REPORT:

SOIL FERTILITY TRAINING IN BLACK STATES

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Introduction

Since the early sixties the Fertilizer Society of South Africa has been involved in furthering the knowledge of soil fertility and fertilizer use in black areas. This was aimed mainly at the Agricultural Officers with two and a half years of training at an Agricultural College after Junior Certificate.

The immediate objective was to equip them better for their extension taxk among unskilled farmers in a subsistence farming tradition. The ultimate objective was to help improve crop production and develop the considerable but under-utilized and often abused production potential. Success could mean self-sufficiency in food production potential. Success could mean self-sufficiency in food production instead of reliance on subsidised food imports. This could also lead to an improved life style. Obviously it also held the prospect of an increase in the fertilizer market. The sales potential in the long term was regarded as very high.

It was realised that success would come slowly. Farmers would have to be approached and influenced in their own idiom — language, customs, traditions, taboos, beliefs. The present state of their knowledge would have to be the starting point, and their own people, trained in scientifically based knowledge of modern farming, are best equiped to lead them into modern practice.

It was soon discovered that most of the Agricultural Officers lacked the technical knowledge to really understand soil fertility and more intensive crop production. Their training was too widely based and not of a sufficiently high standard. Furthermore, it was realised that it would not be possible for the peasant farming communities to adapt quickly to better farming methods.

In view of these considerations additional training was regarded essential and of high priority, not only by the fertilizer industry, but also by the agricultural authorities in these areas, which includes Ciskei, Transkei, Kwa Zulu, Qwa Qwa, Kangwane, Kwandebele, Bophuthatswana, Lebowa, Gazankulu and Venda. Ten states and nine languages spoken, ranging from high altitude mountainous terrain with a cold climate to flat coastal terrain with a humid tropical climate. In all these areas maize is the most important crop and traditional staple food.

Traditionally soil was not regarded to be an economic commidity which may become scarce and depleted of fertility. In the past this lack of appreciation of the nature and value of soil caused vast abuse in places and lead to large areas being severely eroded. Despite this primitive attitude the people saw the soil as the provider of food and life. Soil was held in high regard, but not understood.

Short courses

In the period 1964 to 1968 a number of one-day short courses to promote better crop production were conducted by the FSSA in Transkei. In the 16 year period 1969 to 1984 96 short courses were conducted in all the black areas except Kangwane:

— half-day courses (teacher refresher courses; 1976 — 1982)	12
— one-day courses (farmers and agricultural officers; 1969 — 1978)	17
— two-day course (agricultural officers; 1980)	1
— three-day courses (agricultural officers; 1969 — 1984)	60
— four-day courses (agricultural officers; 1973 — 1981)	6
	96

Since 1973 55 two- to three-day courses were conducted. These included evaluation of the agricultural officers' performances. The courses were free of charge.

After initial discussions with the local agricultural authorities about the need for training in the black areas, these courses were conducted on request from the authorities. Kwa Zulu embarked on extensive training programmes for its agricultural officers and farmers, and hence most of the courses were held there:

TABLE 1. Soil fertility and fertilization short courses held by the FSSA in black areas, 1969 — 1984.

	½ day	1 day	2 day	3 day	4 day	Total
Kwa Zulu	–	9	–	25	–	34
Transkei	–	–	1	12	–	34
Ciskei	–	–	–	9	–	9
Bophuthatswana	–	–	–	4	5	9
Gazankulu	–	1	–	5	–	6
Lebowa	–	2	–	2	1	5
Venda	–	3	–	2	–	5
QwaQwa	–	1	–	1	–	2
Kwandebele	–	1	–	–	–	1
Dept of Education & Training	12	–	–	–	–	12

Courses were attended by between 10 and 40 persons. In the case of agricultural officers an attendance of 15 to 25 was preferred. The overall average was probably 20 persons per course.

Objective of courses

The courses for agricultural officers, who have had formal schooling in the subject matter, were intended to:

- serve as a refresher course, reminding and updating the facts of the subjects;
- promote better understanding of the principles involved in soil fertility, plant nutrition and fertilization;
- emphasize the relative importance for successful crop production of the aspects dealt with;
- illustrate and demonstrate means for the practical application of the knowledge.

Language medium

The courses were presented through medium of the English language as virtually all agricultural officers had been educated and trained (school and college) through this medium. Except for most of the officers from Ciskei, Transkei and Kwa Zulu, the officers were also conversant with the Afrikaans language.

In a few cases Afrikaans was better understood than English, but the medium remained English.

In courses for farmers interpreters were used, the interpretation often taking considerably longer than the text. This was so because statements of fact had to be explained.

Structure of courses

Pertinent handouts, distributed free of charge after the relevant lectures, include booklets, pamphlets, charts, copies of articles, notes and leaflets.

