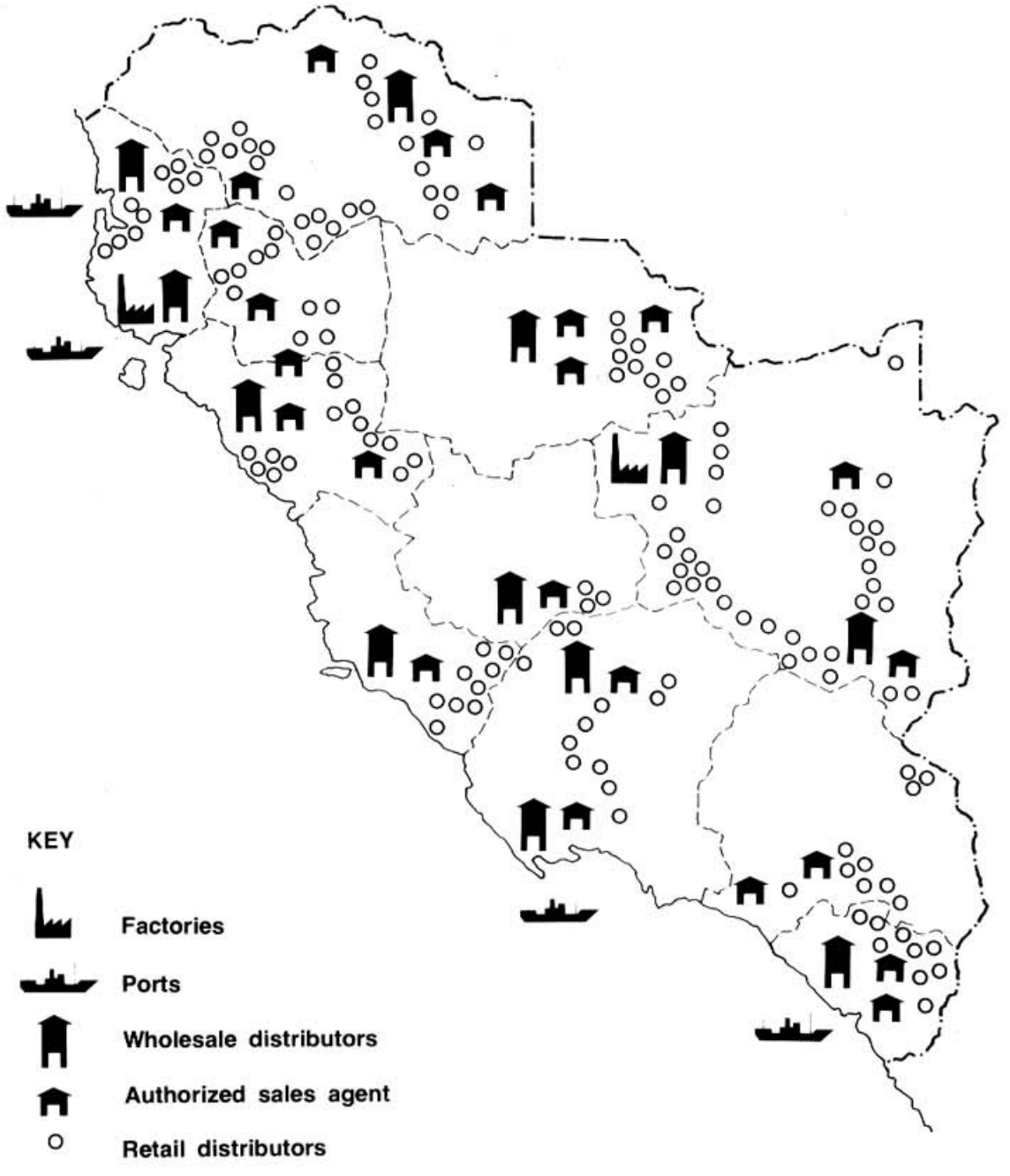
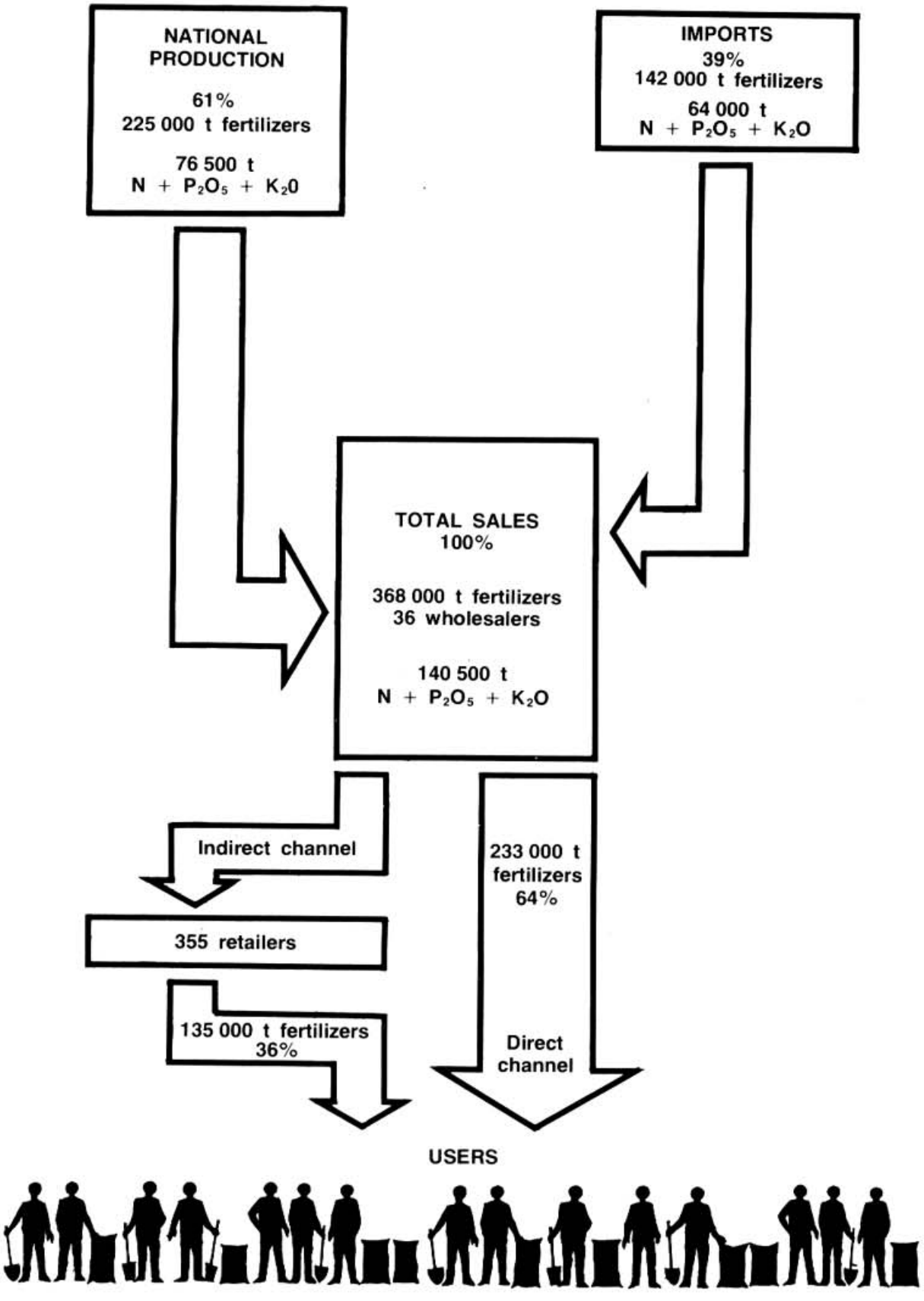


Figure 26
Trade flow and quantities moved in terms of product and of nutrients (1978)



3.3 Distribution Channels

It is evident from what has already been said that, to obtain the best coverage of fertilizer customers, two distribution channels should be used; where they both exist, one channel would be through parastatal or cooperative distribution networks, and the other channel would be through private, licensed wholesalers and retailers. The retailers are an indispensable part of the system for ensuring timely and continuing supply to the end users to whom they make fertilizers available as near as possible to the place where they are used.

Figure 26 shows the commercial trade flow of fertilizers in the country and the participation of each level in terms of the quantities moved in a year. The origin and final destination of the fertilizers are also indicated.

From Figure 26 one can see the interrelationship between the different levels of the distribution system and the trade flow of fertilizers. The sizes of the blocks and of the arrows joining one level to another are proportional to the quantities involved.

If there are enough fertilizers at each level, they will move steadily and continuously throughout the year and it will only be necessary to ensure that they move with sufficient speed and in sufficient quantities to satisfy the farmers' demand. If fertilizers are lacking at any level or if one of the trade channels is blocked for a very short time, then there will still be a normal flow to the lower levels and the end users will not notice the shortage. But if such disturbances continue for a longer period, then the end users will feel the shortage sooner or later.

These supply problems may occur unexpectedly in national production and/or importation of fertilizers, or by a breakdown of delivery channels during the rains. Minimum stocks should therefore be held in store at strategic points at all levels.

Nevertheless, in order to maintain a steady flow, it is generally undesirable to keep more fertilizers in store than necessary, as this would be uneconomic. To determine the minimum stock levels to be able to supply the farmers and, in consequence, to increase sales, account must be taken of the combination of distances, trade routes and procedural delays.

3.4 Procedures, Routes, Distances and Minimum Stocks in Relation to Demand

The time needed to arrange a purchase, organize transport and move fertilizers according to the state of the roads, constitutes a factor which, coupled with the frequency of purchasing, determines both the storage capacity required and the amount of stock that ought to be held at a particular level in the distribution system. The relationship between these aspects is best understood from Figure 27 which shows the duration of each stage of fertilizer movement from port or factory to the end user.

From Figure 27 one can see that the retailer must allow an average of 10-20 days from the time he places his order with the wholesaler's regional depot to the time he receives the fertilizer. Similarly, this figure also shows the transport times that are needed from the central wholesaler, or directly from the factory or port, to the regional depot.

If a retailer has a sale of 6 t/day during the agricultural season, then one can say that he needs to receive an average of 6 t/day, i.e. a small lorryload. That would be easy if he were the only one to be supplied by the nearest wholesale depot, if the lorries were all in

Figure 27
Normal times for fertilizer movement through the distribution system

	LEVELS	OPERATION	TIME (in days)
	Port and/or factory	Arranging purchase Organizing transport	2-3 2-3
	Wholesaler (central)	Arranging and transporting load	7-10
	Wholesaler (regional)	Transport to the regional depot	20-23
○	Retailer	Ordering, formalities, transport (for outward and return journeys)	10-12
	User	Purchase and transport to the farm	1-2
		TOTAL	42-53

good order throughout the season and, above all, if the retailer could rely on his own lorry.

As things do not usually happen that way, and as a regional depot often has to supply an average of 10-15 retailers at the same time and in addition to supplying large users direct, each retailer ought clearly to maintain his own minimum stock of fertilizers.

If for example, at the beginning of the season, a retailer forecasts a daily sale of 3 t, he needs to maintain a minimum stock of 30-36 t, i.e. enough to last 10-12 days, the time needed for re-stocking, as indicated in Figure 27.

If later, in mid-season, he envisages a daily sale of 6 t, he needs to maintain a minimum stock of 60-72 t, to allow for the 10-12 days for re-stocking.

The average amount needed to be held in stock varies considerably between one distributor and another. Table 22 illustrates the concrete example of a retailer who:

- sells 400 t in 4 months;
- has a storage capacity of 60 t;
- has to transport his fertilizers over a distance of 100 km;
- has the advantage of a road that is passable at all times;
- attends to the formalities himself;
- arranges his transport by contract.

This example provides a basis from which each distributor can work out the actual figures corresponding to his own situation.

Table 22
Calculation of retailer's minimum stock

First month:	Sale of 3 t/day	Minimum stock = 30-36 t
Second month:	Sale of 4 t/day	Minimum stock = 40-48 t
Third month:	Sale of 6 t/day	Minimum stock = 60-72 t
Fourth month:	Sale of 2 t/day	Minimum stock = 20-22 t

3.4.1 Stocking-up in advance

Retailers often make their arrangements for purchases and transport during rather short periods, which causes some congestion at the wholesale level. This results in delays and additional costs.

For this reason it is a good idea for the retailer to advance his purchases to 2 months before the start of the agricultural season with the aim of spreading his sales over a perid of 5 months instead of the 3 months of peak demand.

As this advance buying calls for a large outlay of money by the retailer, he might take advantage of a 60-day credit offered against a Bill of Exchange guaranteed by a commercial bank.

Advance buying requires that the retailer puts into effect an aggressive sales campaign by means of which he will effect sales of fertilizer before the agricultural season begins and preferably direct from the wholesaler's depot to the user. The credit that the retailer is also able to offer to the farmer will assist this type of transaction.

3.4.2 Types of fertilizer

As a result of the congestion that is liable to occur at the wholesale level during a short period at the height of the season, there is sometimes a shortage of a particular type of product for which the users have a traditional preference. In such a situation, it is most important that the distributor has available at least one type of fertilizer for each of the major nutrients (N, P_2O_5, K_2O) and that he knows how to explain and convince the farmer that one product can be replaced by another having the same effect.

These early sales assure the farmer of his supply. Further, they lead to a reduction in marketing and storage costs at both wholesale and retail levels. Such advance selling should be promoted by emphasizing the additional advantages that they bring, such as:

- better service;
- less congestion;
- more transport facilities;
- more time available.

Table 23 gives an example.

Table 23
Replacement of one product by another meeting the same N-P_2O_5-K_2O recommendation (Recommendation in kg/ha: 120-120-60)

Traditionally	1st alternative	2nd alternative
20 bags 12-12-12	7 bags AN 12 bags SSP 2 bags MOP	5 bags AN 2 bags DAP 2 bags MOP
Total: 20 bags	Total: 21 bags	Total: 9 bags

It is to be noted that both alternatives are economically advantageous because, with them, the exact recommendations for N, P_2O_5 and K_2O can be applied, whereas the complete fertilizer 12-12-12 supplies 60 kg K_2O too much.

3.5 Sales Promotion

So far, we have concentrated on the actions and decisions that the retailer should take with his supplier - the wholesaler - in order to be able to put into effect the corresponding actions of providing service and sales promotion directed towards the farmer, aspects which are discussed below.

Before beginning to develop in detail how to achieve promotion activities, the retailer must appreciate that fertilizer is not an object of dubious value or a once-only sale for the sake of business but that it is an important and useful input for the farmer.

He should also realize that in providing a service which is satisfactory to the customer, he will be able to effect larger sales to the same customer year after year, for it is not a question of selling just for the sake of selling but rather of selling in the correct way and with good service.

Again, it is not enough to direct sales promotion only towards regular customers who come back for more, but promotion should also be directed towards potential new customers.

3.5.1 Participation in farmers' field days

A good method of sales promotion is to attend farmers' field days, conducted by various organizations and institutions, with the object of offering technical assistance and transfer of technology to farmers.

Earlier in this manual, in the chapter on How to make sales forecasts, mention was made of the effect of trials and demonstrations undertaken on farmers' own fields. The result in general is a wish to use fertilizer, but that does not always mean that the farmers will buy them. In most cases, in fact, the farmers neither know how to buy them nor where to buy them; maybe, too, they fear they will not get adequate fertilizers for their money.

For these reasons, it is vital for the retail distributor to be present at farmers' field days, particularly at harvest time.

These field days provide an opportunity for meeting and cooperation between Ministry of Agriculture staff, farmers and the fertilizer retailer, as shown in Figure 28.

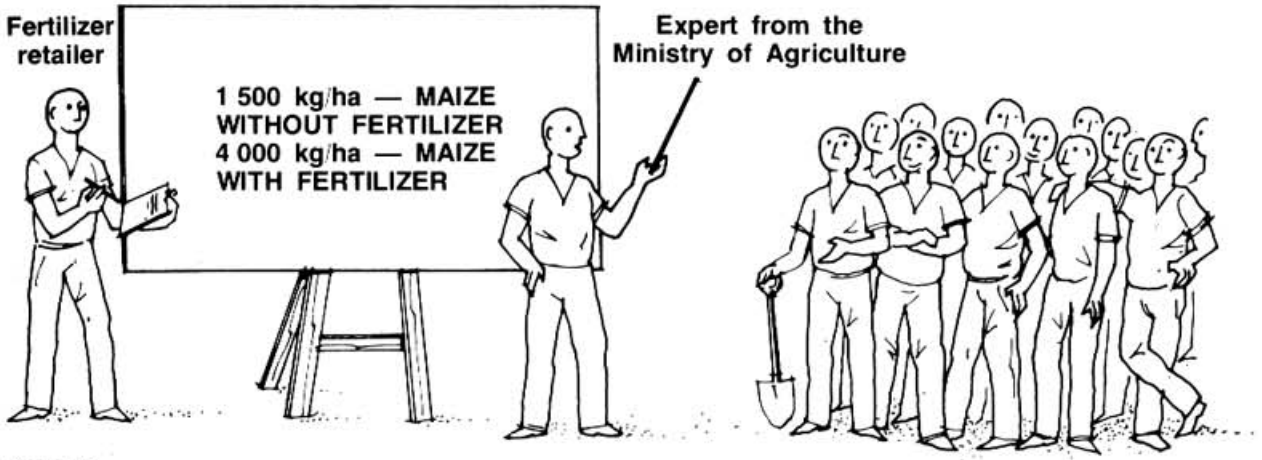
Once the Ministry of Agriculture expert has explained the result of the demonstration to the farmers, both in terms of harvested yield and of monetary gain, the fertilizer retailer who attends should take the opportunity to make known to the farmers the following:

- his full name and address;
- how to get to his point of sale;
- what fertilizers he has in his store;
- how much they cost;
- the days and times when he is open;
- what the farmers should do in order to buy.

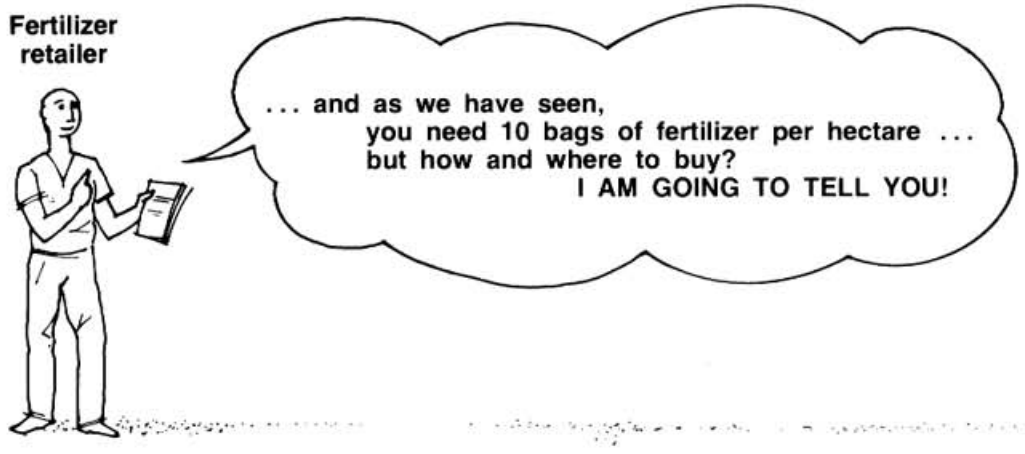
It would be even better if the retailer could distribute to all the farmers a simple leaflet (prepared in advance) giving all the above information together with a map showing the location of his point of sale. A specimen leaflet is shown in Table 24.

Figure 28
Farmers' field day at the harvesting of a fertilizer demonstration

WEIGHING THE HARVEST



YIELDS



THE RETAILER SPEAKS

Table 24
How and where to buy fertilizers

HOW AND WHERE TO BUY FERTILIZERS

1. POINT OF SALE_____

2. NAME OF RETAILER_____

3. ADDRESS : Street_____

Town_____

District_____Province_____

Region_____Tel: _____

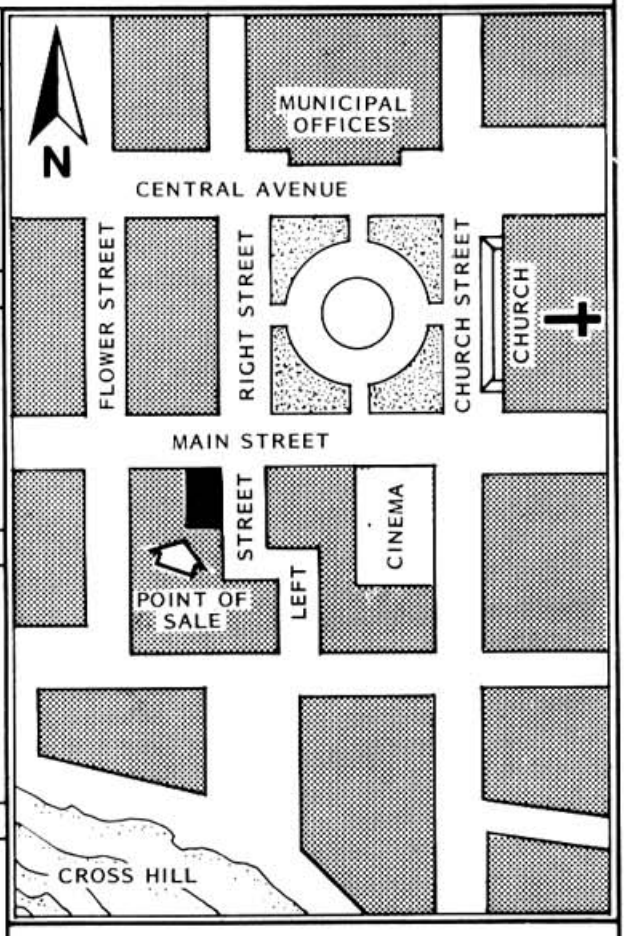
4. OPEN:

HOURS:_____to:_____

DAYS: MONDAY TO SATURDAY INCLUSIVE

5. TYPES OF FERTILIZERS

NITROGENOUS	PRICE PER 50 kg BAG
_____	_____
_____	_____
_____	_____
PHOSPHATIC	
_____	_____
_____	_____
_____	_____
_____	_____
POTASSIC	
_____	_____
_____	_____
_____	_____
_____	_____
COMPOUNDS	
_____	_____
_____	_____
_____	_____
_____	_____



HOW TO GET TO POINT OF SALE

3.5.2 Group buying

In the hill region where there are many small farmers each needing only a small quantity of fertilizers, the farmers' field days provide the opportune moment for the retailer to propose that they should buy and transport the fertilizers to their farms collectively. In fact, if each farmer goes individually to buy a few bags of fertilizer on his own account, the transport will cost more, will be slower and in addition will involve him in much more work and trouble for the transaction, as for the retailer too.

Figure 29 shows how to organize 40 farmers into groups within the same localities.

The dealer can take advantage of his presence at field days to propose that the farmers form themselves into groups both for buying and for transporting their fertilizers. Further, for greater economy, he can suggest that they appoint a single member of the group to buy their fertilizers instead of all going to the point of sale.

Briefly, there are a number of advantages in grouped sales, as is demonstrated in the following example. Let us suppose:

i. that, of the 40 farmers, there are 20 who buy 4 bags of fertilizer on average; or

ii. that 30 of the farmers, divided into 3 groups, buy 40 bags per group; or

iii. that the 40 farmers, divided into 4 groups, buy 40 bags per group.

The total sales with these 3 alternatives are shown in Table 25.

Analysing the results of Table 25, one may conclude that, in order to promote sales in alternatives (ii) and (iii), the dealer is justified in allowing a discount on the total volume of group sales as a result of the savings in time, work and trouble involved.

Such a discount can also be given for sales 1 or 2 months in advance, i.e. before sowing-time. The economic advantages accruing to the dealer, both for advance sales and for group sales, can be shared between him and the farmers by means of this discount which benefits both parties, as can be seen in Figure 30.

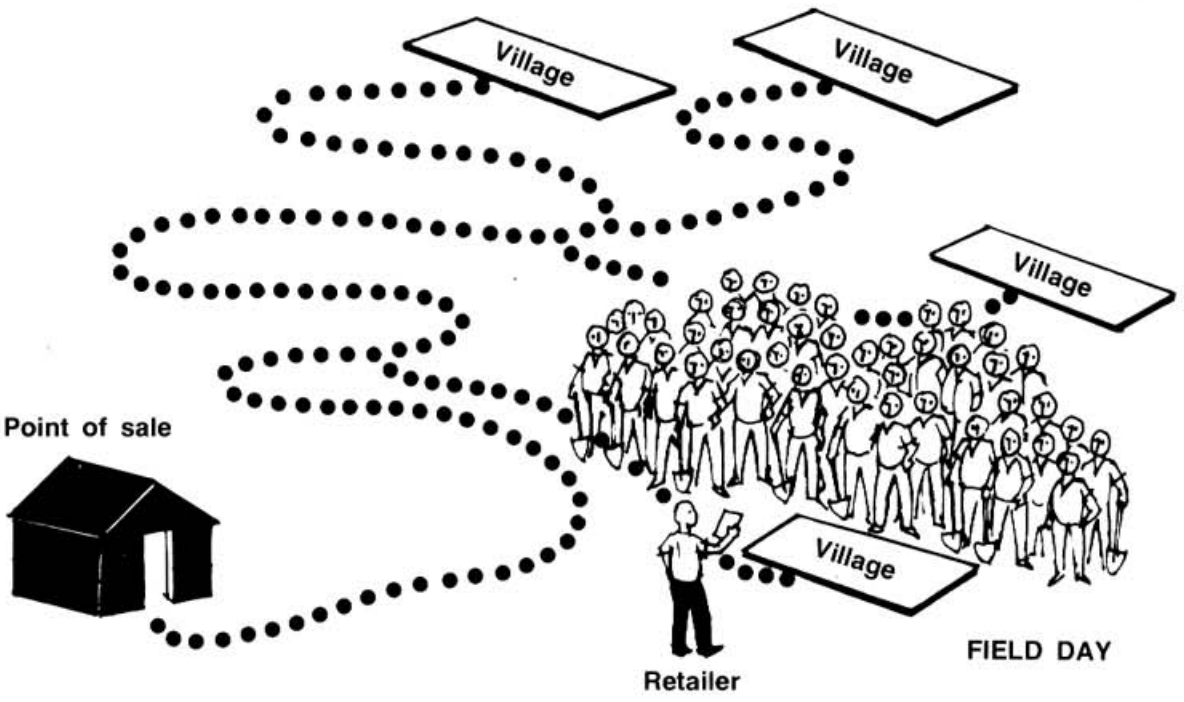
3.5.3 Visits to farmers

Obviously, direct contact between the dealer and users can be made more easily at farmers' field days. However, an individual visit to each farmer, preferably before the season begins, can also give good results in sales promotion. During these visits, it is a matter of contacting those users and eventual customers who have a certain

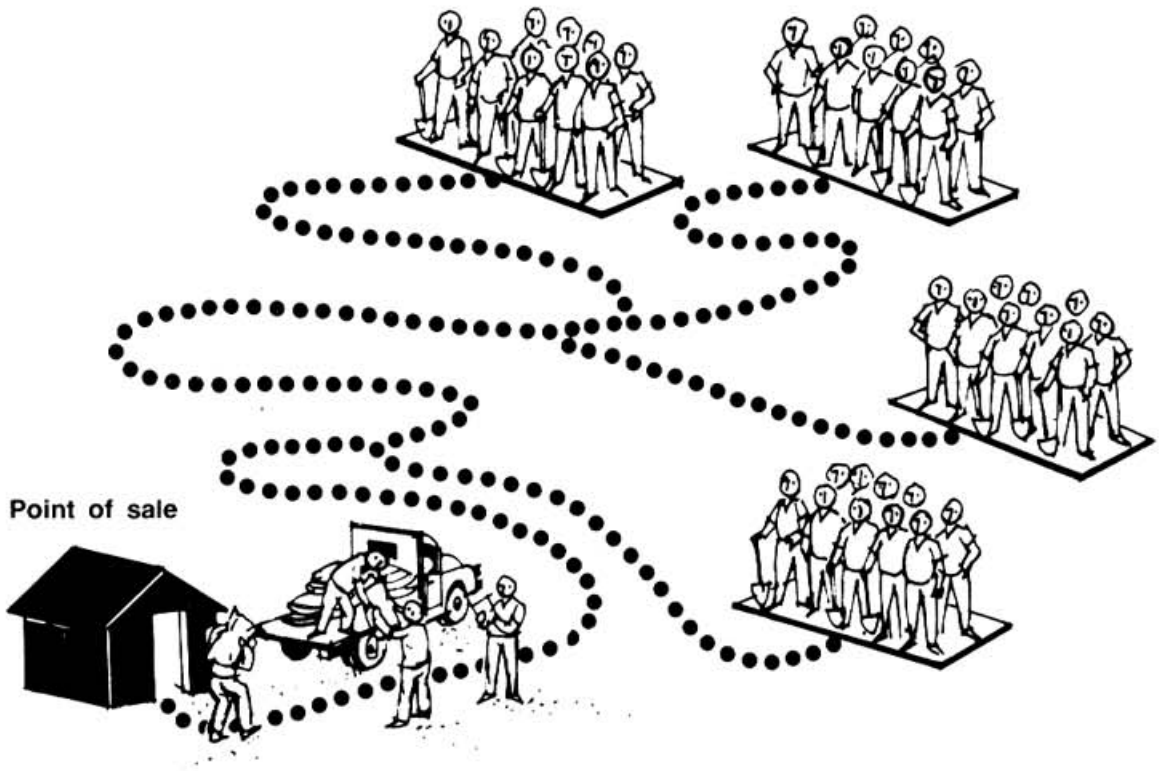
Table 25
Result of selling fertilizers to individuals or to groups

Alternative 1	Alternative 2	Alternative 3
20 farmers buy 4 bags each, or 80 bags	3 groups of 10 farmers buy 40 bags per group, or 120 bags	4 groups of 10 farmers buy 40 bags per group, or 160 bags

Figure 29
Organization of farmers' buying groups



At a farmers' day,
the retailer proposes the formation of buying groups
to purchase fertilizers collectively.



A single member of each group
buys the fertilizer and organizes the transport.

influence on other farmers, for example by recounting the results obtained with fertilizers in the past season and the possibility of using more fertilizers in the present season. Direct visiting is illustrated in Figure 31.

The dealer will achieve a better sales promotion effect if he takes advantage of his visits to give the farmers a good number of information leaflets of the type illustrated in Table 24 and suggests that they pass them on to other farmers. The dealer could also distribute technical extension bulletins, etc.

3.5.4 Exhibits at agricultural shows

Another means of sales promotion by commercial contact with the customer is by participating in the agricultural shows which are held in many areas. Generally such participation costs little. Even so, it should be reckoned in terms of a small stand in which to display promotional material and publications, as listed below:

i. samples, in plastic bags, of fertilizer stock;

ii. posters, calendars, and other promotional materials that the dealer may have in his store;

iii. simple tables demonstrating the effect of fertilizer use on the principal crops in the area;

iv. technical bulletins on fertilizer recommendations, showing alternative options as to fertilizer types, based on manuals published by the Ministry of Agriculture (these bulletins can be given away to all who ask for them);

v. copies of the leaflet shown in Table 24, containing

Figure 30
Discount for advance sales and for group sales

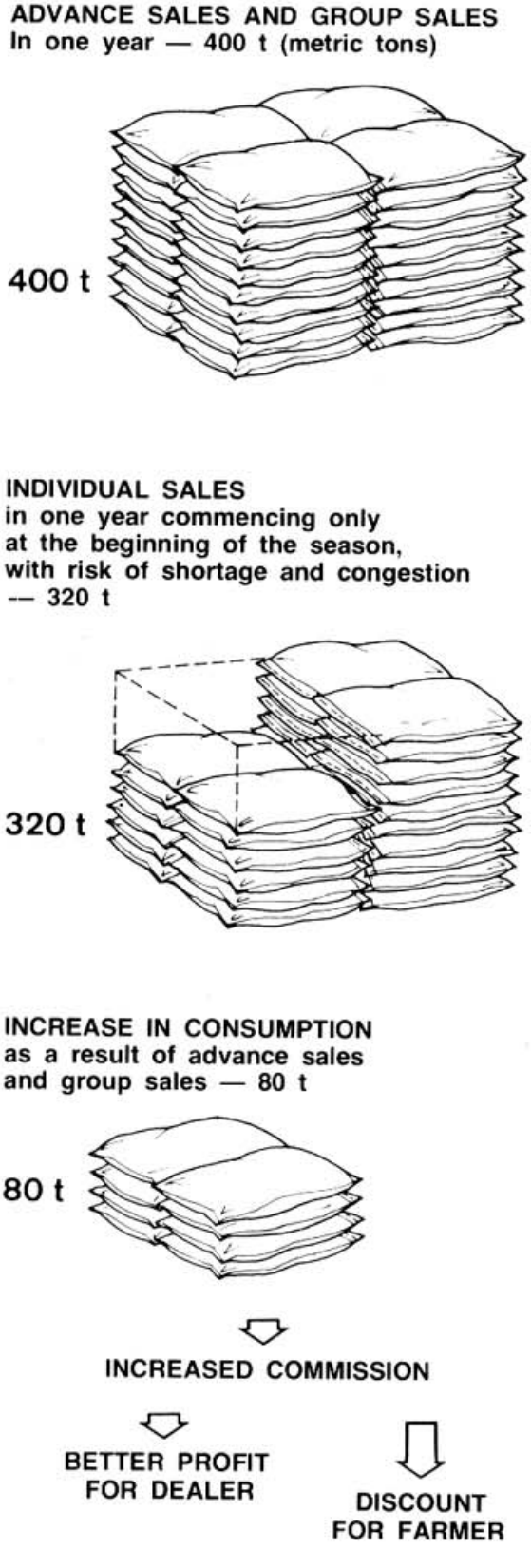
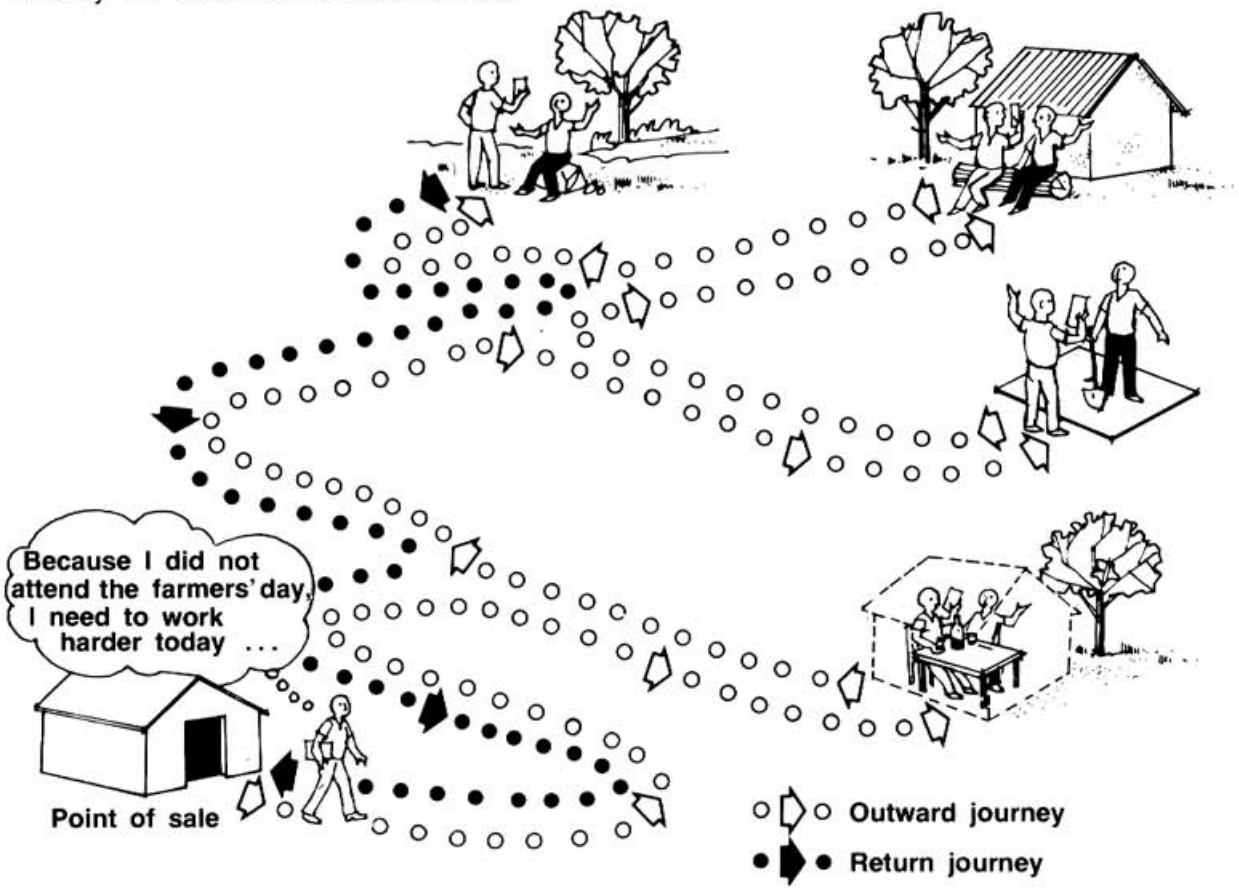
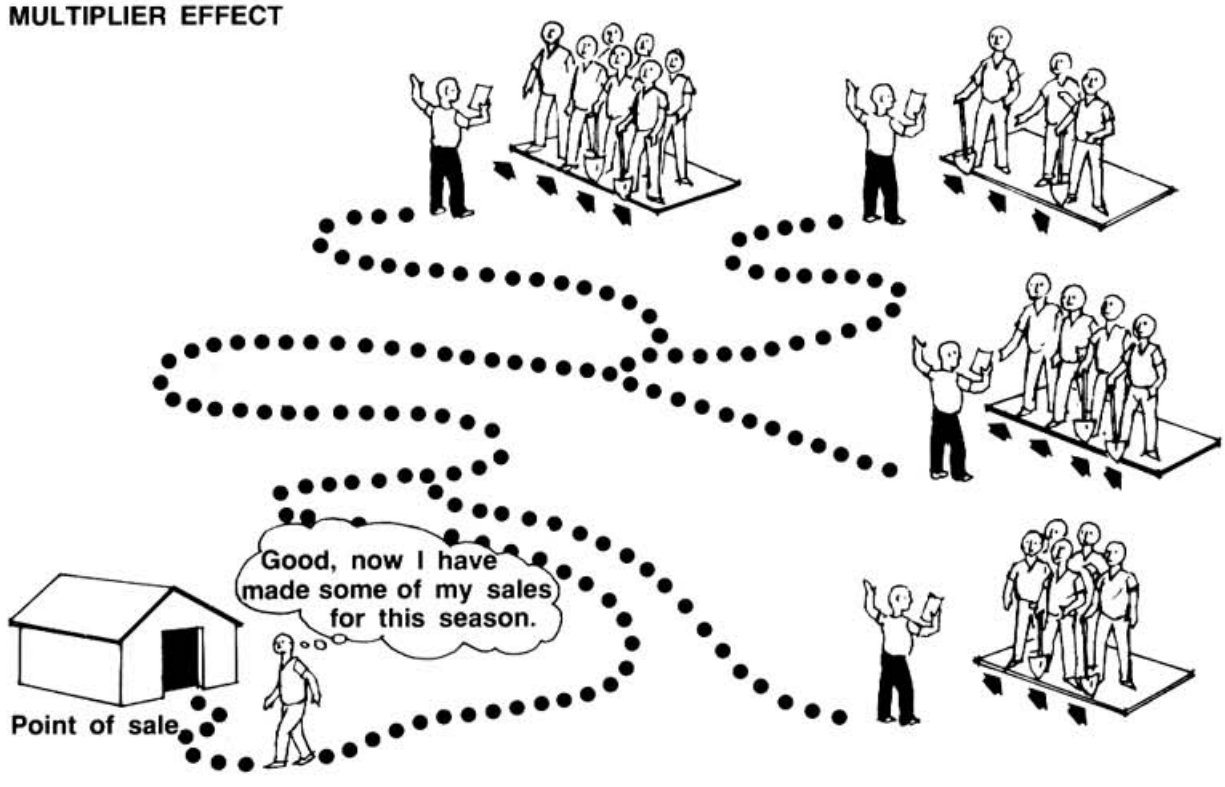


Figure 31
Visits by the dealer to individual farmers



MULTIPLIER EFFECT



information on the location of the point of sale, for distribution to all farmers present.

In the case of regional shows, a series of slides can be exhibited, 2 or 3 times a day, on the subject of fertilizer use and trade. Should the distributor have to construct and erect his own stand at a show, he could make use of the design shown in Figure 32.

It is preferable that the dealer himself mans his stand in person in order to answer all the farmers' requests for information. He ought also to arrange that, on show days, an assistant or a member of the family is available at his sales office to look after any regular customers or new users who may appear.

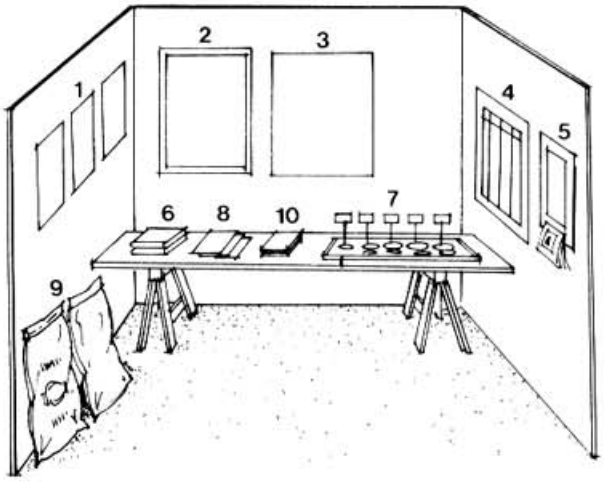
3.5.5 Radio broadcasts

Use of the local radio to broadcast information on correct use of fertilizers should be considered by the retailer as a means of increasing his sales. The content of these radio programmes should be prepared in coordination with technical agricultural experts and can deal with the following aspects:

- the importance of fertilizer use;
- the advantages of using fertilizer;
- fertilizer recommendations, etc.

For example, one might contract with a local radio station to broadcast programmes containing technical messages specific to the

Figure 32
Design for a stand for an agricultural show



INTERIOR

1 Educational posters
2 Publicity poster
3 Fertilizer recommendations
4 Fertilizer price list
5 Calendar
6 Manual on fertilizer use
7 Tray with fertilizer samples
8 Technical bulletins
9 Fertilizer bags on display
10 Information leaflets

EXTERIOR

crops grown in the area and information on the supply and distribution of fertilizers offered by the retailer.

The radio, as a means of social communication, quickly reaches a large number of farmers on account of the wide use of transistor sets.

3.6 Improvements in Service

Another means which the dealer should take into account for increasing his sales is improvement of the service offered to the customer at his sales office. The following aspects ought to be taken into consideration:

- the farmer ought to be able to find the sales office easily;
- the farmer should find useful information there;
- the service should be appropriate and quick.

Of these, the third aspect is the most important, because most farmers make their fertilizer purchases at the last minute and, if they do not receive careful attention from the retailer, they waste time which would be better spent on agricultural tasks.

3.6.1 Identification of and improvements to the sales office

The sales office is the place where the distributor can best attend to his customers and serve them; and they should find there an agreeable and helpful atmosphere. It is also important that farmers can find his office easily. The following recommendations to retailers are given only as an example of what can be done:

i. paint the front or facade with washable paint (latex type) in a pale colour;

ii. paint the lower part of the facade with a contrasting colour in stripes (e.g. blue, orange, or green), 15 cm wide, sloping at an angle of 45 degrees;

iii. leave an unstriped space on the upper part of the facade, a blank area of one square metre, on which to paint in black and white the symbol or logotype identifying authorized retailers;

iv. paint the entrance door in the same colour as that chosen for the stripes.

To put this scheme into effect, the retailer will decide what area of the front is to be painted, according to his possibilities. The retailer could, depending on the space available, paint publicity slogans such as Your land will yield more if you give it fertilizer.

There could also be placed in an easily visible position, preferably over the entrance door, a nameplate bearing the words Authorized Retailer (if that is the case), the dealer's name and telephone number, as shown in Figure 33.

It is equally important to show when the office is open to the public. The opening times ought to be arranged, to the extent possible, to be convenient to the farmers, bearing in mind the days of the week (including Saturdays and Sundays) when there is most money about, often corresponding to market days and fairs.

The board showing opening times, see Figure 34, should be in an easily visible position, e.g. on the entrance door. It may also be combined in a single panel incorporating the retailer's name.

Figure 35 shows a specimen facade of a fertilizer retailer's store.

Figure 33
Name-plate for retailer

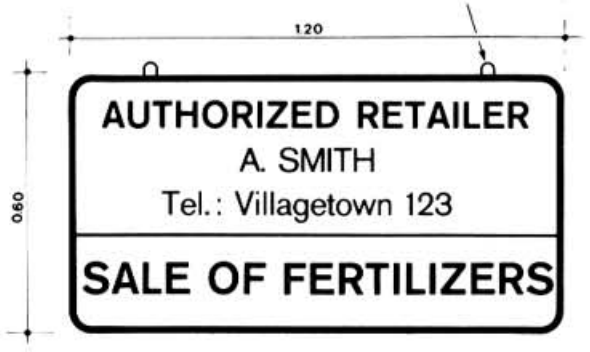


Figure 34
Notice giving opening times

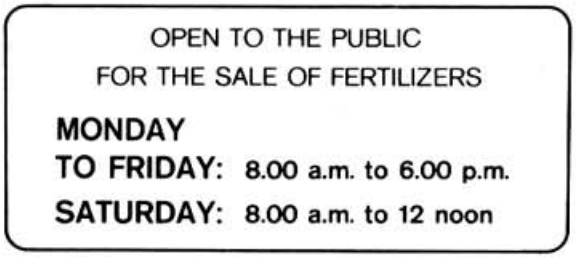


Figure 35
Facade of a fertilizer retail sales office

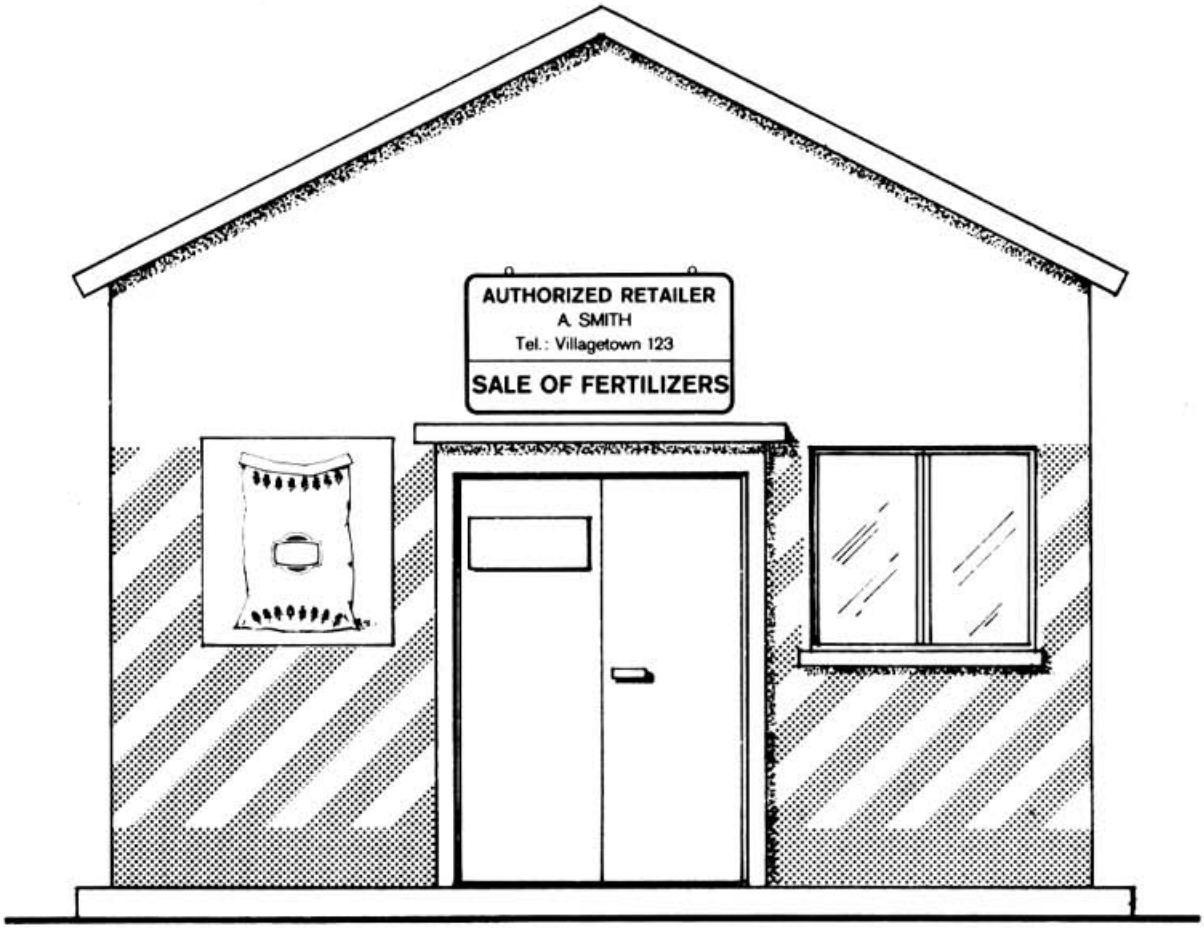
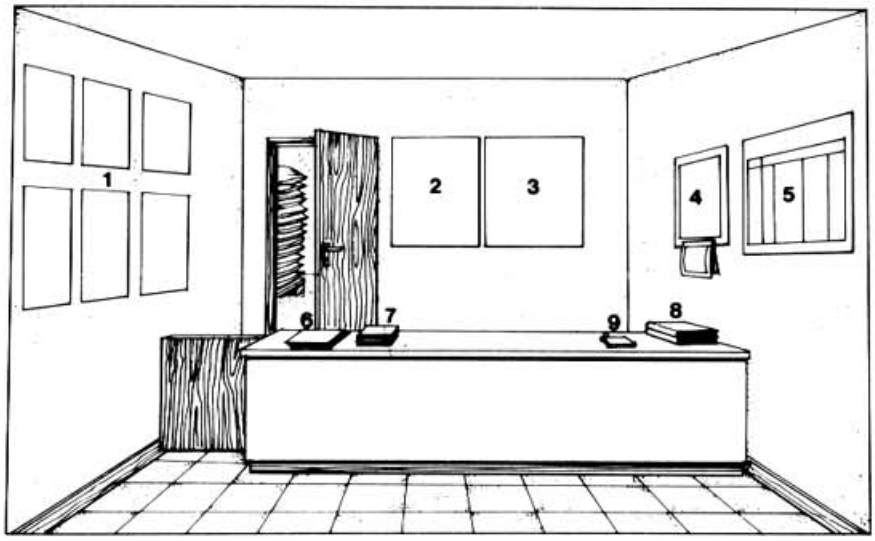


Figure 36
Interior of a fertilizer retail sales office



Useful information in the sales office:
1 Area for affixing educational posters on fertilizers
2 Publicity poster
3 Fertilizer recommendations
4 Calendar
5 Fertilizer price list
6 Technical bulletins (for giving away)
7 Information leaflets (for giving away)
8 Field guide and Fertilizer recommendations (for consulting)
9 Invoices

3.6.2 Useful information inside the sales office

With the object of the farmer learning about fertilizers while waiting to be served, the retailer should display inside his sales office the following educational aids:

i. notice boards with easily legible letters and numerals showing the alternative choices of fertilizers offered to meet current recommendations in N - P_2O_5 - K_2O for the principal crops grown in the area;

ii. posters which explain in a simple manner what should be known about fertilizers, fertilizer use and fertilizer marketing;

iii. calendars or almanacs to offer to customers as well as the current list of prices;

iv. series of bulletins, for giving away, on the correct fertilizer treatment of crops;

v. finally, he should have readily available for reference purposes, but not for giving away, technical publications on fertilizer use such as the Ministry of Agriculture Manual on Fertilizer Use, Manual on Fertilizer Marketing and Field Guide.