In the case of refresher courses for school teachers, the course content was prescribed by the school curriculum, covering selected aspects related to that of the 3 day course.

The *three-day* short courses for agricultural officers were structured as follows:

TABLE 2. Structure of 3 day FSSA short course.

Programme	Method				
	Lectures and discussions	Demonstrations and displays	Slide stories	Assignments	
				Written	Practical
First day:					
Orientation	x				
Questionnaire A				x	
I Soil —					
• Formation	x	x	x		
• Characteristics	x	x	x	x	x
• Potential	x			x	
• Classification	x	x	x		x
Second day:					
— Classification (cont)		x			
II Plants —					
• Energy and food	x				
• Plant nutrients	x		x	x	
• Plant nutrition	x				
III Fertilizers —					
• Nature and composition	x	x		x	

TABLE 2. Continued.

Programme	Method				
	Lectures and discussions	Demonstrations and displays	Slide stories	Assignments	
				Written	Practical
Third day:					
— Fertilizer composition (cont)	x			x	
• Farm manures	x				
• Lime and gypsum	x				
• Fertilization	x	x		x	
— Maize (in detail)					
— other (briefly)					
IV Crops —					
— Crop production (all practices briefly, to emphasize role of each in an integrated system)	x				
Questionnaire B				x	

Lectures

Lectures were presented in a semi-formal fashion, question and discussion being allowed and encouraged during the presentation. The negative effects of the lengthening of presentations were offset by the greater interest, ensuring better understanding. Intermediate 10 minute breaks were given whenever necessary, at least every 40 minutes.

Lectures were presented with the aid of an overhead projector. Some of the notes handed out after lectures as summaries, were copies of the transparancies used.

During the earlier years of the courses lectures were presented by two or three persons, viz from the FSSA and agronomists of fertilizer companies. Later the entire course was conducted an employee of the FSSA.

Demonstrations and displays

The following aids were used during lectures and excursions in the field:

— rocks (soil forming)
— soil material (physical characteristics, both in situ and samples)
— soil pits (usually two different soil types)
— fresh plant material (in situ as well as samples)
— soil sampling procedures and equipment
— fertilizer material (samples)
— fertilizer application methods

Colour slides

The following slide stories were used:

— rock types and weathering
— soil types (forms) and some physical characteristics
— nutrient deficiency symptoms (maize)
— crop production (practices and malpractices).

Assignments

Assignments were done jointly by groups of three persons. Assignments were not marked, but the answers were discussed, explaining the correct situation or answers.

The written assignments were mainly concerned with calculations and the use of tables, eg maize yield potential tables, fertilizer price lists, composition of fertilizers, types and quantities of fertilizer to be used on a land, given the conditions.

Practical assignments were concerned with identification of physical characteristics (texture structure, soil horizons, depth, root penetration, colour, compaction, strength), rock types, deficiency symptoms, land suitability for crop production.

Questionnaires

Nature

Questionnaires consisted of 25 questions to test the candidates' knowledge level about the subject matter as well as comprehension. Some questions were of the limited choice type ('monkey puzzle') requiring only marks for answers; others were open-ended, requiring only words or phrases for answers; and others required calculations.

They are called 'questionnaires' to avoid the examination connotation and replies were indeed evaluated differently from examination paper answers.

'Questionnaire A' was an unprepared test about the material to be presented during the course. 'Questionnaire B' was a test, similar in content and degree of difficulty to 'A'.

Whenever required, the meaning of a question was explained to candidates. There was no time limit for the completion of the questionnaires, but it took between 25 and 45 minutes to answer the 25 questions.

Questions

The following types of questions were included in both quistionnaires:

(i) Soil (physical characteristics and acidity) — 10 questions; closed.

(ii) Plants (nutrients and crop production) — 7 questions; open-ended.

(iii) Fertilizers and ameliorants (lime, manure, fertilizer products and calculations) — 8 questions; open-ended.

The range covered about 80% of the subject matter.

Interpretation model

(i) The purpose of *questionnaire 'A'* was to
- — pinpoint dificiencies in knowledge;
- — guage the level of knowledge;
- — introduce the subject matter dramatically;
- — service as basis for evaluation of improvement.

It was *not* the purpose of questionnaire 'A' to discriminate against candidates and brand them into categories; it was also not intended to determine merit with respect to the subject matter.

(ii) the purpose of *questionnaire 'B'* was to
- — test the level of knowledge and understanding;
- — obtain an estimate of the improvement, ie the benefit gained by candidates from the course;
- — determine merit with respect to the subject matter;
- — identify, if applicable, exceptional merit or demerit, which may be of use in staff placement, development or promotion.