A method of displaying on the walls all useful information in the sales office is shown in Figure 36.

3.6.3 Appropriate and effective services to the farmer

To improve his service to the user, the dealer should always try to keep in touch with his customers, providing them with the information they want on fertilizer use,

purchase and delivery. With this in mind, the retailer should attend to the following points:

i. have his fertilizers in good order in his store;

ii. always have ready pads of invoices, pens, paper, postage stamps and other needed office supplies;

iii. transact all fertilizer sales on an invoice written in ink or preferably typed, with no erasures;

iv. deliver and despatch the fertilizers quickly;

v. file the sales records separately from all other items.

Points i and iv above are discussed in more detail in the next chapter on Handling and storage of fertilizers.

As regards invoicing, a specimen invoice is shown in Figure 37 as an aid to the retailer. It includes, printed, all the information needed solely for the sale of fertilizers. It standardizes the information, at the retail level as well as at the wholesale level.

The model invoice comprises an original and two copies. The original is white and the copies are pink and yellow. All the sheets should be completed by the retailer in a legible fashion, with no mistakes and with all the correct information. The original is for the customer and serves as proof of purchase to enable him to obtain the fertilizers from the store. The pink copy is for the wholesaler or the appropriate government authority, if required. The pink copy may be produced when the retailer makes further purchases. It may also be used to send regularly to the wholesaler as a purchase order, for example, in the first week of each month or at the beginning of a new season. The yellow copy is for the retailer's files and serves him for registration and control. It should be noted that the invoice must not be used for selling goods other than fertilizers. If an invoice is cancelled, it should be fastened together with the pink and yellow copies.

3.6.4 Sale of other products

In many cases authorized retailers sell other agricultural inputs besides fertilizers. This necessitates certain precautions which are explained in the next Chapter.

From the commercial point of view, the sale of other products offers several advantages, including:

i. the sale of other agricultural inputs entails little more administrative expense;

ii. many farmers who come intending to buy fertilizers can also buy the other inputs they need for their crops; alternatively, if they come to buy other inputs, they may also buy fertilizers;

iii. the marketing costs of fertilizers and other products are reduced if the operations of buying, transportation, storage and selling are conducted jointly;

iv. it is easier and less expensive for the farmer to make his various purchases at the same place.

Finally, it is very important to point out that the retailer should never make the sale of one product conditional on that of another, and that he must use a different type of invoice for the sale of other inputs and keep his accounts and files for fertilizers completely separate from those for the other inputs.

Figure 37
Typical invoice for fertilizer sales

INVOICE TO BE USED EXCLUSIVELY FOR FERTILIZER SALES

N° 1001

POINT OF SALE.....

RETAILER.....

FARMER.....

DAY	MONTH	YEAR

VILLAGE.....

DISTRICT..... STATE.....

CODE	FERTILIZER	No OF BAGS	PRICE PER BAG	TOTAL
01	Urea 45/46%			
02	Ammonium nitrate 33.5%			
03	Ammonium sulphate 21%			
05	Single superphosphate 18/20%			
06	Triple superphosphate 46%			
07	Muriate of potash 60/62%			
08	Sulphate of potash 50/52%			
09	Sulphate of potash magnesia 18/22%			
10	Diammonium phosphate 18/46/0			
11	12/12/12 compound			
24				
30	7/14/7 compound			
			TOTAL	

SIGNATURE OF FARMER

SIGNATURE OF RETAILER

NOTE: The prices per bag shown on the invoice should not exceed those approved for Authorized Retailers.

L.T. No.:

SALES REGISTER No.:

Exercises on means of promoting fertilizer sales and improving service

1 Give in your own case, the following information:

- Fertilizer supplier(s)
- Distance between the supplier(s) and your point of sale
- State of the roads according to season
- Time needed to arrange a purchase
- Time needed to organize transport
- Monthly fertilizer sales (metric tons/month) during the agricultural season
- Dates of the beginning and end of the agricultural season
- Annual fertilizer sales (metric tons/year)
- Your fertilizer storage capacity

2 Calculate the average time (in days) that is normally needed from the date of ordering (say, 6 metric tons of fertilizer) until the fertilizer is in your store ready for sale.

3 State whether you have attended farmers' field days and how many times a year you have visited individually the farmers in your area.

4 Which do you prefer to sell?

- 3 bags each to 24 farmers, or
- 24 bags each to 3 groups of farmers
- What are the advantages of each alternative?

5 Try to draw the front of your sales office the way it is now and the way it could be improved.

6 Which of the following do you have in your sales office?

- Painted front
- Metal nameplate
- Slogans
- Notice of opening time (days, hours)
- Posters, calendars
- Boards listing fertilizer prices
- Technical manuals and bulletins
- Other promotional materials

7 Enter the following items on an invoice, to be used solely for fertilizer sales, using the current prices in operation in your country:

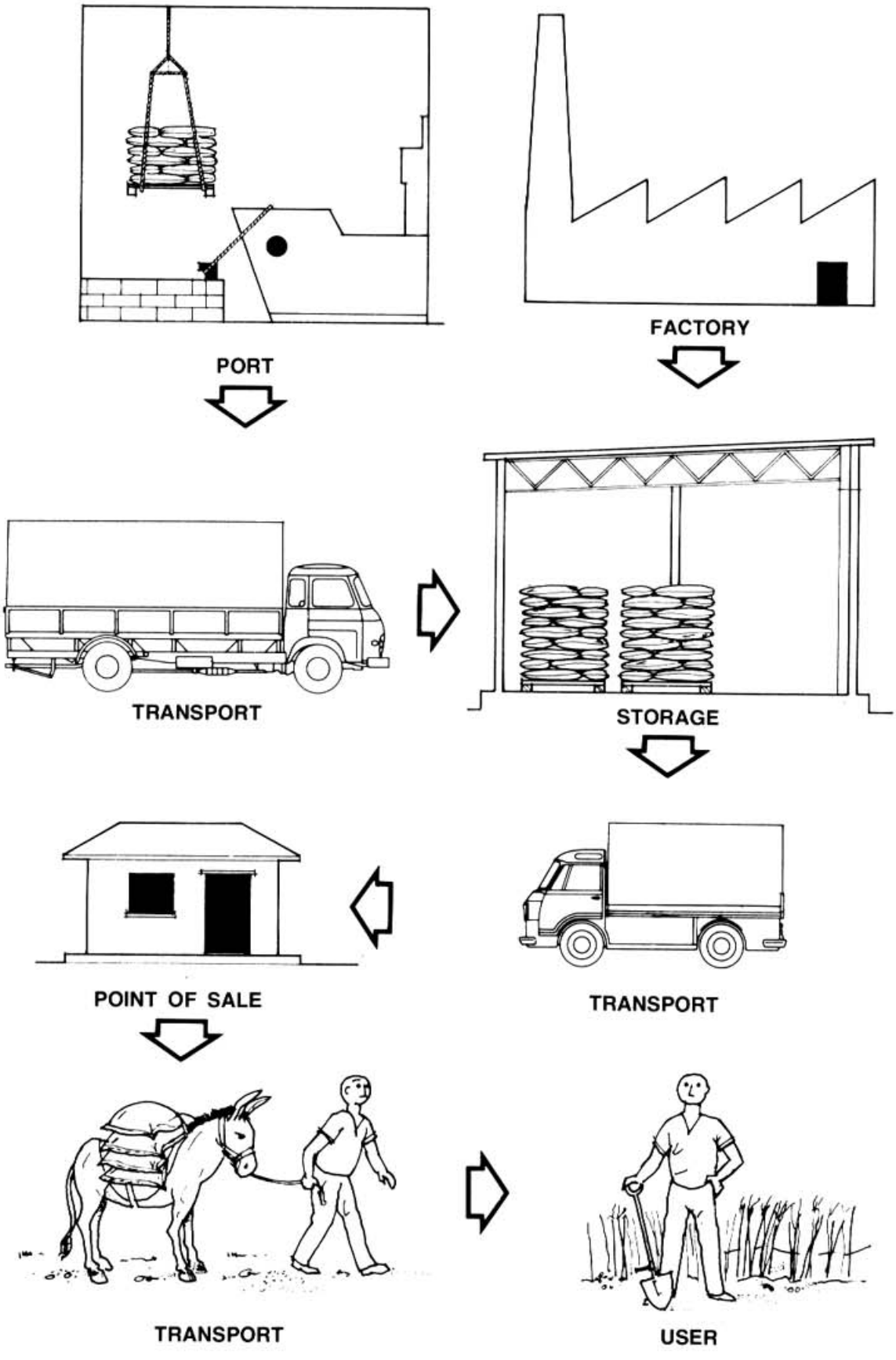
- 8 bags ammonium nitrate
- 4 bags triple superphosphate
- 3 bags muriate of potash

8 How much time does it take on an average to deal with a customer from the time he comes into your sales office until the fertilizer is delivered?

9 Explain what products you sell other than fertilizers, and why.

4 HANDLING AND STORAGE OF FERTILIZERS

Figure 38
The movement of fertilizer from port or factory to user



4.1 Introduction

To keep fertilizers in a condition acceptable to farmers and to avoid appreciable losses, they should be carefully looked after during handling, bagging, storage and transport from port or factory to user, see Figure 38.

This chapter gives guidance on the correct handling of fertilizers through the various stages of bagging, storage and transport, in the hope that distributors will put it into practice so as to minimize handling losses and keep the fertilizers in good condition.

4.2 Principal Physical and Chemical Characteristics of Fertilizers

Before starting to handle fertilizers, in the first place, it is necessary to know the most important characteristics such as hygroscopicity, free acidity, explosion hazard, volatilization and other physical and chemical qualities, because the precautions to be taken into account are strictly related to these characteristics.

4.2.1 Hygroscopicity

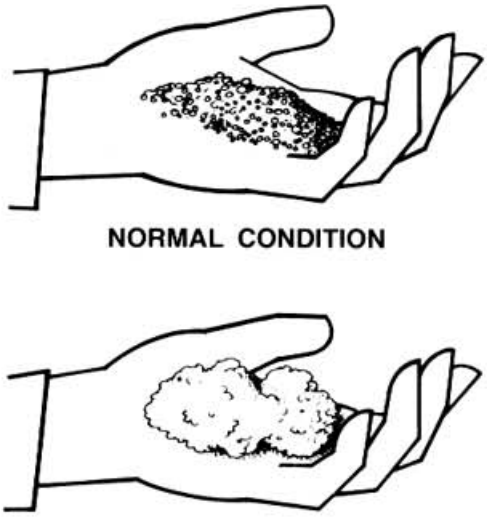
Mineral fertilizers, because they are soluble in water, are hygroscopic. The phenomenon of hygroscopicity occurs when the fertilizer absorbs enough water vapour from the atmosphere to reach a critical level, which varies with each type of fertilizer, in relation to the humidity of the air.

In these conditions, the fertilizers dissolve or become sticky. Then, when the ambient temperature rises, the fertilizer releases water and becomes compacted. In this way, crystalline bridges are formed between the fertilizer particles, caking and uniting them, which makes them difficult to handle and use. This is demonstrated in Figure 39.

Hygroscopic phenomena are not only caused by the humidity of the ambient air but also by sudden changes in temperature between day and night. In addition, the pres-

Figure 39
Effect of hygroscopicity

The particles become caked, which creates difficulties in storage, handling and use.



NORMAL CONDITION

CRITICAL CONDITION: the fertilizer becomes compacted and/or caked (hygroscopicity)

sure from the weight of stacked bags accelerates the chemical reaction.

Of all these factors, the ambient humidity has the most effect. Hygroscopicity is more serious in the tropics or in zones of high relative humidity such as hill and forest regions.

Degrees of hygroscopicity

Knowledge of the degree of hygroscopicity associated with each type of fertilizer is basic for recommending suitable precautions for bagging and storage. Of all the manufactured fertilizers, nitrogenous ones are more hygroscopic than phosphatic or potassic fertilizers. For example, urea becomes hygroscopic when the relative humidity of the air reaches 75%, and ammonium nitrate when it is above 59%; in contrast, sulphate of potash, only from 96%. That is to say, ammonium nitrate is the most hygroscopic and sulphate of potash the least hygroscopic. Table 26 shows, for each of the most important fertilizers, the critical relative humidity that they can tolerate at a temperature of 30°C; in other words, the relative humidity above which each fertilizer, whether straight or mixed, will absorb water vapour from the atmosphere.

Table 26
Critical relative humidities of fertilizer materials at 30°C (Relative humidity in percent)

Ammonium nitrate	Urea	Triple superphosphate	Ammonium phosphate	Muriate of potash	Sulphate of potash
59.4					
18.1	75.2				
62.3	56.4	79.2			
59	62	72	82.5		
67.9	60.3	71.3	70	84.0	
69.2	71.5	81.4	77	87.8	96.3

Source: TVA (Tennessee Valley Authority)

How to avoid hygroscopicity

There are methods of preventing hygroscopicity from the very moment of manufacture by covering the fertilizer with an inert coating, good granulation and drying, or by mixing with synthetic anti-caking agents. Furthermore, the dealer must also take action to prevent hygroscopicity and to do this, he must observe the following precautions, which are not onerous:

i. avoid draughts, which carry atmospheric water vapour. Keep the doors and windows of the store shut, particularly in areas of high relative humidity;

ii. keep bags away from the floor and damp walls, even when fertilizers are packed in waterproof plastic bags, because these are often not enough to prevent penetration of dampness from the ground;

iii. sweep the floor of the store frequently with a dry broom so as to remove any spilled fertilizer which, when mixed with dust or other sweepings, would absorb ambient moisture.

4.2.2 Free acid

Free acidity is another characteristic which must be taken into consideration in the case of single or triple superphosphate, which are made with strong acids (sulphuric, phosphoric). In the course of time, free acid causes damage to weak seams in the bags (principally to cotton threads). This results in external spillage of fertilizer where it becomes subject to hygroscopicity.

The effect of free acid on bags is illustrated in Figure 40.

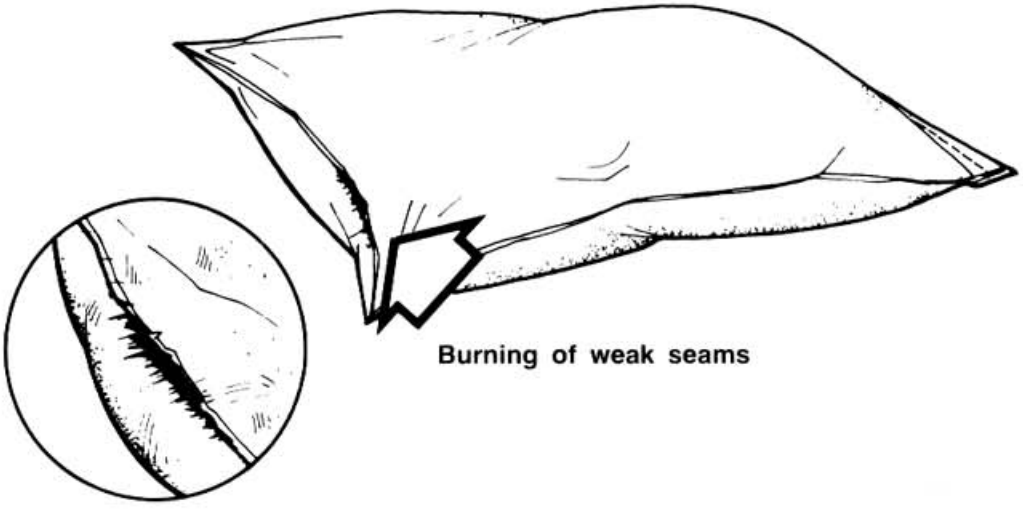
It should be noted that single superphosphate has more free acid than triple superphosphate and therefore has a greater tendency to damage the packaging.

To avoid problems with free acid:

i. superphosphate should not be stored more than six months;

ii. the bags should be arranged in low stacks, to avoid compacting the fertilizer.

Figure 40
Effect of free acid



Burning of weak seams

4.2.3 Explosion hazard

Ammonium nitrate is the only fertilizer which, as an oxidizing agent, can react in such a way as to cause explosions when it is in contact with organic materials, oil, certain metals, sulphur, phosphorus, etc.

To avoid the danger of fire, ammonium nitrate should be handled with care, taking note of the following:

i. avoid violent shocks to the bags, do not drop them;

ii. stack the bags in such a way as to leave an empty space in the centre of the stack as a kind of chimney;

iii. do not smoke inside the store and do not expose the bags to fire or heat (e.g. from the sun);

iv. do not leave the bags open;

v. always store the bags away from other fertilizers and away from electric wiring, steam pipes, radiators, explosive materials, acids, and inflammable and easily oxidizable materials.

The special precautions to be taken in storing ammonium nitrate are illustrated in Figure 41.

Figure 41
Handling of ammonium nitrate

4.2.4 Volatility

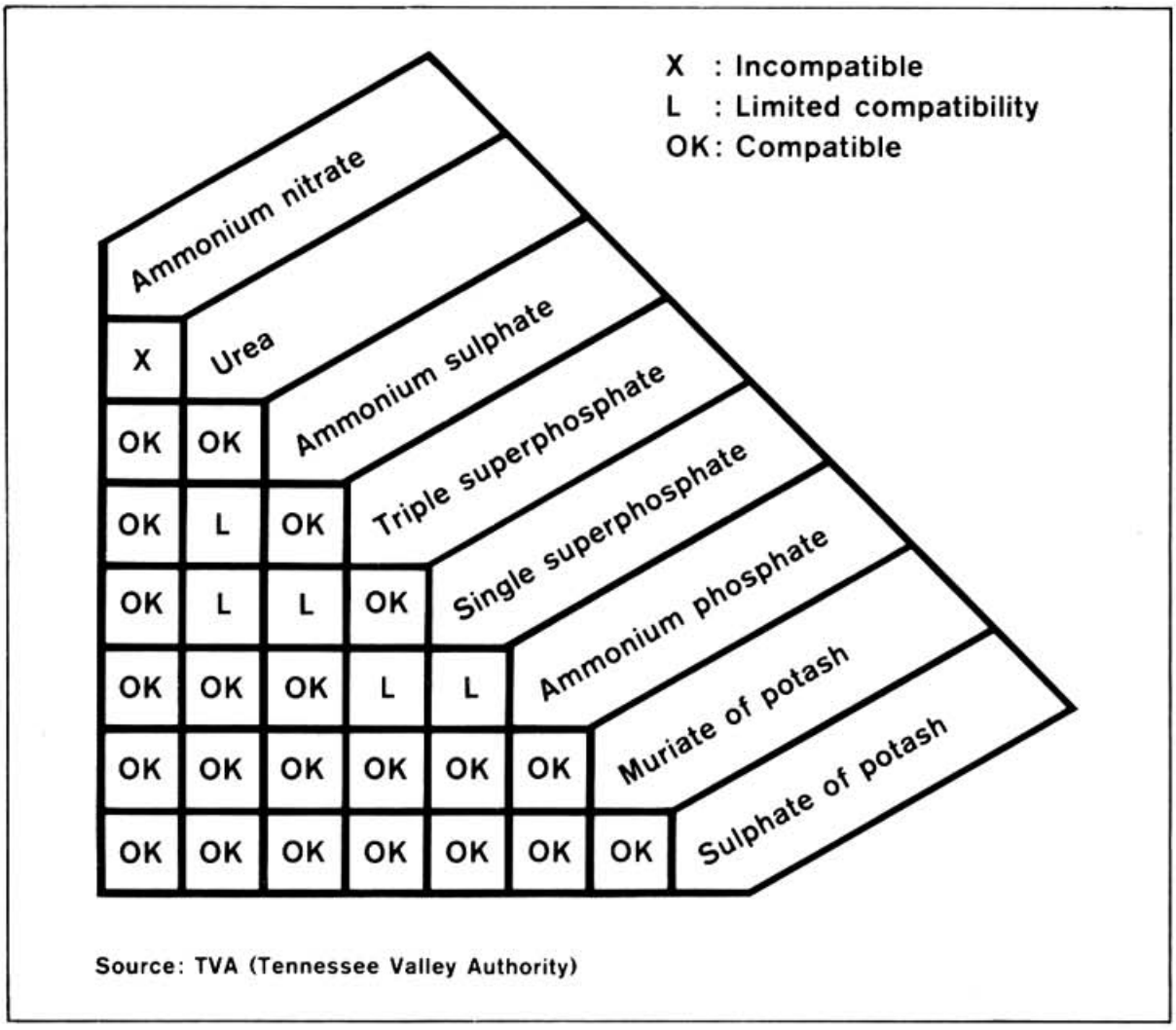
This can be a problem with organic compound fertilizers which emit ammoniacal vapours (ammonium chloride and ammonium bicarbonate), such as guano. These can suffer losses of ammoniacal nitrogen when handled badly, too much or, above all, when exposed for a long time to sun and rain. So bags containing these fertilizers should not be left open nor left outdoors for long. They should also be arranged in low stacks with a minimum of pressure. With these precautions they will not only not volatilize but they will also not lose moisture and therefore not lose weight.

4.2.5 Chemical compatibility

This other important characteristic needs to be considered with mixed fertilizers. It is not possible to mix all fertilizers with one another on account of the chemical reactions which could occur. For example, urea should not be mixed with ammonium nitrate or triple superphosphate, nor diammonium phosphate with single superphosphate.

Table 27 shows the chemical compatibility between the principal fertilizer materials as a guide to the dealer in advising users on practicable mixtures.

Table 27
Chemical compatibility of fertilizers for mixing



Source: TVA (Tennessee Valley Authority)

4.3 Fertilizer Handling

Handling is a marketing activity which can be defined as the manual and/or mechanized movement undergone by fertilizer during its transport from factory or port to the end user.

It should be borne in mind that a fertilizer changes hands on average seven to ten times between its manufacture or importation and the end user. When fertilizers are sold in bags, the latter must be treated in such a way that they do not deteriorate, causing spillages and resultant losses in their content.

Fertilizers imported in bags suffer the most damage because, when they are unloaded from ships by means of ropes or cables and the quantities lifted are large, the slings can cut into the bags as is shown in Figure 42. To avoid this the bags should be lifted and lowered with considerable care, in particular not hitting the sides of the hatchways.

Slings should be withdrawn after the bags have been removed and never before.

Bags also suffer serious damage when they are unloaded by dock

Figure 42
Unloading bags containing fertilizer at the port

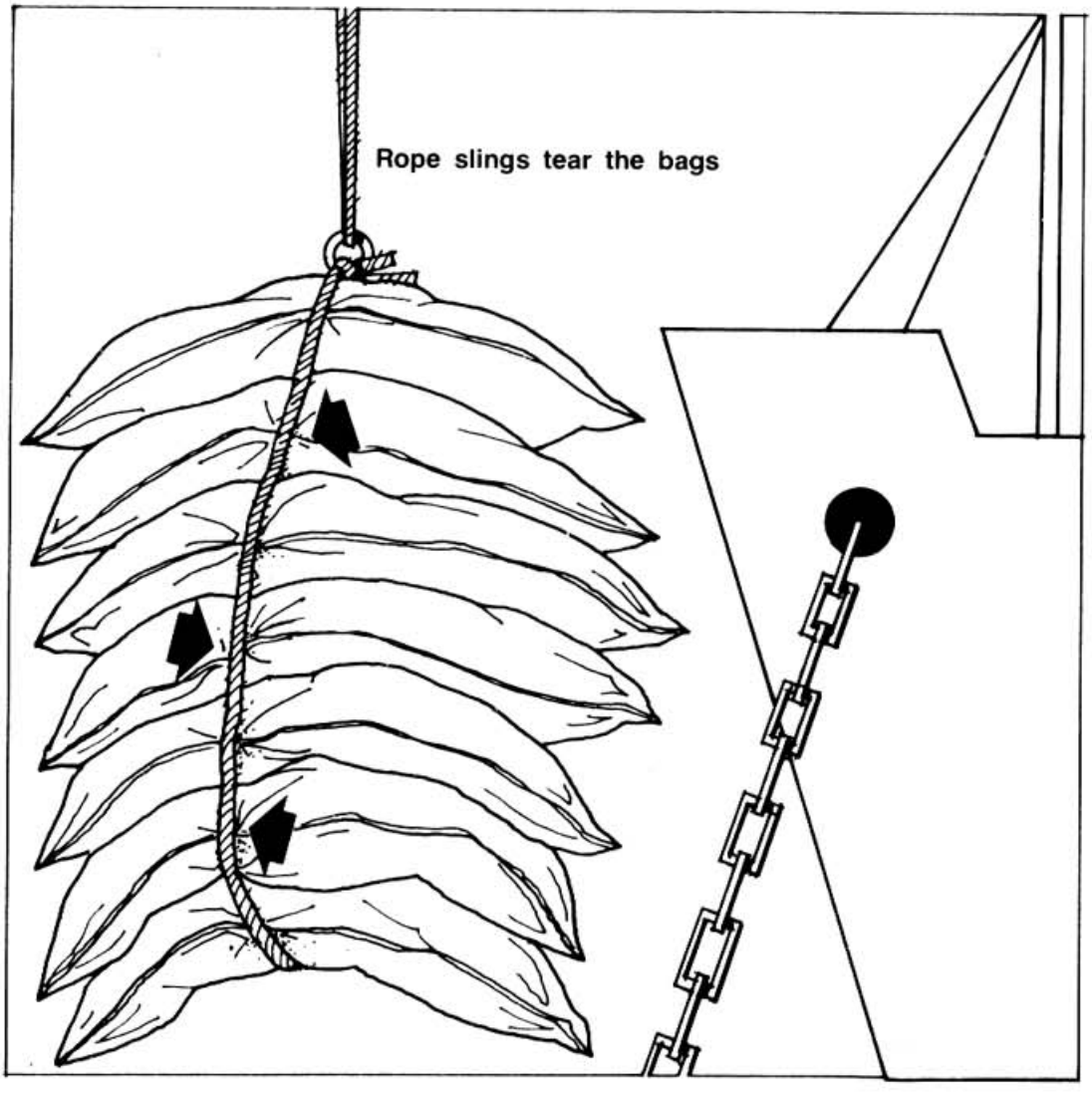


Figure 43
Use of hooks

workers using hooks for lifting and pulling, with the result that the outer (plastic) layer is torn and the inner layer is damaged, as is illustrated in Figure 43.

Once a bag is damaged, not only can its contents spill out but also whatever is left will be exposed to humidity, rain and sun. So, use of hooks must be rigorously avoided at the port, in factories and in storage depots.

Very often bags are damaged during loading and unloading of vehicles, the commonest causes being nails, sharp edges, pieces of iron, etc.

These causes can be avoided by checking vehicles before starting to load. During such checks, nails, splinters, etc. can be removed or suitable material (waterproof paper, matting or straw) can be laid on the floor of the vehicle to protect the packaging.

There are other causes of damage of bags; for example, those stacked near doors can be damaged by continual opening and shutting of the doors, and badly stacked bags can slip during transit over rough roads or even in the store itself.

4.4 Bagging

Correct packaging protects the fertilizer against humidity and bad weather conditions; it eases handling, transportation and storage; it simplifies identification and finally it eases use by the farmer.

The most commonly used types of bags designed both to maintain fertilizer in the best condition and to be handled with the greatest efficiency are analysed below.

4.4.1 Types of bags

The choice of packaging material should be related to the individual characteristics of each type of fertilizer: hygroscopicity, free acid, granulation, volatility, etc. Materials used for packaging include plastics, jute and paper.

The average dimensions of a 50 kg fertilizer bag, when full, are: length 92 cm, breadth 60 cm, thickness 15 cm, as shown in Figure 44.

Plastic bags

Initially, the use of plastic bags presented some disadvantages compared with jute bags because they did not withstand the rough treatment they were given. Now, with the development of woven plastics and of stronger, lighter and cheaper bags, the use of plastic bags has become advantageous for two reasons:

i. they do not rot and do not sustain fungal growth in hot, damp conditions;

ii. in some cases they can be stored in the open without suffering much damage, always bearing in mind that the storage period for fertilizers in plastic bags is limited as a result of ageing of the plastic in sunlight through the action of ultra-violet rays.

Despite these advantages, however, the dealer must observe the following precautions to obtain good use from plastic bags. To avoid deterioration due to exposure to sunlight, such as splitting and consequent absorption of ultra-violet rays by the fertilizer, stacked bags should be protected on the top and at the sides by black plastic sheeting or other material such as matting, as shown in Figure 45. This also helps to isolate the bags from ambient humidity.

Figure 44
Characteristics of a fertilizer bag

Cross-section

Length ..... 92 cm
Breadth ..... 60 cm
Thickness ..... 15 cm

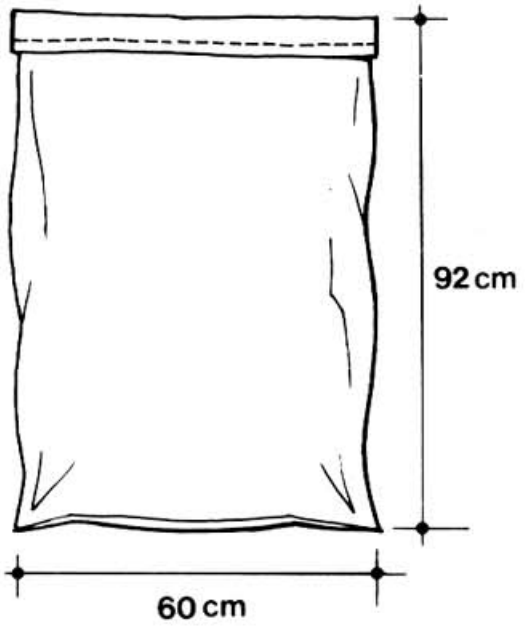
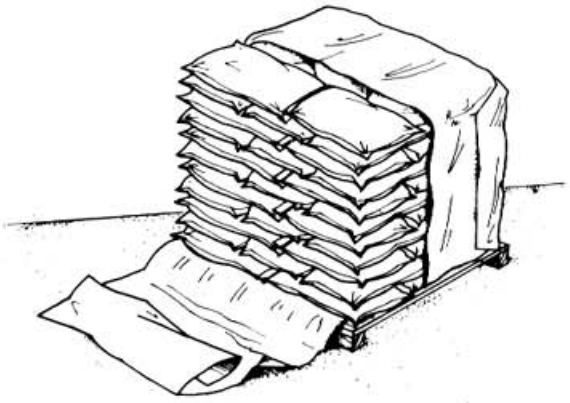


Figure 45
Protection of bags exposed to bad weather



The plastic materials most commonly used for making fertilizer bags, in view of their hermetic and waterproof properties, are polyethylene (PE), polypropylene (PP) and the two together.

Polyethylene bags

Polyethylene bags have the following advantages:

- transparency;
- relatively light weight (about 200 g);
- thermal stability;
- effective barrier to vapour;
- greater resistance to sun exposure.

However, certain precautions must be taken with this type of bag because they are liable to be badly torn either by hooks at the port or factory or by nails and splinters projecting from the sides and/or floors of vehicles used for transport. In general the most hygroscopic fertilizers, such as urea, are packed in polyethylene bags.

Polypropylene bags

Polypropylene bags have the following advantages over polyethylene:

- less slippery;
- stronger;
- less weight (about 100 g);
- greater resistance to tension because of dense weave (5 x 5 mesh/cm^2);
- cheaper.

In general, the least hygroscopic materials are packed in polypropylene bags.

Bags made of polyethylene and polypropylene

Good results are also obtained with bags made of low-density polyethylene (PE) on the inside and high-density polypropylene (PP) on the outside. With this double material the bags can better withstand tearing and rough handling during loading and unloading.

4.5 Storage

This marketing activity consists of storing and carefully maintaining fertilizers under optimum conditions for delivery and use at the moment they are needed.

The principal actions to be taken by dealers and storemen to rationalize storage relate to the storage area and stacking of bags, how to protect them so as to ensure that the fertilizers remain in good condition, control of stocks and rotation of bags.

These items are indispensable, on the one hand, to reduce losses and/or keep them at the minimum possible level and, on the other hand, to save time and to avoid major expenses while holding and maintaining stocks.

4.5.1 Storage area and stacking of bags

To determine the storage area on which to stack fertilizers, one starts from a basic unit which is one fertilizer bag. The bag may vary in its dimensions according to the product it contains. But all bags have a uniform weight of 50 kg, with average dimensions of 92 cm x 60 cm x 15 cm, as already stated. Based on this average size, the most practical methods of stacking are outlined below.

To keep the fertilizers in an orderly fashion in the store, the bags should be properly stacked.

For easier understanding, the different layers of the stack, their arrangement and their dimensions, are described below.

Firstly, the base of the stack has to be laid down, that is to say the area occupied by a certain number of conveniently placed bags, in the form of 3 side-by-side and 2 at right angles (the first layer) as shown in Figure 46. As may be seen in this diagram, it is recommended that a space of 10 cm be left between each bag to provide ventilation, particularly with ammonium nitrate.

On top of the base (i.e. bottom

Figure 46
Five-bag base for fertilizer stack

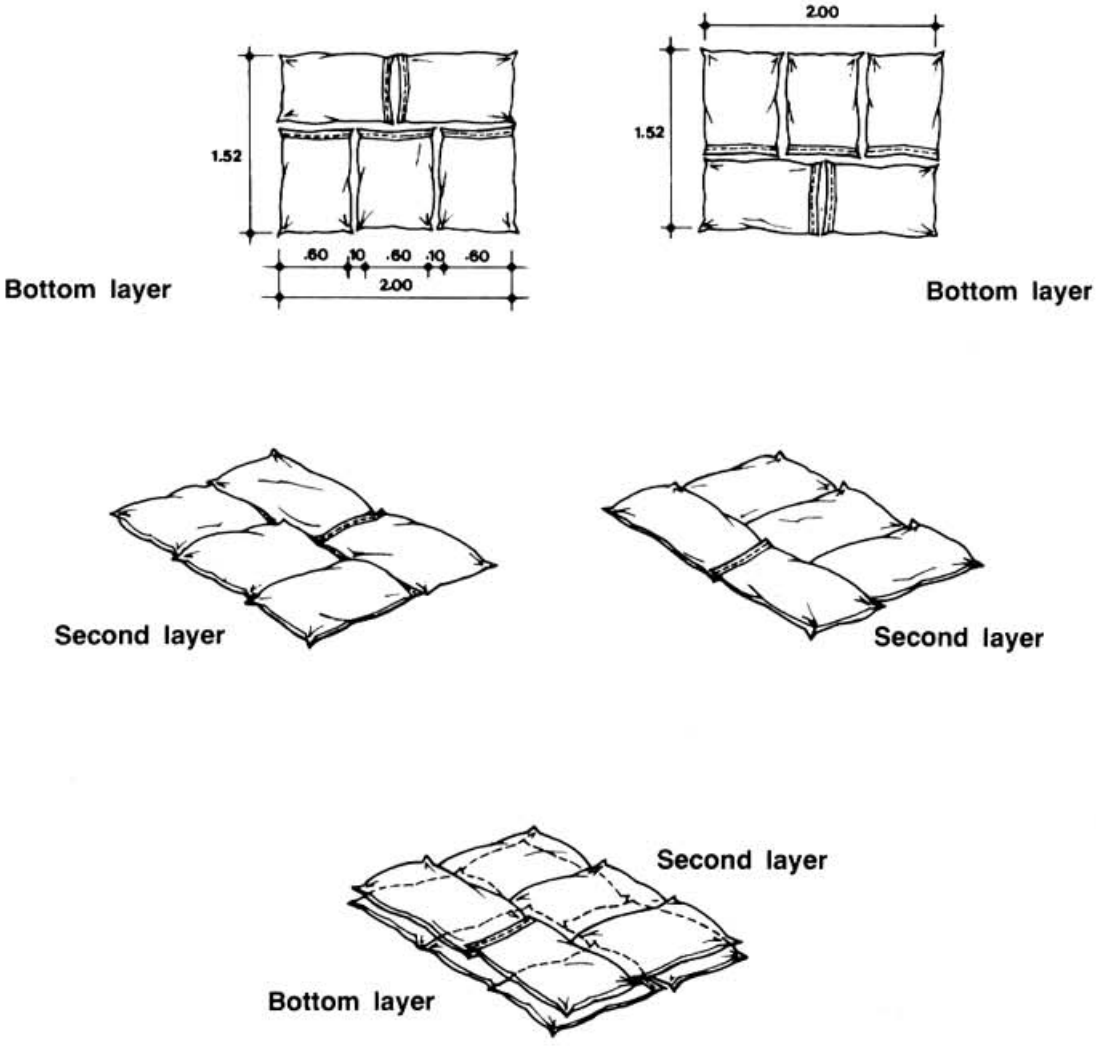
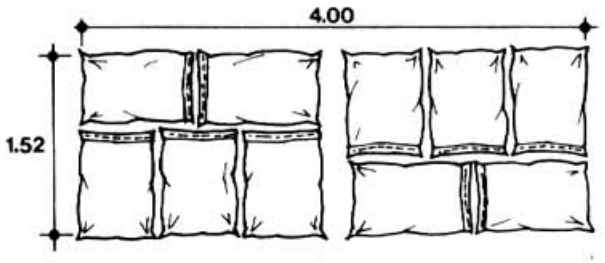
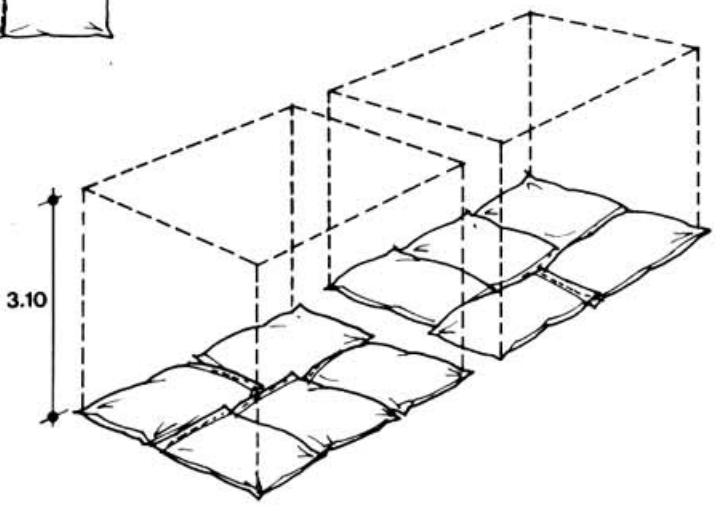


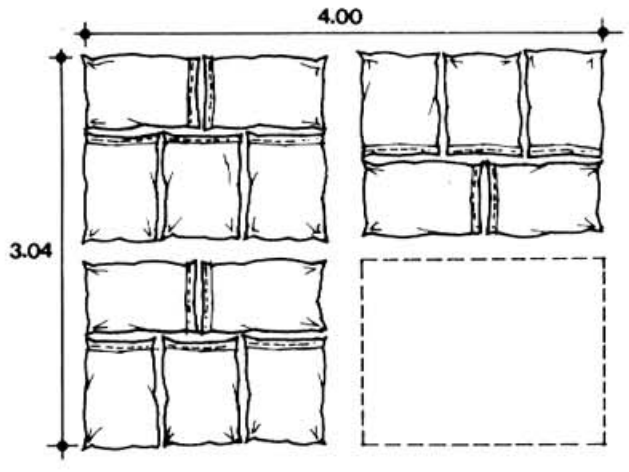
Figure 47
Two and four stacks of fertilizer bags



Two stacks

Area = 6.08 m²/capacity = 10 t





Four stacks

Area = 12.16 m²/capacity = 20 t

layer) a second layer is placed with the positioning of the bags changed as shown in the second part of Figure 46, and so on, layer by layer, up to a maximum height of 3.10 m.

In this case, the five bags in a 2 x 3 arrangement occupy an area of 3.04 m^2 (1.52 m x 2 m). A total of twenty layers to a height of 3.10 m gives 100 bags. Multiplying 100 by the 50 kg weight per bag, the total comes to 5000 kg or 5 metric tons of fertilizer.

So 2 stacks would occupy an area of 6.08 m^2 and comprise 10 metric tons weight; 4 stacks would amount to 20 metric tons weight and would occupy an area of 12.16 m^2, 4 m long by 1.5 m wide, as shown in Figure 47.

For control purposes and easy and effective counting, Table 28 shows the storage area in square metres occupied by such stacks. The column headed Area Occupied refers only to the area occupied by the fertilizer bags. In order to calculate the total storage area needed, another one-third must be added to allow for handling.

For example, to store 100 metric tons of fertilizer, an area of 80.86 m^2 is recommended. As was explained earlier, each type of fertilizer should be stored separately, i.e. one stack for single superphosphate, a second stack for ammonium nitrate, etc. as illustrated in Figure 48.

In the same way, and almost automatically, fertilizers packed in bags of different materials, for example those in polyethylene (PE) and those in polypropylene (PP) should also be stacked separately.

Table 28
Storage area in square metres according to tonnage

	Quantity of fertilizer (metric tons)	Area occupied (m^2)	Area needed (m^2)
	20	12.16	16.17
	40	24.32	32.35
	60	36.48	48.52
	80	48.64	64.70
	100	60.80	80.86
	120	72.96	97.04
	140	85.12	113.20
	160	97.38	129.51
	180	109.54	145.69
(Others)			
TOTAL	1 000	608.00	808.00

It is of the greatest importance when stacking to ensure that the bag openings always lie towards the centre of the stack, as shown in Figure 49, bearing in mind the vulnerability of the seams.

Figure 48
A separate stack for each type of fertilizer

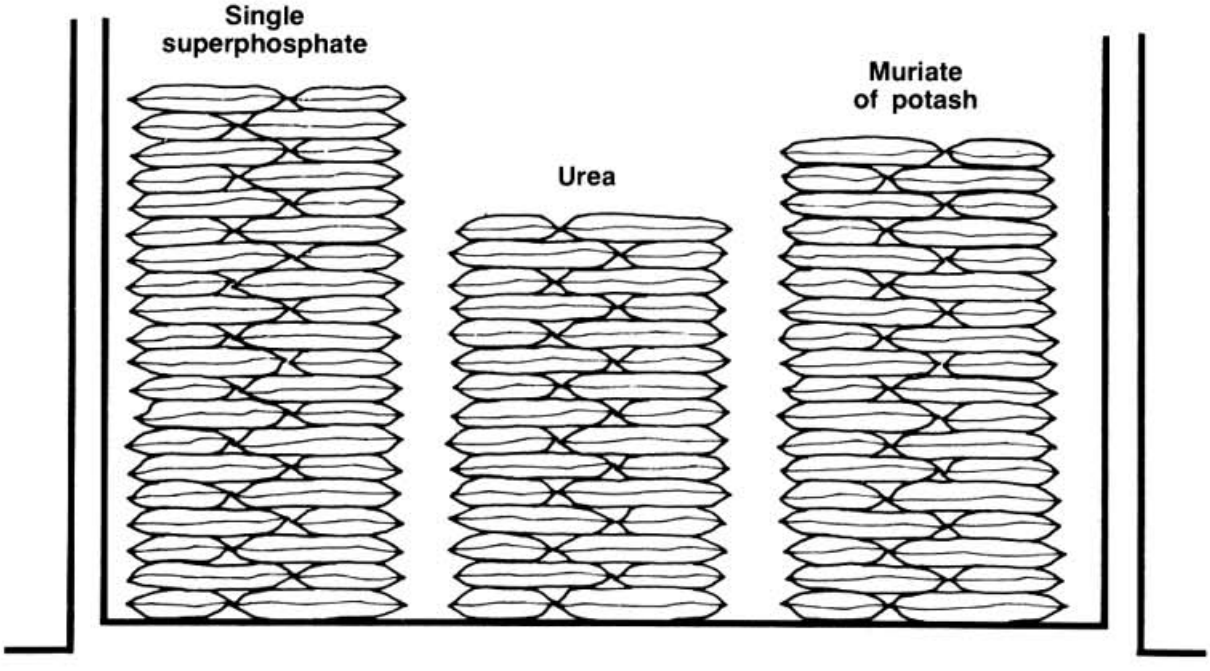
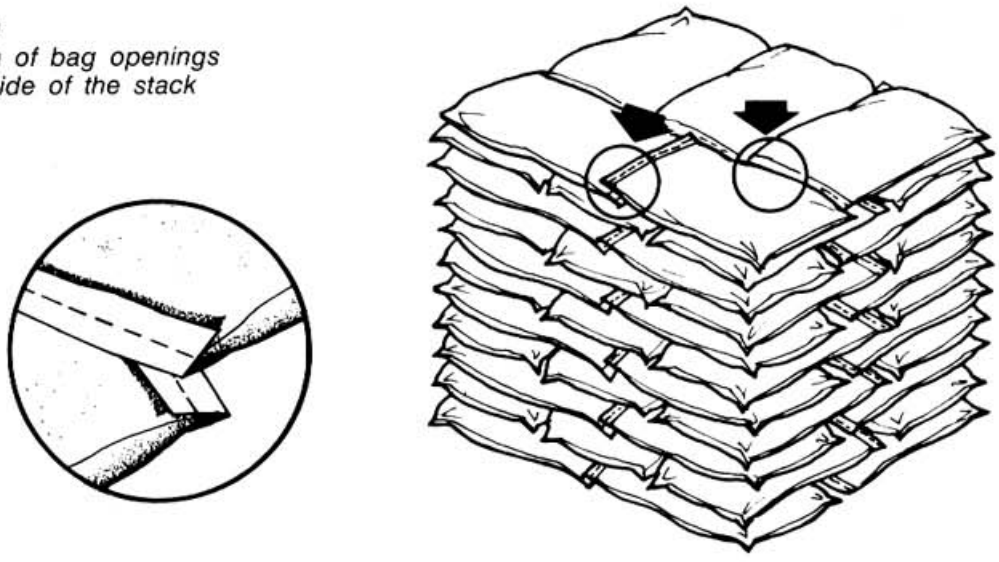


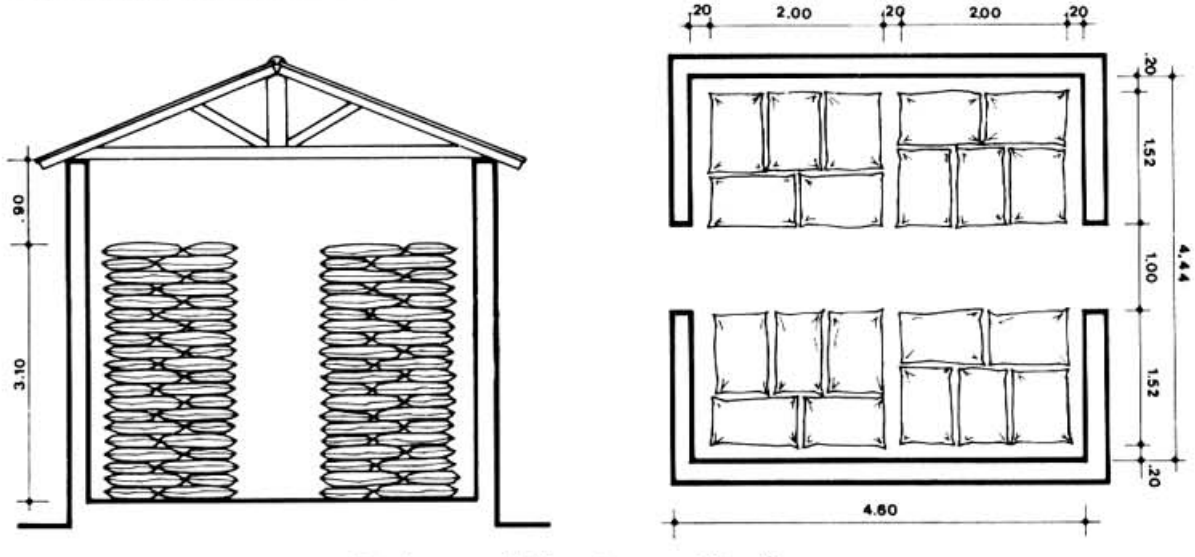
Figure 49
Protection of bag openings in the inside of the stack



In the same way, it is important to make allowance for a central corridor or gangway, one metre wide, according to the type of premises, to facilitate movement and handling of bags in the store. This will permit rapid counting or stocktaking. One should also allow a space 20-30 cm wide between the stacks and the walls, so as to avoid pressure from the weight of the stacks against the walls of the store and to prevent the fertilizer coming into contact with damp walls. In addition, space between the tops of the stacks and the base of the roof enables personnel to move about and facilitates loading and unloading, as shown in Figure 50.

As regards the height of the stacks, they ought in theory not to exceed 15-20 layers of bags. It should be noted that lower stacks are better for the bags and their content, because they are then subjected to less pressure. It is

Figure 50
Correct siting of stacks in the store



Total area of the store = 20 m²
Capacity = 20 t (4 stacks of 5 t each)

useful to remember that 15 layers of 2 bags each (i.e. 30 bags of 50 kg) exert a pressure of 1.5 metric tons (1500 kg) on an area of about 0.8 m^2.

Finally, when stacking bags, the problem of compaction, which is common to all fertilizers, must be remembered.

Compaction results mainly from excessive weight of the column of material pressing down on the bottom layer of fertilizer. The ideal height to minimize the risk of compaction varies between 3.1 and 3.5 metres, as shown in Figure 51.

4.5.2 How to protect fertilizers

Due to unfavourable conditions in storage without proper shelter, the bags should be protected in the following manner.

On earth floors which hold moisture and provide little stability for stacking, direct contact between the fertilizer and the soil should be avoided. This can be done by installing a false floor which isolates the stack of fertilizer from the moist soil and at the same time guarantees aeration. It also protects the earth floor from any damage that might be caused by the fertilizers.

False flooring (or dunnage) can be made easily and cheaply using materials locally available to each region such as bricks, planks, wooden slats, etc. With the selected material a platform can be made 2 m x 1.52 m, i.e. of the same dimensions as the 5-bag base of a fertilizer stack, see Figure 52.

Figure 51
Height of the stack

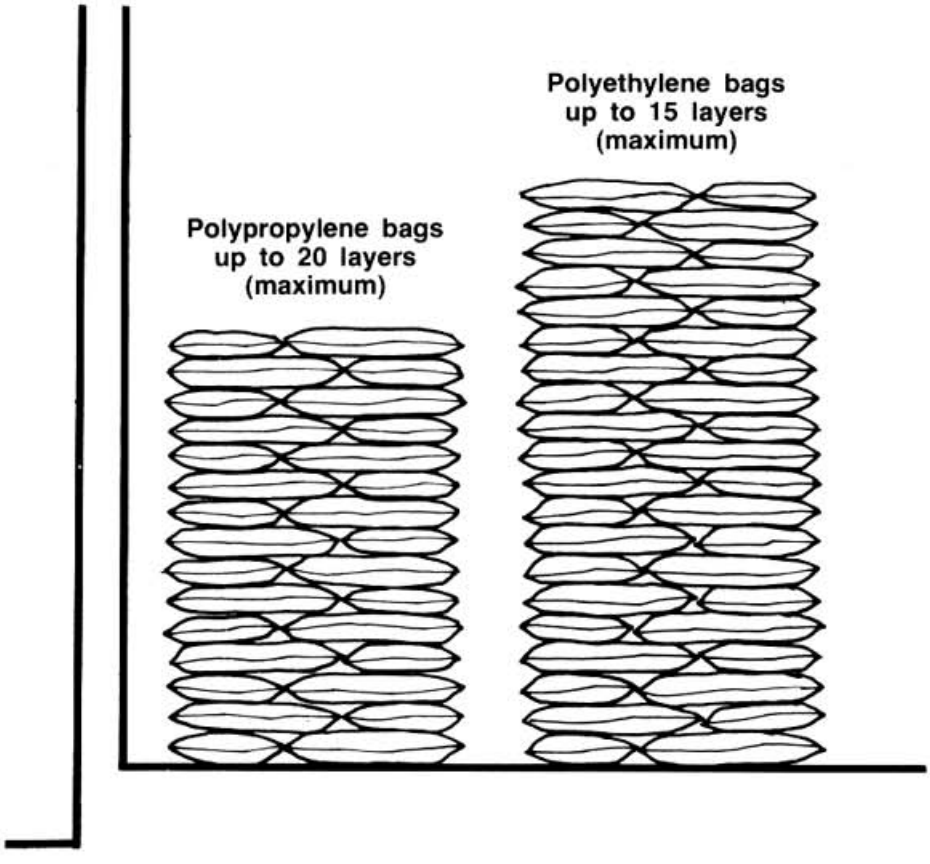


Figure 52 shows a platform made from 7.5 cm x 7.5 cm timbers with planks 10 cm wide and 1.5 to 2.5 cm thick placed across them.

Where a false floor of this description is impracticable, locally available materials such as bamboo matting, rice hulls, straw, old sacks, etc. may be used. A false floor may be made by spreading the selected material on the earth floor, then putting a plastic cover over it, and then spreading a second layer of the selected material on top.

In the case of ammonium nitrate, on account of the explosion hazard, it is not recommended to stack this fertilizer on top of organic materials such as straw, etc. It may be stacked, however, on a wooden platform. Figure 53 shows a false floor made of bamboo and matting which costs very little.

Figure 52
False floor or dunnage

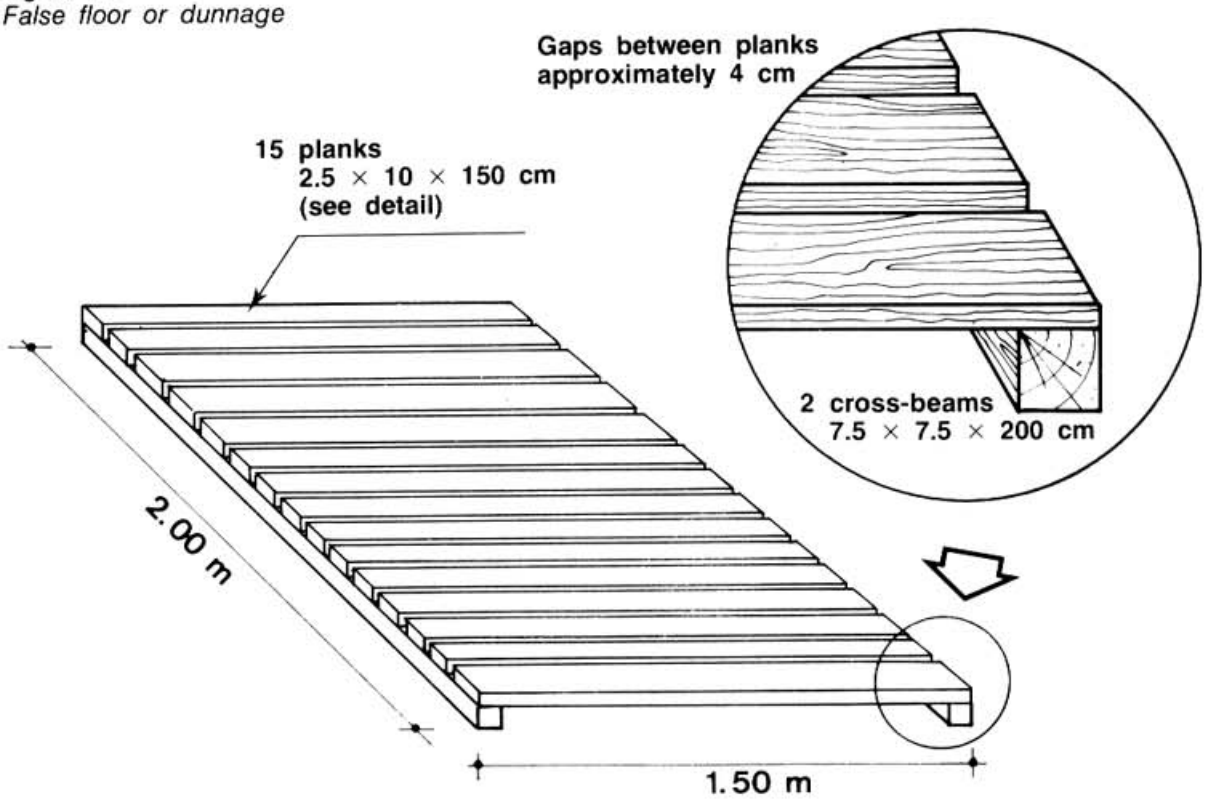
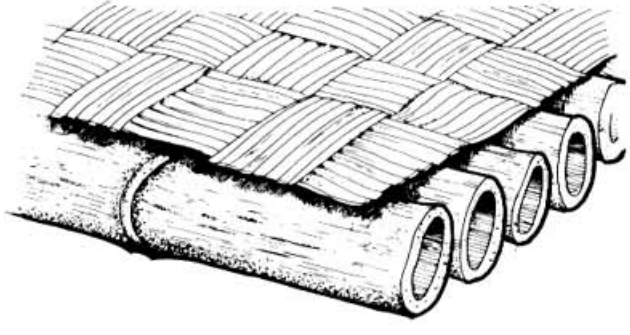


Figure 53
False floor made of bamboo and matting



Where bags are stacked near windows facing the sun and liable to be exposed to prolonged sunlight, it is recommended that the windows should be darkened by using newspaper or old sacks, for example, or simply by painting the panes of glass black, as is shown in Figure 54.

When following the above instructions for the protection of fertilizers, attention must be paid to doors and windows. In periods of high humidity, ventilators, opening windows and doors must be kept firmly shut. The store should only be ventilated during certain hours of the day when the ambient humidity is low and the temperature high. In this way, condensation of water vapour in the store will be avoided.

It should be remembered that humidity rises at night. Consequently, doors and windows should be shut before nightfall.

Fertilizers should always be stored on a floor that is kept clean by continually brushing away any spilled fertilizer (sweepings) or other spilled material, because they hold the damp and cause deterioration of the floor and/or the walls. For this reason it is advisable not only to sweep the floor frequently but also to paint the walls, especially when they are damp or dirty.

Figure 54
Darkening the windows of a store

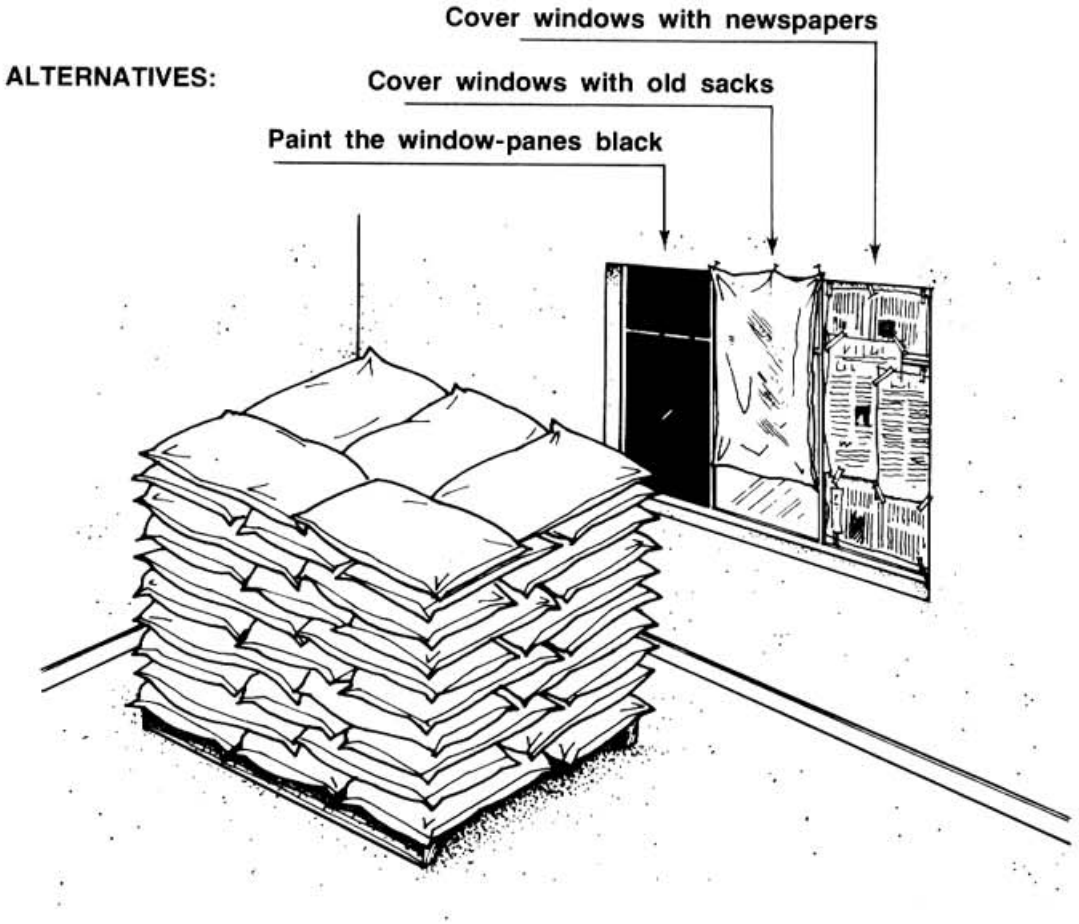


Figure 55
Index card for store inventory by fertilizer type

PAGE _____

INDEX FOR STORE No. 001

STORE CODE _____

PLACE _____

DATE OF MOVEMENT	REFERENCE DOCUMENT	INTO STORE	OUT OF STORE	BALANCE OF STOCK
1-3-80	R/I - 13257	100		100
1-3-80	G/S - 23837 -59		20	80
	TOTAL FOR THIS CARD			

Continued on page _____ Card No. _____

Code: Description: UREA Unit: BAG Unit weight: 50 kg.

Finally, special care should be taken not to store fertilizers near other products such as oil, liquids or inflammable or easily combustible materials or objects. If the necessity should arise to use the building for storing other products such as grain, seed and other inputs, then the building should be thoroughly cleaned and ventilated before and after storing fertilizers. All the other products should be bagged.

4.5.3 Stock control and rotation of bags

Stock levels should be controlled by means of index cards and the maintenance of a separate file for each type of fertilizer, which then acts as a store inventory providing quick and accurate information on daily stocks and the rotation of bags.

These index cards should contain the information shown in Figure 55, such as date of movement, into or out of store, balance of stock held in store.

Also, on receipt of a fertilizer consignment, a note should be made of any bags which have arrived in bad condition (torn, opened, etc.), any short weight, and any shortfall in the number delivered, i.e. bags despatched from the wholesaler but which have not been delivered to the retailer.

For a correct rotation of goods in store it is essential that the first lots received are the first to be despatched, in other words: first in first out, as shown in Figure 56.

4.6 Fertilizer Transport

Transportation is a marketing activity which consists of moving fertilizers from one point to another, from the factory or port, through the wholesalers and retailers, to the user. In most cases the fertilizer has to be transported over long distances and handled several times in the course of loading and unloading.

Transport and handling of ferti-

Figure 56
First in — first out

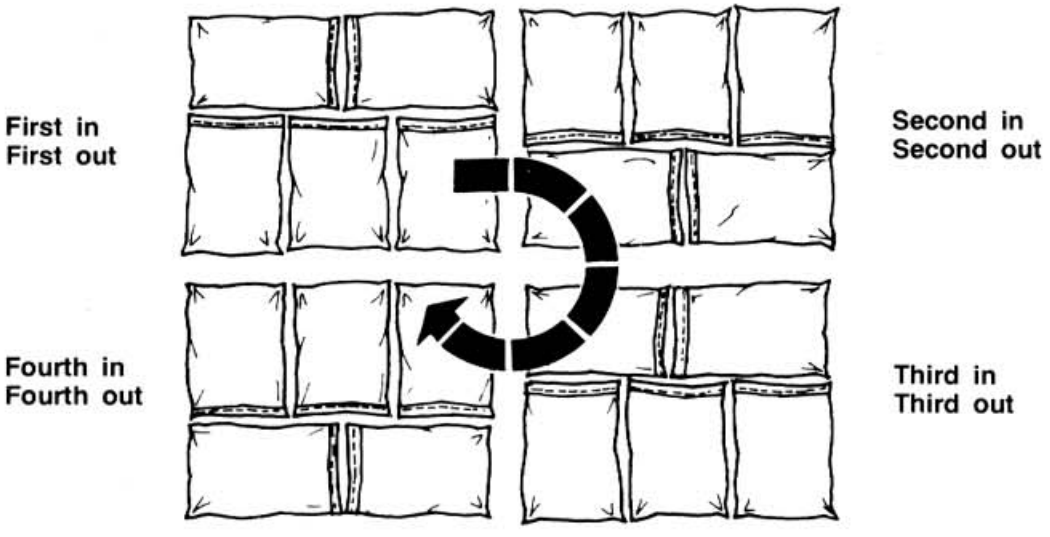


Figure 57
Methods of carrying fertilizer bags

They are picked up like this. **They are carried like this ...** **or like this.**

lizer therefore call for rational planning if this input is to reach the user at a minimum price, at the right time and in good condition. With this objective, transport and handling can be simplified so as to save time and money, especially from wholesalers and retailers to the end user.

4.6.1 Loading and unloading

There are various ways of improving loading and unloading of bags from factory and warehouse to the farmer.

First, Figure 57 shows the correct manner of carrying bags from the lorry or from the stack inside the store. There are two ways of carrying: either on the shoulder or in the arms, depending on the employee's individual choice and on the physical characteristics of the fertilizer to be carried.

To ease the loading and unloading of fertilizer as well as the work of the man who has to carry it, he should be able to count on a helper to place the bags on his shoulder, as illustrated in Figure 58.

Figure 58
Unloading fertilizer bags from a lorry

If the bags are put on the shoulder of a man weighing about 65 kg who should be able to move over a floor free of obstruction, he would be able to carry a 50 kg bag a distance of 20-25 metres without showing signs of fatigue.

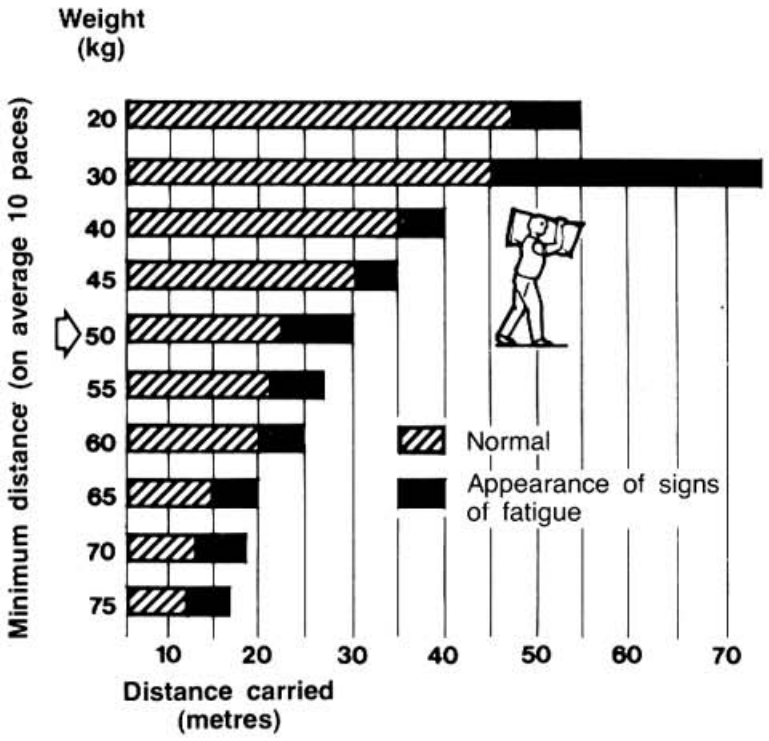
Table 29 shows the distance that a man can normally carry a 50 kg bag on his shoulder on a cement floor free of obstructions. This distance averages 22 metres.

Another way of simplifying handling inside the store consists of mechanizing a part of the loading or unloading of the fertilizer in order to save time and distance.

In the first place, in large or average-size stores, a moving belt may be used from the lorry to the store entrance or to the stacks, as shown in Figure 59. This facilitates the movement and handling of the fertilizer to the inside of the store. This equipment has a handling capacity of 30-50 metric tons per hour.

Alternatively, if it is not worthwhile investing in a moving belt, the purchase of which is only justified for stores with a quick turnover, loading and unloading of fertilizers can be greatly eased if the floor of the store is at the same level as the floor of the lorry. This can be done by building a platform in front of the entrance to the store to a height equal to the height of the lorry floor (this is illustrated in Figure 60). It also allows the introduction of a semi-mechanized system of loading and unloading.

Table 29
Relation between the weight of fertilizer bags carried on the shoulder and the distance they can be carried



Note: Bags are placed by another person on the shoulder of a man weighing about 65 kg and walking on a cement floor free of obstacles.
Source: Juan Urbina Barreto, UNA, La Molina

Figure 59
Loading and unloading fertilizer bags on a moving belt

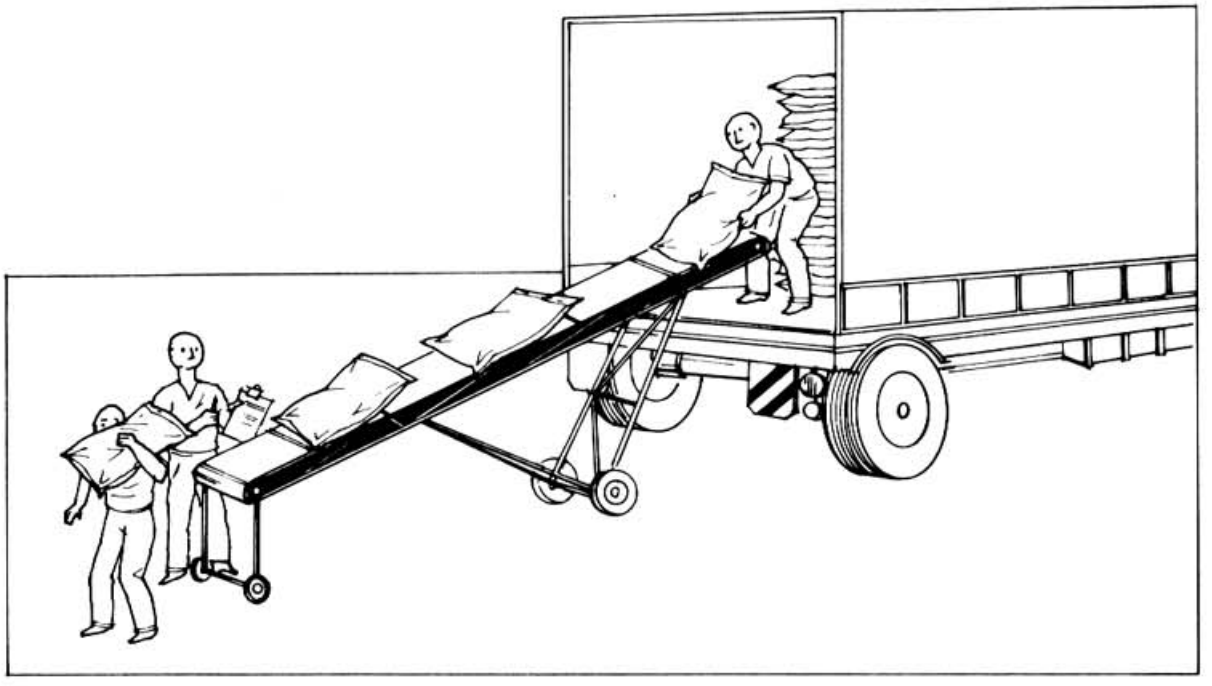
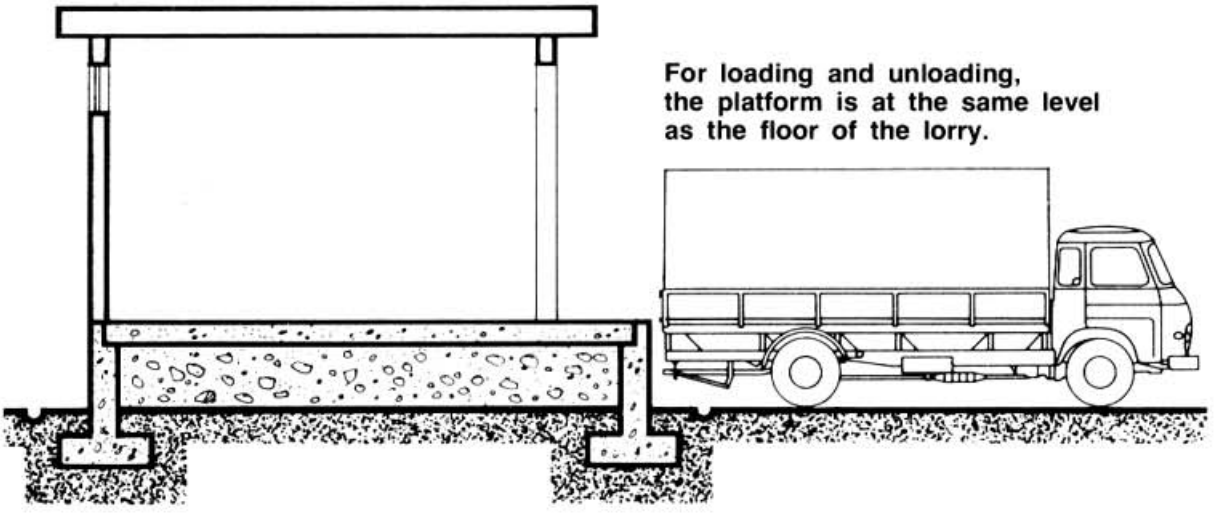


Figure 60
Raised exterior platform for loading and unloading



At the wholesale level, mechanized hoists or fork-lifts may be used for more rapid movement of fertilizers inside the store, depending on the type of warehouse and the movement desired. A fork-lift and a wooden pallet of appropriate dimensions are illustrated in Figure 61. This equipment can carry between 1 and 2 metric tons (i.e. between 20 and 40 bags stacked on a pallet). They increase the efficiency of loading and unloading, and reduce the amount of manual labour and handling costs at factories, ports and large and medium-size warehouses.

In smaller stores ordinary stack trolleys may be used, see Figure 62, which carry up to 300 kg or 6 bags stacked one on top of another. These small metal trolleys, of the type used in wholesale markets and elsewhere, can easily be bought or assembled.

Figure 61
Fork-lift and front loader for carrying fertilizer

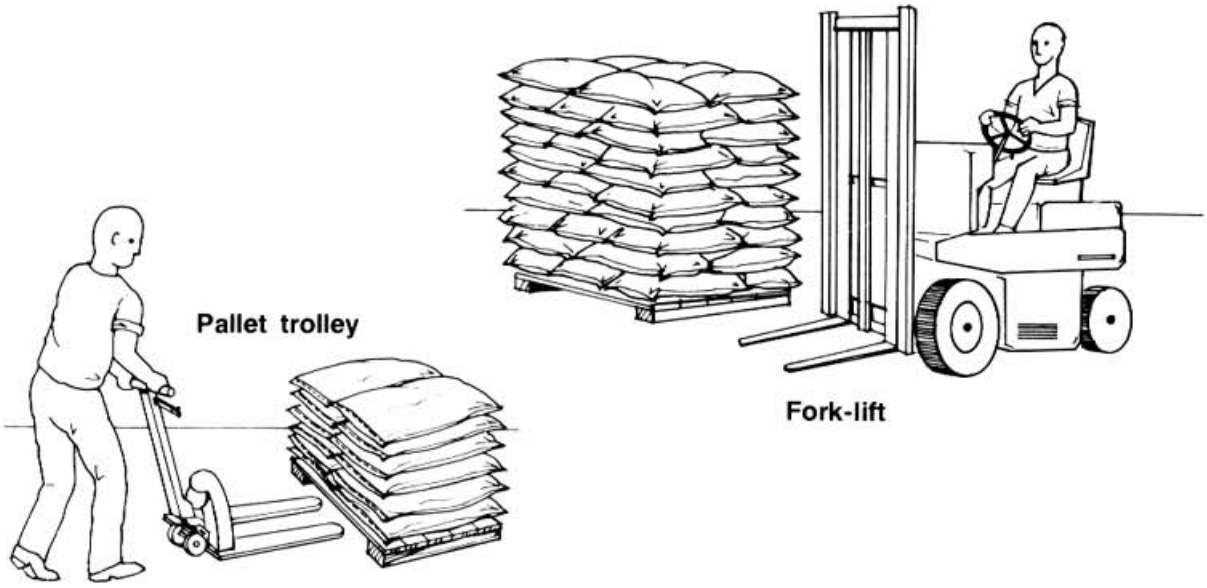


Figure 62
Sack trolley for carrying fertilizer

Figure 63 summarizes the whole process of loading and unloading fertilizers, transporting them from the central warehouse to the retailer, and delivering them to the user, employing the improved methods described above.

4.6.2 Organizing transport

For transporting fertilizers from the wholesaler to authorized retailers' stores, dealers may use their own vehicles or employ haulage contractors or hire lorries themselves. Each of these methods has advantages and disadvantages of which one should be aware.

The use of his own vehicles will be more economic for a retailer when he can be assured of a return load, which is not always feasible. This limitation can be overcome by employing a haulier or lorry rental firm whose principals are in a better position to find return loads. Their continuing haulage activities allow them to handle different types of load. For example, a haulier who has an order to collect fertilizers from a dealer will take the opportunity to carry, in the opposite direction, harvested crops to the market or commercial centre.

In organizing transport rationally, bear in mind that the transport cost is the highest of the general distribution costs (handling, storage, bagging, etc.). Consequently it has a major influence on the fertilizer price that is paid by the end user.

The real cost of transport depends on various known factors such as distance, the condition of the roads, return load and the efficiency of the transport services, see Figure 64.

To make efficient and economic use of transport, attention must be paid to the following major points.

i. The capacity of the vehicle is an important factor. Loading an average of 80% of the capacity can result in a loss of 20-30%. Completely using the capacity of the vehicle results in a major saving in cost, as may be seen in Figure 64.

ii. When the vehicle returns empty, the transport cost rises considerably because the dealer then has to cover the cost of the empty return journey. Figure 64 shows how to make better use of capacity with the return load.

iii. The cost of transport also varies with the distance travelled. The greater the distance, the lower the cost per ton kilometre. As may be seen in Figure 64, the most direct transport from the central warehouse to the retailer will reduce the number of times the fertilizer has to be loaded and unloaded, and thus also the handling cost.

iv. Finally, transport costs can be still further reduced by buying more highly concentrated fertilizers. For example, one metric ton of nitrogen in the form of urea requires a load of 2222 kg, while the same amount of nitrogen in the form of ammonium sulphate requires a load of 4762 kg. That is to say, when transporting one ton of ammonium sulphate one is paying a supplementary freight charge equivalent to 2540 kg.

In summary, fertilizers with a high content of nutrients considerably reduce the cost of their transport, see Figure 64, not only as far as the retailer but also from the retailer to the farm.

Figure 63
Loading and unloading of fertilizers during transport (from the main warehouse to the end user)

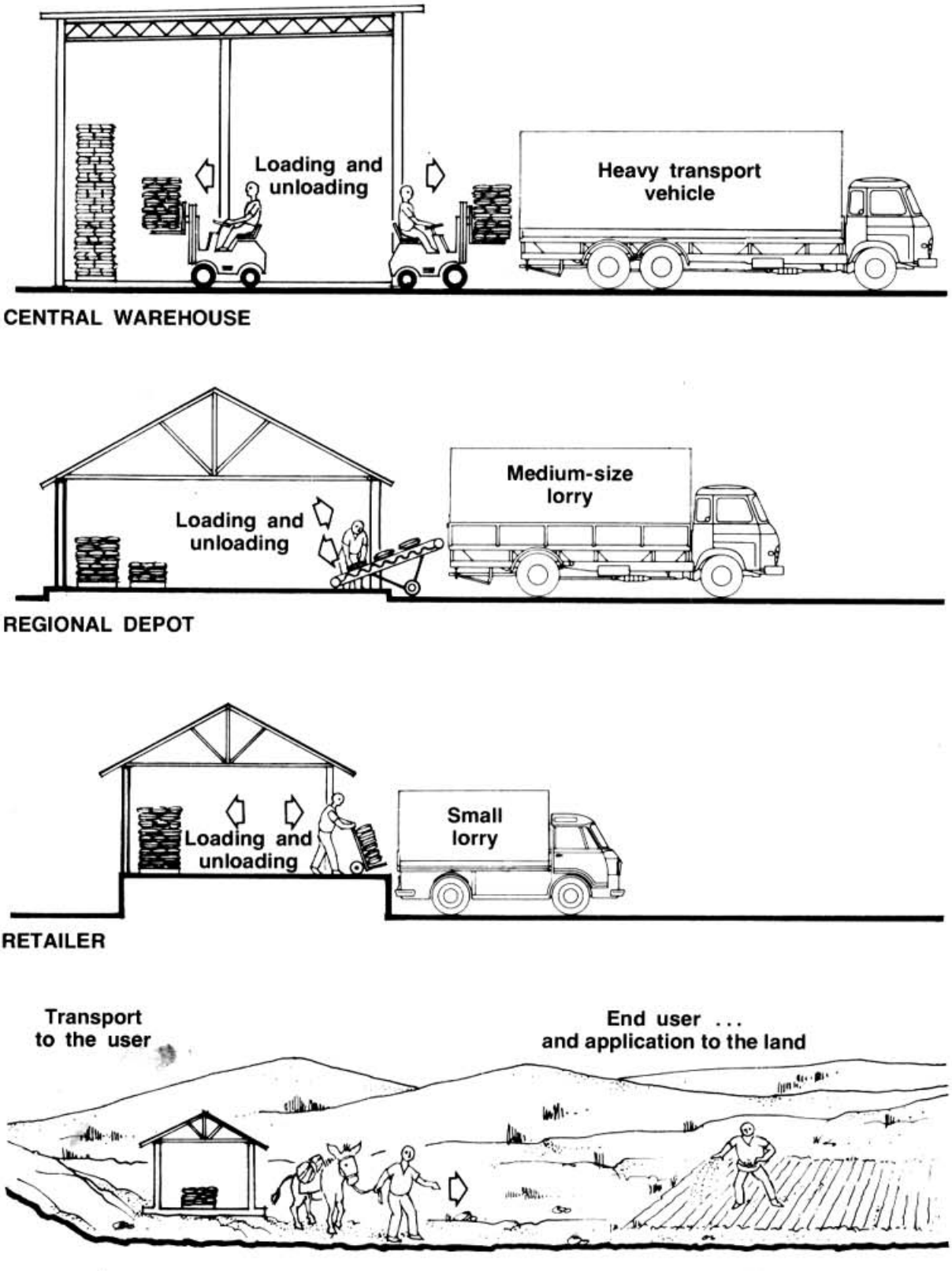
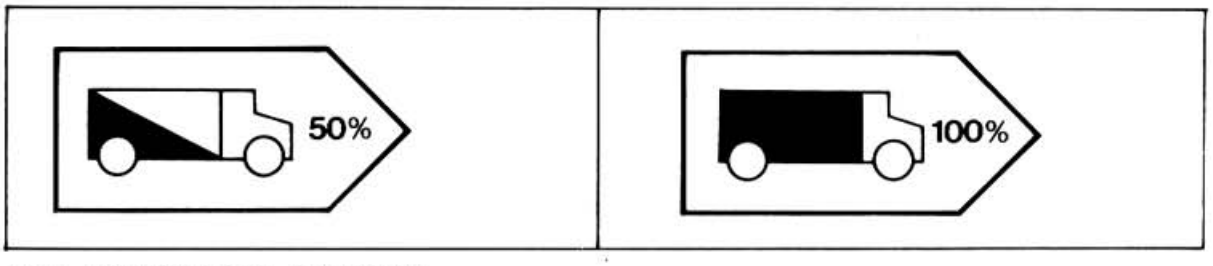
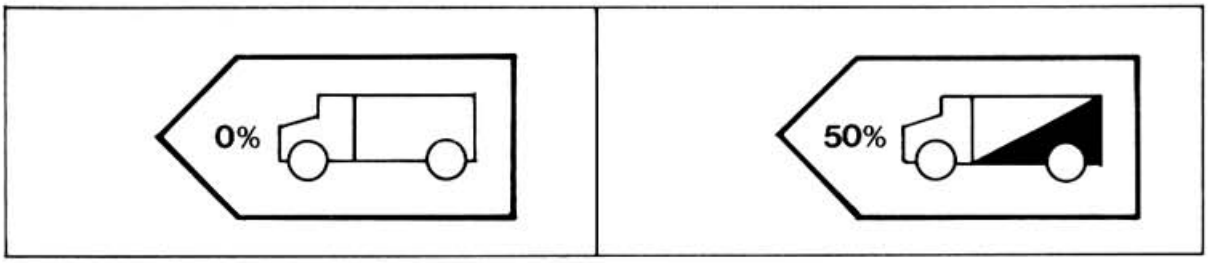


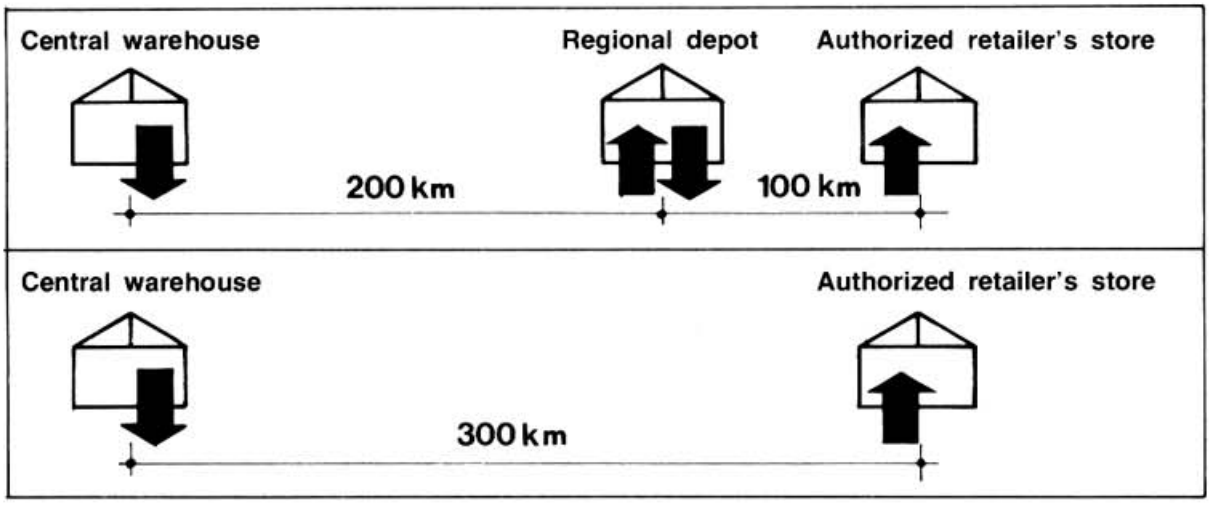
Figure 64
How to reduce transport costs



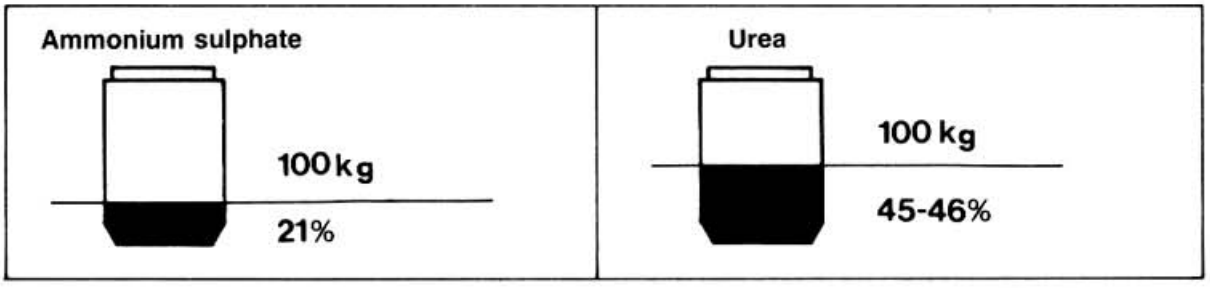
FULL USE OF LOAD CAPACITY



INCREASED USE OF CAPACITY FOR RETURN LOAD



DIRECT TRANSPORT REDUCES THE AMOUNT OF HANDLING



A MORE CONCENTRATED FERTILIZER REDUCES COST OF TRANSPORT

Exercises on handling and storage of fertilizers

1 Which fertilizer is the most hygroscopic and from what critical humidity (%) does it become hygroscopic?

2 In the case of mixtures of straight fertilizers, taking as an example urea and muriate of potash, what is the critical humidity (%) from which this mixture becomes hygroscopic?

3 Which fertilizer contains the most free acid?

4 Which fertilizer is of an explosive nature and what precautions must be taken during its storage?

5 In what type of plastic bags are (a) urea and (b) muriate of potash sold?

6 What are the average dimensions of a full fertilizer bag (length, breadth and thickness in cm)?

7 Sketch the 5-bag base of a stack of fertilizer.

8 What storage area (m^2) is occupied by (a) 5 bags of fertilizer (i.e. 250 kg) and (b) 10 metric tons stacked on a 5-bag base?

9 Sketch a fertilizer stack, showing the maximum height in terms of the number of layers for (a) polyethylene (PE) bags and (b) polypropylene (PP) bags.

10 Supposing the available stock in your store on 1 January 1980, according to the card index for urea, is 50 metric tons and that, on 2 January 1980, you invoiced 20 metric tons of urea of which 10 tons were returned, what is the balance and what will the store inventory show on the evening of 2 January?

11 Rotation of fertilizers coming into and going out of the store is necessary. State what you think this means: whether "last in first out" (i.e. the last to have come in is the first to go out) or whether the first to have arrived should be the first to be sent out.

12 Show by means of a drawing how a 50 kg fertilizer bag should be carried from a lorry into the store and indicate how far (in metres) a man can carry it without showing signs of fatigue.

13 What weight of fertilizer, in terms of the number of bags, can a small trolley carry?

14 Show how fertilizers are loaded and unloaded at the wholesale level.

15 Show how and by whom fertilizers are transported from the central warehouse to the wholesaler's regional depot and how the fertilizer is unloaded from lorries as far as the fertilizer stacks.

16 In what form are fertilizers delivered to farmers and what means of transport are most commonly used by the farmers who use them?

17 Explain how fertilizer transport costs can be reduced when using your own vehicle.

5 IMPROVEMENT AND CONSTRUCTION OF SMALL STORES

5.1 Introduction

The requirements for a warehouse or store depend on the quantity of fertilizers to be stored, the duration of storage, the local climate, on whether it is to be used only for fertilizers or, also, at particular periods of the year, for other inputs and agricultural products.

This chapter gives a series of technical recommendations which will enable the retailer, within his capabilities, to improve and maintain his fertilizer store or to construct a new store, making use of locally available materials.

These recommendations are for stores with an annual turnover of 300-2000 metric tons of fertilizers and a storage capacity of 50-150 metric tons of fertilizers at a time. Larger warehouses whose construction calls for detailed and specialized engineering drawings, which are beyond the scope of the present Chapter, are not dealt with here.

It should be added that there is no fixed rule by which to determine the marketed tonnage beyond which investment in enlarging an existing store or constructing a new one would be justified. It might, however, be said that it is always necessary to improve existing stores and that new ones may generally be constructed when the annual quantity marketed is in excess of 600 metric tons.

5.2 Maintenance and Improvement of Small Stores

Fertilizer stores should combine the minimum conditions of security, hygiene and cleanliness for good functioning and to provide the needed protection for the products they contain. Fertilizers need to be kept in a dry atmosphere, protected from rain, sunshine and dampness. At the same time, the layout should allow easy access for loading and unloading and for rapid stocktaking.

Protection of fertilizer has obviously become much easier with the widespread use of airtight, waterproof plastic bags. Use of these bags, moreover, allows fertilizers to be stored together with other products in the same building, so long as it is clean and well ventilated.

When overhauling or improving existing stores, it must not be forgotten that all the element of construction - floor, walls, roof, doors and windows - are subjected in one form or another to:

i. chemical reactions with fertilizers, for example when the latter are badly packed (torn or burst bags) or stored for a long period;

ii. action of the ambient atmosphere.

Firstly, floors are subject all the time to abrasive action due to decomposition of fertilizers which often happens. If this occurs, the affected portions should be repaired, taking care that the repaired areas are rectangular or square in shape. There should also be a border around the damaged areas, equivalent to an additional one-third in area. Finally, a mortar mixture (1 part cement to 5 parts coarse aggregate) should be poured over the surface and then smoothed down.

Floors are also subject to forces of tension (stretching) and compression (contraction) which cause cracks. These result from sudden changes in temperature. To remedy the damage, it is best to replace the damaged areas, using the same material and the same technique as mentioned above in respect of both shape and filling in.

Moreover, dampness and fissures may be produced when water rises to the surface by capillarity, so causing deterioration of the stored products. In this case the capillarity should be interrupted by removing the affected portion of the floor, re-covering with concrete at least 20 cm thick, and pouring over it a new surface, preferably using materials in the same proportions as mentioned above.

Secondly, walls are generally damaged by the ambient humidity causing cracks and fissures. To alleviate such damage, it is recommended that exterior walls should be painted once a year with a washable, waterproof latex-based paint. If the damage has already been done, however, the walls should be repaired, the damaged parts taken out and filled in with the same material, and then the walls should be painted.

In a dry climate, only the exterior would be painted with a latex-based paint; a lime base would be used for the interior surfaces. In a humid climate the latex-based paint should be used for both the exterior and the interior surfaces.

As regards roofs, when they are of wood they may be attacked by insects depending on the type of wood. To remedy this, the wood should be treated with a mineral oil product. For metal roofs or for metallic structures oxidized by the ambient humidity, it is best to clean them with a wire brush and then to use a corrosion-resistant paint, three times year in a humid climate or twice a year in a dry climate.

Finally for doors and windows, whether of wood or of metal, there are the same causes of damage as for roofs and ceilings. The same maintenance procedures should be followed, i.e. painting at least twice a year. For better functioning of doors and windows, it is advised that hinges should be made of cadmium so that they do not oxidize easily.

5.3 Elements of Construction of Small Stores

The structure of a depot or store consists of a floor, walls, a roof or ceiling, doors and windows. The construction of these items is related to the most suitable materials in each area and their price.

To assist good construction of small stores, technical recommendations are given below for each item.

5.3.1 Floors

In most small stores the floors are of beaten earth; only a few are cemented. In general, earth floors are satisfactory but they have their disadvantages, both in the stacking of bags, on account of unevenness in the surface (mainly in large stores), and in the damage to the floor which can result from the pressure exerted by the weight of bags.

The floor should have the following characteristics:

- a level, flat surface;
- a resistant, dry surface:
- the floor covered or made with materials such as bricks, ordinary or reinforced concrete, stones and mortar, or wood.

Figure 65 shows the characteristics of a floor at the same level as the exterior loading bay or platform and as the floor of the lorry, to ease loading and unloading.

Types of floors differ according to the materials of which they are made. Thus, there are rustic floors, 90% of which are made from the existing soil and 10% with

added material or from new material; and there are finished floors composed 100% of an industrial nature, which give a uniform surface.

In making a floor it is important to take account of the topography of the terrain so as to obtain a flat, hard and dry surface as indicated above. Then, attention must be given to cleanliness and levelling, the digging of drainage ditches, timbering and pouring of concrete, erection of retaining walls, and finally the filling and compacting of the surface on which the material chosen for the flooring is to be spread.

Analysis and determination of the prices of the different types of materials to be used in the structure of rustic and finished floors can be estimated on a square metre basis as indicated in Table 30.

Figure 65
Floor of a store at the same level as that of a lorry

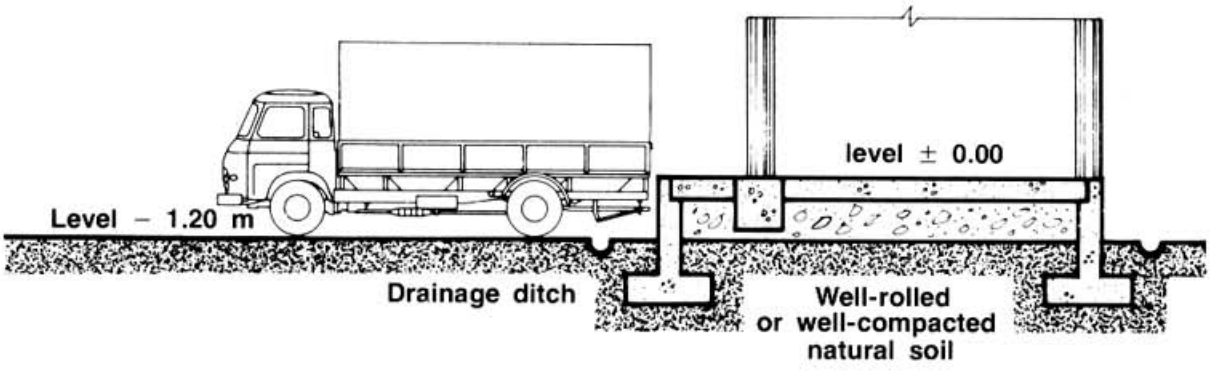


Table 30
Materials for the construction of rough or finished floors

	Type	Unit	Quantity (per m^3)
i.	Asphalt floors	litres	4
ii.	Lime floors	kg	6
iii.	Cement floors	kg	6
iv.	Brick floors		
	Brick (12 x 12 x 40)	number	13
	Cement	kg	3
	Concrete	m^3	0.1
v.	Rough wood floors	ft^2	70
vi.	Cobbled floors		
	Cobblestones	m^3	0.25
	Cement	kg	16
	Sand	m^3	0.062

5.3.2 Walls

The walls of small stores are generally made of local materials, although they are often not the best.

Walls should have the following characteristics:

- they must be deeply embedded in the soil;
- they must be absolutely vertical;
- they must be resistant to horizontal movements or forces such as wind, earth tremors and other pressures;
- they must be impermeable to the humidity of the ambient atmosphere;
- they must have perfect joins with other walls and the roof (see Figure 66).

The different materials that can be used for the construction of walls are: bricks, wood, corrugated iron.

5.3.3 Ceilings and roofs

The covered part of existing small stores is often inadequate because it covers only a part of the area and does not provide side protection against sun, rain, wind, humidity, etc.

The characteristics of the roof are determined by climatic factors. For example, in dry zones, roofs can be almost horizontal. In wet zones, they must be sloped at an angle depending on the intensity of rainfall so that the water runs away quickly.

Roofs should have the following characteristics:

- they must be horizontal or sloping according to the locality;
- the surface must be resistant and waterproof;
- the frame must be of wood, iron or reinforced concrete;

Figure 66
Walls and roof of a small store

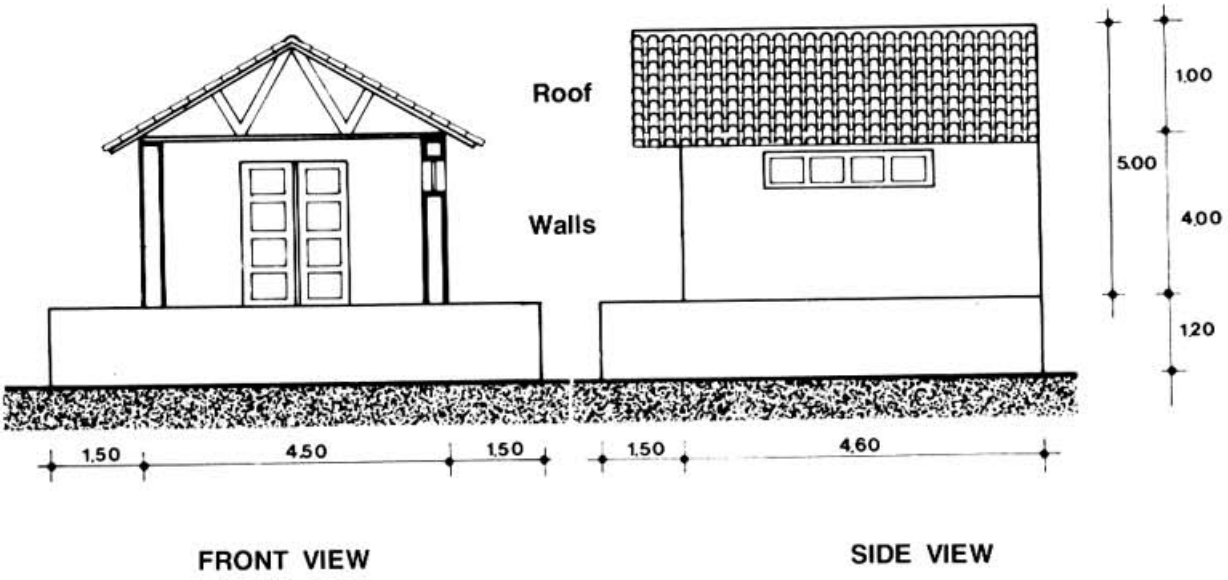
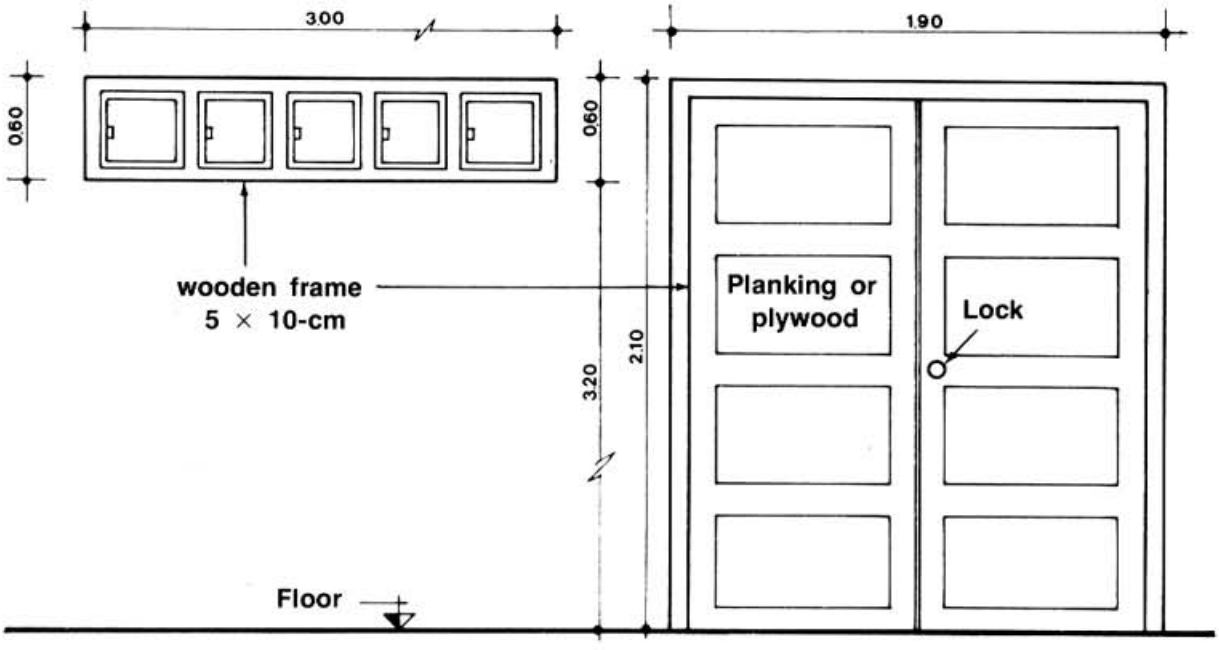
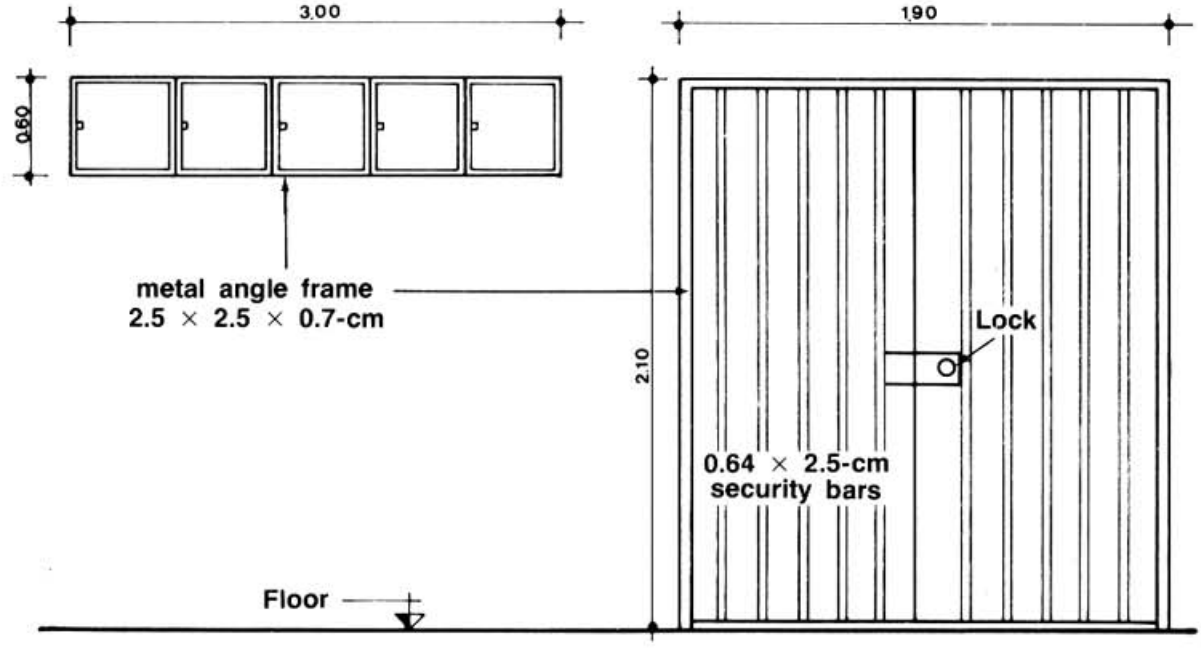


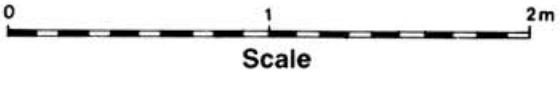
Figure 67
Types of doors and windows

WOODEN DOORS AND WINDOWS



METAL DOORS AND WINDOWS





- the covering may be tiles, straw, matting, reeds, eternit, corrugated iron, thin stone slabs, etc. (see Figure 66).

5.3.4 Doors and windows

In many cases the doors of small stores are low and narrow, which adds to the labour of storing and hinders movement of personnel engaged in loading and unloading.

Security, good lighting and good ventilation depend wholly on the characteristics of the doors and windows of the store, which should be as follows:

- flat, vertical surface;
- easy to open and shut completely;
- security and resistance;
- correct functioning of the locks;
- correct functioning of the hinges;
- frames secure and well-fitting.

Doors and windows may be of wood or of metal depending on the region. Types of doors and windows for a store are illustrated in Figure 67.

5.3.5 Construction materials

The principal materials used in the construction and/or improvement of small stores are listed below indicating the process of manufacture and their use in the structure of the different elements described above.

i. Earth: this means natural soil completely free of vegetable residues, rubbish and stones. The best is a balanced mixture of clay and sand from which bricks and other kiln-baked materials are made.

ii. Sand: this should not contain clay or earth in excess of 3% by weight.

iii. Coarse aggregate: the particles should be between 0.5 and 2 cm in size. The aggregate should come from hard, stable rock, resistant to heavy impacts and to deterioration caused by sudden changes in temperature. It should not contain earth or clay in excess of 1% by weight.

iv. Portland cement: this is a product with specific proportions of calcareous materials baked in a kiln and ground to a high degree of fineness.

v. Concrete: this is a mixture of Portland cement, sand, coarse and fine aggregates and water. It is generally used for floors and pathways.

vi. Heavy-duty concrete: this is ordinary concrete to which stones of 25 cm diameter are added in a proportion not in excess of 30% by volume. It is used for the foundations of walls.

vii. Reinforced concrete: this is ordinary concrete mixed in suitable proportions according to the desired hardness and run into moulds or frames containing steel reinforcements to withstand structural tensions.

viii. Water for concrete-making: this should be clean, fresh water, not containing any solution or foreign matter that could affect the strength or durability of the construction.

ix. Steel rods: these are the longitudinal steel elements of 0.6-2.5 cm diameter which

are placed inside a mass of concrete to resist structural tension.

x. Mortar: this is a pliable mixture of Portland cement, sand and water which is generally used for laying bricks in walls or for finishing off the surfaces of floors and walls.

xi. Baked clay bricks: these are prismatic blocks made from a mixture of clay or clayey earth with a small amount of fine aggregate in the correct proportion, mixed with water, moulded and baked in a kiln. They are used essentially for the construction of walls and floors.

5.3.6 Plans for small stores holding between 50 and 100 metric tons

In an earlier Chapter a design was given for stacking bags 3 x 2, twenty alternating layers high, giving a total weight of 5 metric tons. The dimensions of a 50 m^2 store with a capacity of 50 metric tons and of an 84 m^2 store with a capacity of 100 metric tons on this basis are shown in Figures 68 and 69 respectively.

These two stores have a central passageway 2 metres wide with exterior access by means of a door 2 metres wide and 2.10 metres high. On each side of the passageway there are stacking areas, 3 x 6.3 m for a 60 ton store or 3 x 10.5 m for a 100 ton store. These stacking areas are at a distance of 0.20 m from the walls.

The roofing of these stores may be of wood, metal or eternit sheets, whichever is the most economical. The roof should extend 1 metre beyond the walls in order to give protection to loading and unloading areas.

Figure 70 shows a store roofed with eternit sheeting. The area can be extended progressively horizontally in two directions at right angles, with a capacity varying from 15 to 240 metric tons.

In the first stage this store can be enlarged from 15 t to 120 t capacity without any structural alteration, simply by extending the existing structure.

In order to bring the capacity up to 240 t, the right-hand wall is removed and the store enlarged towards the right by erecting a new wall as shown in Figure 70.

Another type of store which is capable of progressive extension has a single-span roof. Its construction, shown in Figure 71, can begin with a single 5.40 m x 6.08 m section, giving a capacity of 45 t with a passageway occupying one row of three units.

The figure shows two 5.40 x 6.04 m sections being used, with a passageway 1.80 m wide, which allows for a capacity of 120 t (or 90 if a subsidiary passageway is required).

This type of store has the following advantages:

- possibility of lateral extension to left and right without changing the front elevation, simply by opening doorways 1.52 m x 2.10 m in the left and right-hand side walls;

- possibility of using corrugated eternit sheets for roofing, which are both practical and cheap;

- by eliminating a row of 5 t units at right-angles to the main passageways a subsidiary passageway is obtained which, due to the spacing of 1.52 m between stacks, allows different products to be stored.

Figure 68
Store for 50-60 metric tons

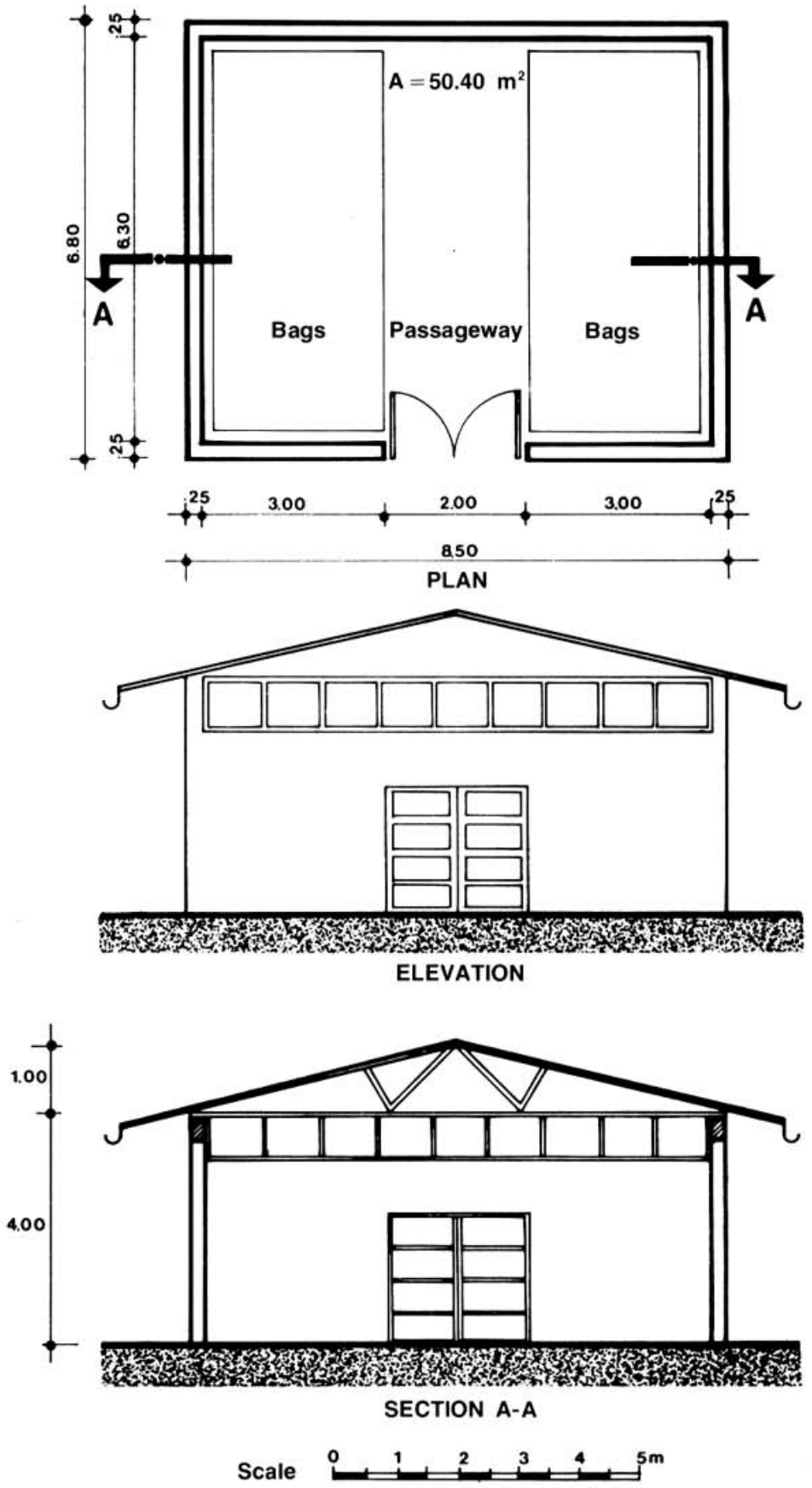


Figure 69
Store for 100 metric tons

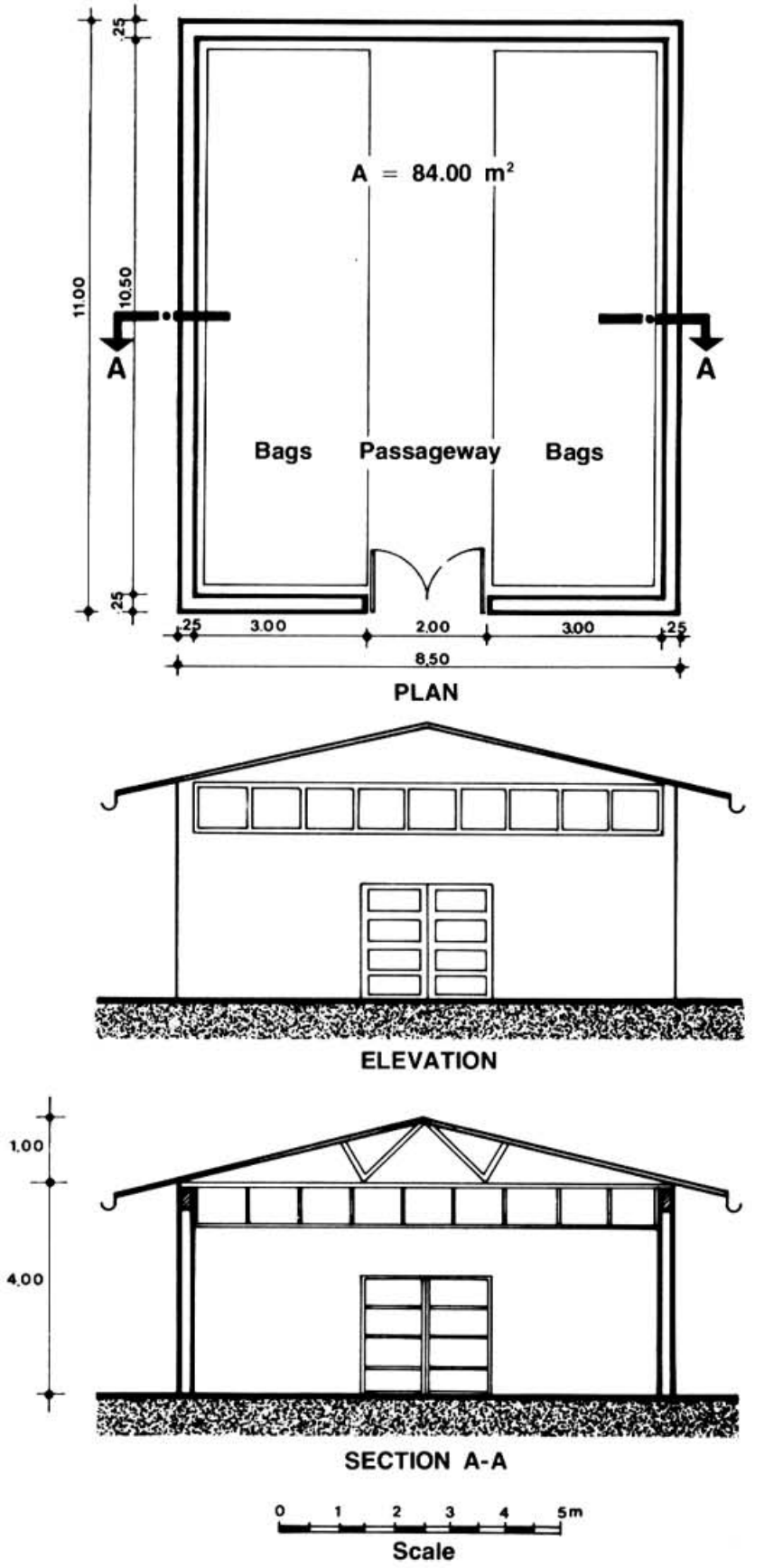


Figure 70
Store for 120 metric tons with extension up to 240 metric tons

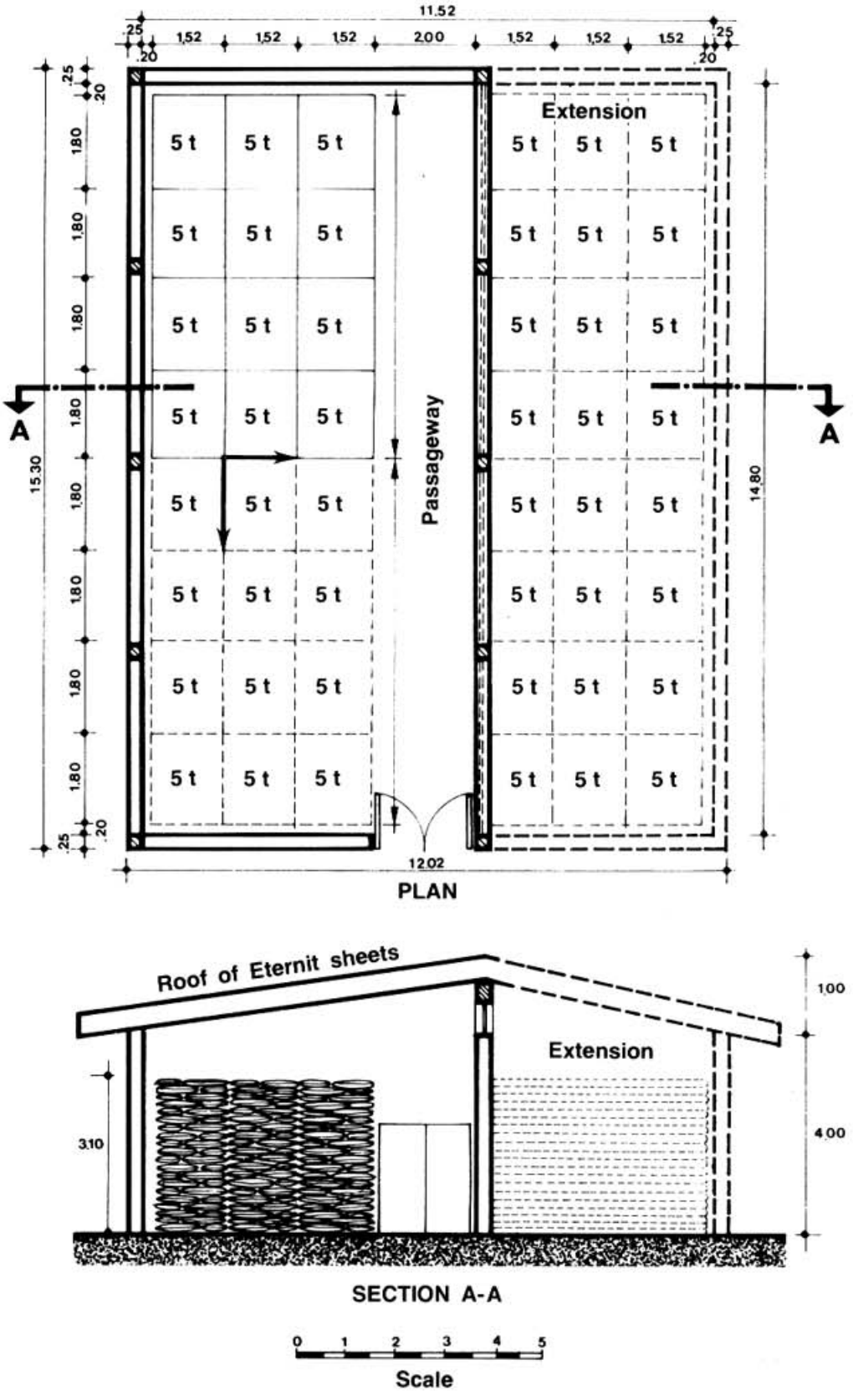
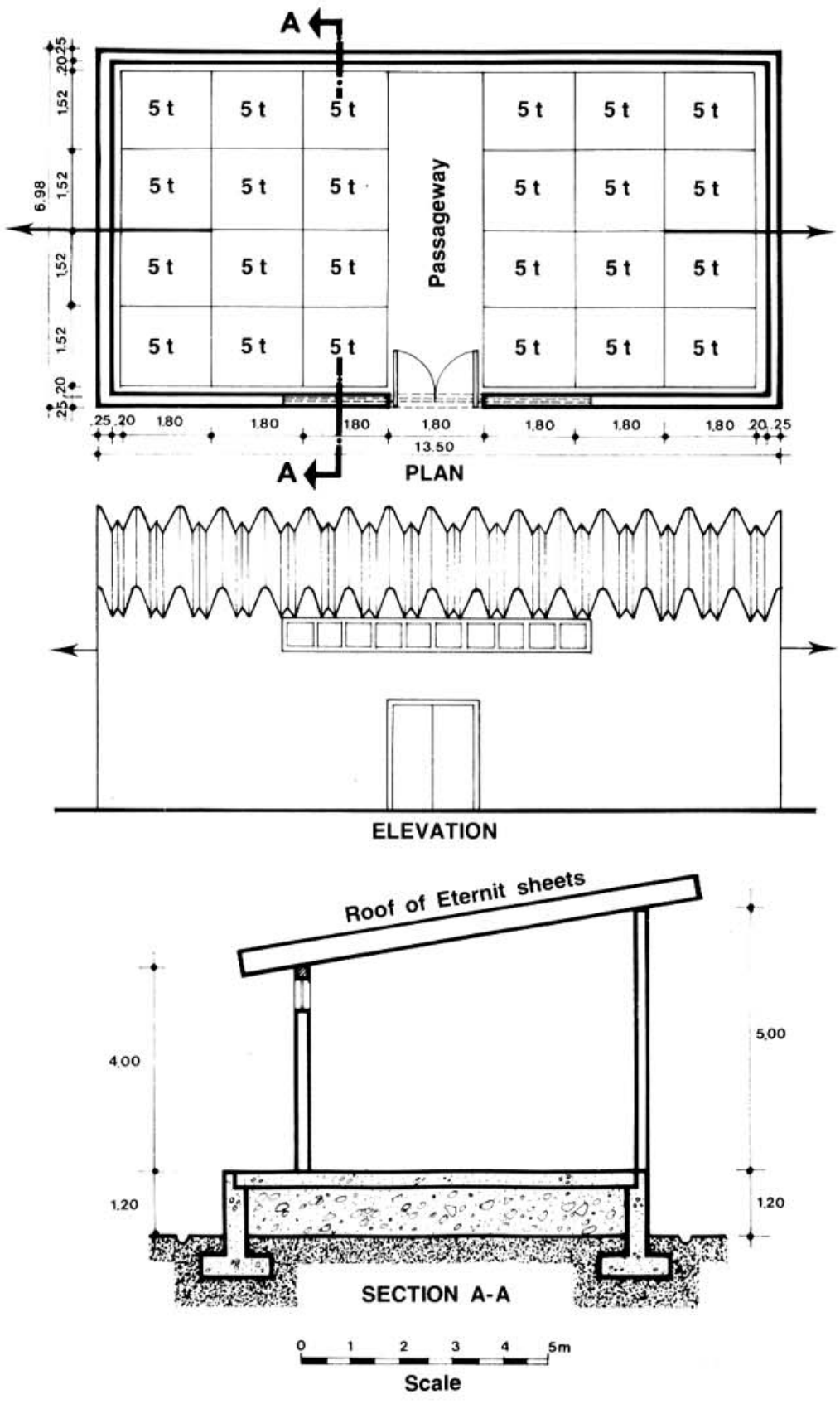


Figure 71
Store with sloping roof
with the possibility of progressive extension



5.3.7 Construction costs

To calculate the overall cost of a store, whether of 50 or 100 ton capacity, the retailer should first select the type of structure on the basis of calculations as set out in Tables 31 and 32.

Having found the cost per square metre of each element of construction, the relevant figures should be entered in these tables in the column headed Unit cost. Then each unit is multiplied by the area in square metres from the previous column and adding the respective totals gives the total cost of the store, excluding labour. In practice, the labour cost can be estimated at 55% of the overall cost of construction, so the total from the final column of the tables must be multiplied by a factor of 2.2 in order to arrive at the overall cost. For example, if a store costs S. 800 000 for the materials of construction, then its overall cost will be S. 800 000 x 2.2 = S. 1 776 000.

Table 31
Calculation of the total cost of a 50-ton store

Item	Units	Area (m^2)	Unit cost	Total cost
Floors	m^2	50		
Walls	m^2	88		
Roofing	m^2	92		
Doors	m^2	5		
Windows	m^2	6		
Others				
TOTAL				

Table 32
Calculation of the total cost of a 100-ton store

Item	Units	Area (m^2)	Unit cost	Total cost
Floors	m^2	84		
Walls	m^2	115		
Roofing	m^2	137		
Doors	m^2	5		
Windows	m^2	6		
Others				
TOTAL				

Exercises on improvement and construction of small stores

1 Sketch the structure of your store with its different elements of construction and showing its storage capacity.

2 Indicate the materials (purchased, or at hand locally) of which the different elements of your store were made:

- floor
- walls
- roofing
- doors
- windows

3 Indicate what kind of improvement or re-structuring you have made to your store and/or depot and the approximate cost of the material used and of the labour employed.

6 EVALUATION OF FERTILIZER SALES AND THEIR EFFECT ON AGRICULTURE

6.1 Introduction

Fertilizer is a business which should be profitable, both for the dealer/distributor and for the manufacturer or importer. Moreover, the use of fertilizers should also be profitable for the farmer. In consequence, when marketing costs are lower, the profitability will be higher at all levels, in all cases and particularly when the marketing margins per ton are fixed by the government.

For these reasons, the early chapters of this manual gave advice on a better and cheaper service which would offer the retailer the highest possible income within fixed marketing margins and at the same time avoid any unfavourable effect of his marketing on the profitability of fertilizer use to the farmer.

The advice was illustrated by examples of calculations which are discussed in greater depth in the present chapter. The intention is to present them in such a way that retailers can directly evaluate their own marketing operations and take the necessary decisions to improve them.

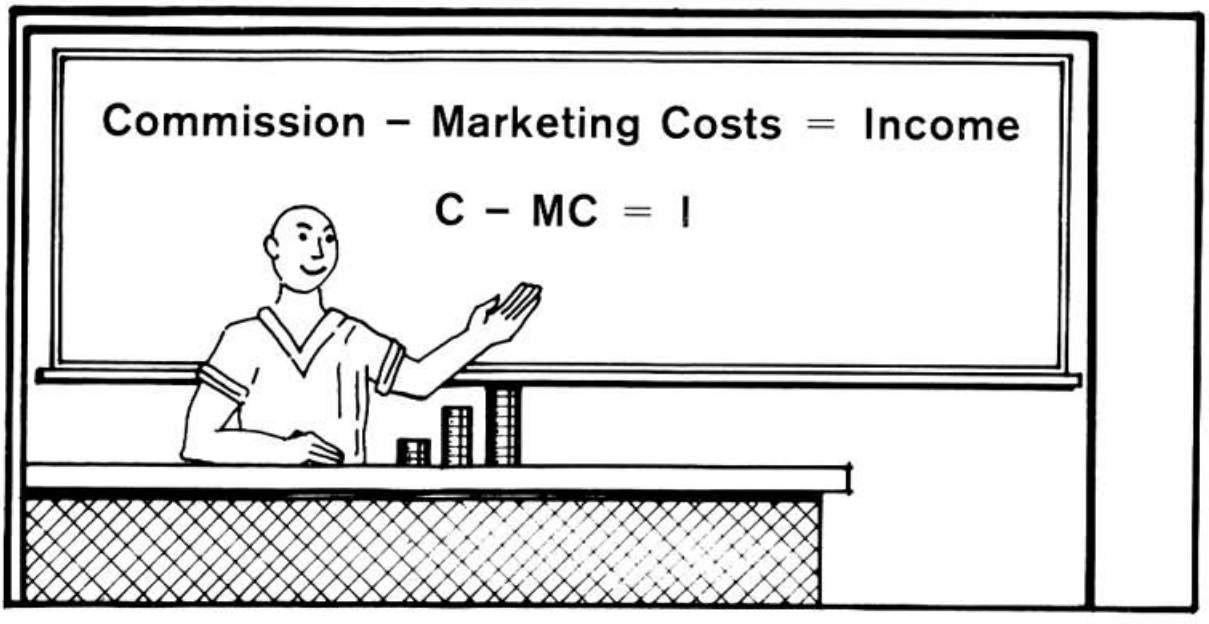
With this in mind, all the examples in this chapter are set out so that, if the retailer fills in his own figures obtained in the course of his commercial operations in place of those given, he will be able to analyse his own situation.

6.2 Sales Evaluation

The result of most interest to the retailer is his net income or the return that he obtains from his financial investment and the effort put into selling fertilizers. This income is directly related to the quantity of fertilizers he has sold and to his marketing costs. Sales of other inputs or other products by the same retailer affect his income in the same way.

Before starting the evaluation, it should be noted that, when the selling prices of fertilizers to farmers are controlled, whether at the farmer or distributor level, the price to the farmer is the sum of the ex works, or ex port of

Figure 72
Fertilizer marketing is a business



entry, value of the fertilizer plus the expenses of marketing, as shown in Figure 73.

What is interesting about this figure is the part concerned with the retailer, which shows the expenses he has to bear. These expenses or costs can be divided into fixed costs and variable costs.

The fixed costs are those which he must pay independently of the quantity of fertilizers sold, within a range which is taken for the present example to be between 300 and 700 metric tons per year. The variable costs, on the other hand, depend on the quantity of fertilizers sold. The fixed and variable costs are shown in Table 33.

Table 33
Structure of fixed and variable costs

Fixed costs	Variable costs
i. Wages and salaries	iv. Interest on capital invested in fertilizers
ii. Rent and upkeep of the store	v. Promotion and publicity
iii. Electric light, water, local taxes, etc.	vi. Office materials
	vii. Invoices
	viii. Travel expenses
	ix. Losses
	x. Loading and unloading
TOTAL COSTS	

Figure 73
Selling price to the farmer

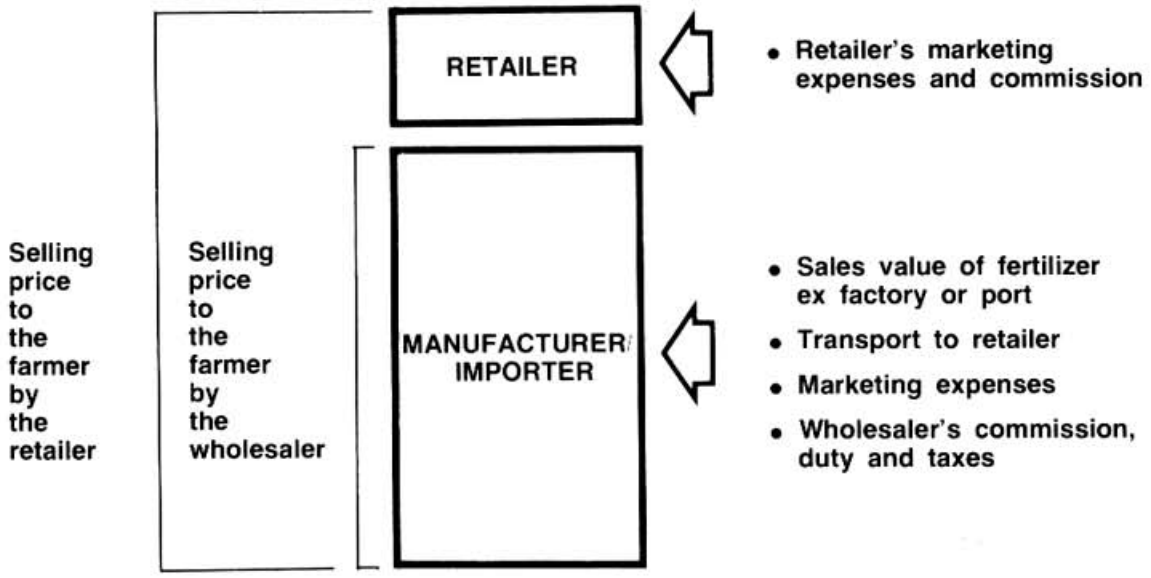


Table 34
Marketing costs of dealers selling 300 and 700 metric tons per year respectively (At the end of 1979)

Item	Sales of 300 t/yr		Sales of 700 t/yr	
	S./yr*	%	S./yr*	%
I. Fixed costs				
i. Wages and salaries	720 000	59.63	720 000	41.78
ii. Rent and upkeep of the property	120 000	9.94	120 000	6.96
iii. Services	60 000	4.97	60 000	3.48
SUBTOTAL	900 000	74.54	900 000	52.22
II. Variable costs				
iv. Interest on capital	94 540**	7.83	283 620***	16.46
v. Publicity and promotion	5 000	0.41	50 000	2.90
vi. Office materials	10 000	0.83	15 000	0.87
vii. Invoices	9 000	0.75	21 000	1.22
viii. Travel expenses	80 000	6.63	200 000	11.60
ix. Losses (0.5%)	78 780	6.53	183 830	10.67
x. Labour	30 000	2.48	70 000	4.06
SUBTOTAL	307 320	25.46	823 450	47.78
TOTAL COSTS I + II	1 207 320	100.00	1 723 450	100.00
COSTS PER METRIC TON	4 024	—	2 462	—

* S. = fictitious currency (to be replaced by the actual currency used in retailer's country)
** On the basis of an average of 20 t for 3 months
*** On the basis of an average of 60 t for 3 months

Table 35
Calculation of income according to quantity sold and marketing costs

Item	Sales of 300 t/yr S.	Sales of 700 t/yr S.
* i. Selling price (wholesaler)	15 756 900	36 766 100
ii. Selling price (retailer)	16 648 800	38 847 200
iii. Difference = commission of 6% (ii − i)	891 900	2 081 100
iv. Total marketing costs	1 207 320	1 723 450
v. Net income	− 315 420	357 650
vi. Income per metric ton	− 1 051	510
vii. Monthly income	− 26 285	29 804

* On the basis of an N-P_2O_5-K_2O ratio of 1.00-0.76-0.50 using end of 1979 prices for ammonium nitrate, triple superphosphate and muriate of potash

Explanation of the costs

i. Wages and salaries

This item includes the annual remuneration of the person in charge of administering the business. In some cases this will be the owner himself, in others it may be an employee or a combination of the two.

ii. Rent

This should take account of the rental value of the property and its upkeep, whether owner-occupied or rented.

iii. Services

These include water, electricity and the various taxes associated with the property.

iv. Interest

This is calculated on the basis of an annual rate of 36% (3% monthly) for an average of 3 months in the year on all the capital invested in fertilizers, whether from the enterprise's own capital or borrowed from a bank.

v. Publicity

This includes all the promotional activities and publicity effected by the retailer, as described in Section 3.6, to improve service.

vi. Office materials

This refers to paper, labels, printed matter, pencils, stamps, etc.

vii. Invoices

This item refers to the special pads of invoices reserved exclusively for fertilizer sales.

viii. Travel expenses

This includes the costs incurred by the retailer in making his purchases at the wholesaler's depot and in visiting the farmers, his customers, in the area.

ix. Losses

This covers losses of fertilizer from burst or torn bags. Such losses should not exceed 0.5% of the quantity handled per year.

x. Temporary labour

This includes personnel recruited for loading and unloading fertilizer, when not included in the freight charge.

On the basis of the expenses listed above, which have to be paid by the retailer, Table 34 includes the annual marketing costs for sales of 300 and 700 metric tons respectively.

As can be seen from Table 34, the marketing costs per ton are much higher for an annual sale of 300 tons than for 700 tons. This means that the retailer who sells only 300 tons should either look for an additional use of his time and investment or should make an effort to boost his sales.

Table 35 shows the retailer's buying and selling prices, the difference between which is the commission he receives for his services. Marketing costs have to be deducted from this commission in order to arrive at the retailer's net income.

As may be seen from Table 35, the income with sales of 700 t/yr is

very attractive. With sales of only 300 t/yr, on the contrary, the result is a negative balance. This does not mean that the dealer loses money but it indicates that he should reduce his salary, look for an additional activity in periods of low sales, find a less expensive store and generally make his marketing less costly or, as stated above, take the necessary steps to increase his sales.

In both cases it may be considered that the total marketing costs shown above for fertilizers cover almost all the costs to the dealer of selling other inputs or other products. These sales bring in an income which has been obtained thanks to the infrastructure created for the sale of fertilizers and which can be taken into account for the benefit of the dealer and his enterprise.

Table 36 shows the income in the case where other inputs or products are sold.

As can be seen from Table 36, the marketing of products other than fertilizers helps to convert the business into a profitable concern with fertilizer sales of 300 metric tons per year and to augment the income at the 700 metric tons per year level.

Just as the other inputs have served to support the sale of fertilizers, so can fertilizer sales help to make a business in other inputs or products profitable.

The figures in Table 36 are extremely important because they show the dealer the possibilities open to him to improve his service and to make investments that could enable him to increase his sales year by year.

6.3 Estimation of the principal costs

Decisions on major investments such as the purchase of a lorry or the construction of a new store call for special care and study by the retailer. Although these investments can sometimes be made on credit, the return must be sufficiently large to guarantee success.

6.3.1 Purchase of a lorry

The case of a retailer wanting to buy a small lorry costing S. 3 500 000, with 5 years of useful life and doing 40 000 km per year, is taken as an example. The annual cost of this investment is shown in Table 37.

Suppose he transports:

	S.
● 300 t from the wholesaler's warehouse at S.30/t/km for 40 km	360 000
● 400 t from his own store to farmers at an average of S.32/t/km for 10 km	128 000
Subtotal	488 000
● Additionally, it is assumed that he is sure of transporting 2 000 t of other products at an average of S.30/t/km for 40 km	2 400 000
Total assured load	2 888 000
Annual cost of lorry	3 408 000
Difference to be covered by finding additional loads	520 000

If one assumes that this difference is to be covered by transporting fertilizers at an average of S.30/t/km for 40 km, through additional sales and transportation of fertilizers, then it can be calculated that

$\frac{520\,000}{30 \times 40}$ = 433 t fertilizers or other products must be carried to justify the investment in a lorry.

Table 36
Fertilizer sales income with and without the sale of other inputs and/or products

Item	Sales of 300 t/yr	Sales of 700 t/yr
Income from fertilizer sales only	– 315 420	357 650
Income from sales of other inputs and/or products	350 000	350 000
TOTAL INCOME	34 580	707 650
MONTHLY INCOME	2 882	58 971

Table 37
Annual cost of a 3-ton lorry

	Item	Cost (S.) per km	Cost for 40 000 km (S.)
i.	Interest (36%/yr) $\frac{\text{S.3 500 000} \times 0.36}{2 \times 40\,000 \text{ km/yr}} =$	15.75	630 000
ii.	Depreciation (final value of lorry = S.350 000) $\frac{\text{S.3 500 000} - \text{S.350 000}}{200\,000 \text{ km}} =$	15.75	630 000
iii.	Maintenance, repairs and replacements (120% of the value of the lorry) $\frac{\text{S.3 500 000} \times 1.2}{200\,000 \text{ km}} =$	21.00	840 000
iv.	Fuel consumption, 25.3 litres/100 km (1 litre = S.52.6) $\frac{\text{S.52.6} \times 25.3}{100} =$	13.33	533 200
	Lubricants (30% of fuel costs)	4.00	160 000
v.	Accident insurance 3.89% of the value plus S.12 550 for civil responsibility $\frac{\text{S.3 500 000} \times 0.039 + \text{S.12 550}}{40\,000 \text{ km}} =$	3.72	148 800
vi.	Driver (S.25 000/month + 52.11% for requirements of social laws $\frac{\text{S.25 000} + 52.11\% \times 12}{40\,000 \text{ km}} =$	11.4	456 000
vii.	Taxes $\frac{\text{S.10 000/yr}}{40\,000 \text{ km}} =$	0.25	10 000
	TOTAL	85.20*	3 408 000*

* S.85.20 per kilometre or S.3 408 000 per 40 000 km are the equivalent of 1.6 litres of fuel per kilometre

Obviously a retailer with annual sales of 300 metric tons of fertilizers ought not to think of buying a lorry, unless he can be sure of using it to transport other products. Neither can the retailer selling 700 metric tons of fertilizer per year justify buying a lorry for handling the fertilizers alone. In fact, (i) he will not find it worthwhile fetching fertilizers from the wholesaler's warehouse unless he also has a load on the outward journey, and (ii) he cannot hope to deliver easily the 700 tons of fertilizers to his farmer customers, either because of a lack of interest or because of the bad state of the roads.

6.3.2 Improvement of the store

Table 38 shows the result of an investment of S. 250 000 which a retailer might make in improving or constructing a store, assuming a benefit lasting for 5 years.

In order to justify the investment, these costs of improving the store should be covered as far as possible by additional sales of fertilizers.

6.4 Evaluation of the Effect of Fertilizer Use at Farmer Level

Throughout this manual it has been

Table 38
Cost of improving a fertilizer store and the additional sales needed to cover them

Item		
Interest on half the capital at 36% per year	$\frac{250\,000 \times 0.36}{2}$	= 45 000
Annual depreciation	$\frac{250\,000}{5}$	= 50 000
TOTAL ANNUAL COST		95 000

Table 39
Economic effect of the use of fertilizers

Item	Example for potatoes	Example for wheat
i. Yield without fertilizers	6 200 kg/ha	800 kg/ha
ii. Yield with fertilizers	12 400 kg/ha	2 200 kg/ha
iii. Increase in yield (ii —i)	6 200 kg/ha	1 400 kg/ha
iv. Value of the additional yield at the price at which the harvested crop was sold (assume S.30/kg for potatoes and S.45/kg for wheat)	S.186 000	S.63 000
v. Cost of fertilizers used to increase yield (on the basis of an average recommendation of 100-120-60 for potatoes and 60-60-0 for wheat, using end of 1979 fertilizer prices)	S. 34 000	S.17 000
vi. Profit in S. per hectare from using fertilizers (iv —v)	S.151 600	S.46 000

taken for granted that the major objective of the trade in fertilizers is to give the best possible service to the farmer and to operate in such a way that fertilizer use is profitable to the farmer and enables him to increase agricultural production to the benefit of his country.

It is therefore important that the retailer understands the economic implications of fertilizer use so that he can explain them to the farmer.

Table 39 illustrates the method of calculation by means of a simple example.

The calculations shown in Table 39 are given only as examples because the effect of fertilizer use varies considerably from one farmer to another. However, in most cases the farmer can obtain a good profit from applying fertilizers if he uses them well and in conjunction with other improved practices.

The whole of this manual has been intended mainly to teach retailers about fertilizer marketing so that they in turn can help to reach farmers. It should never be forgotten that the retailer can only sell fertilizers successfully when the results of fertilizer use are sufficiently worthwhile to farmers.

Exercises on evaluation of fertilizer sales and their effect on agriculture

1 What do you understand by fixed costs and variable costs in fertilizer marketing?

2 How many tons of fertilizer did you sell last year?

3 Show on a separate sheet your own costs for marketing fertilizers.

4 How many tons of fertilizers do you consider you would be able to sell directly to farmers if you had your own lorry and what freight can you carry for this service?

5 How much ought you to invest in improving your store to bring it up to optimum standard?

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