(iii) Estimate of *improvement,* designated 'improvement index', 'I' was based on the additional knowledge acquired with respect to the attainable additional knowledge.

An idealised diagramme of the learning curve illustrates the concept (Figure 1).

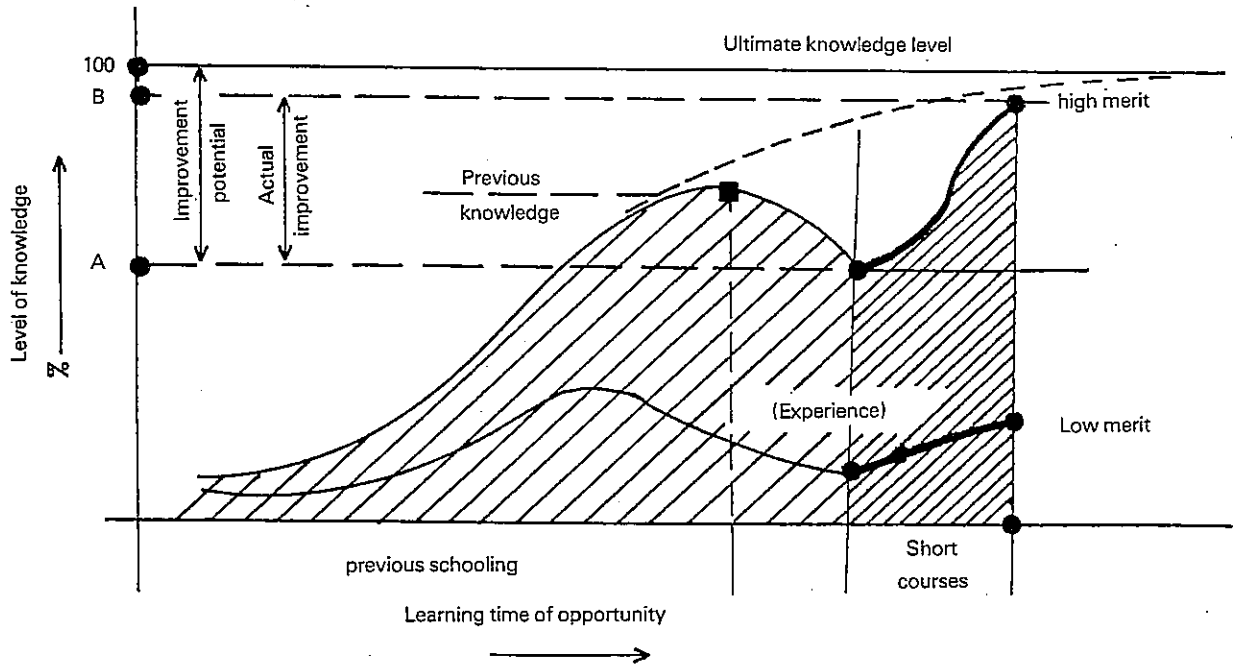

Fig 1. Idealised learning curve, showing effect of short course training.

Improvement index, 'I' $= \frac{B - A}{100 - A} \times 100$

Two extreme cases are shown in the figure.

(iv) Overall achievement

Achievement by a candidate during such short course is demonstrated by the final level of knowledge attained as well as by the improvement due to the course. The 'B' value is a function of the 'A' value, the improvement and the ability (intelligence) of the candidate. It is therefore the most telling description of achievement. Improvement, however, has an independent merit in describing achievement and must also be counted. 'B' and 'I' are arbitrarily allocated the weights 3 and 1. Good arguments may of course be offered why other weights should be attached to them. Overall achievement may be defined as

$$\text{'Ach'} = \frac{3\text{'B'} \pm \text{'I'}}{3\text{'B'}}$$

'Ach' will always be somewhat less than 'B' or at most equal to it (ie when 'B' = 100 and 'I' = 100). Some justification for allowing the 'B' assessment to be lessened is to be found in the fact that some of the newly acquired or refreshed knowledge is soon lost again. This formula was based on experience with the interpretation of 'B' and 'I' against observed performance and achievement by candidates over a period of five years.

(v) *Evaluation*

Arbitrary norms, again based on subjective experience, for the evaluation of the answers have been laid down. They are given in Table 3.

TABLE 3. Norms for FSSA short course questionnaires

Symbol	Interpretation	Before Course 'A'	After Course 'B'	Improvement Indes 'I'	Overall Achievement
		%	%	%	%
A+	Exceptionally good	≥91	≥96	≥81	≥92
A	Very good	81 - 90	91 - 95	71 - 80	86 - 91
B	Good	71 - 80	86 - 90	61 - 70	80 - 85
C+	Normal to good	66 - 70	81 - 85	51 - 60	74 - 79
C	Normal (Satisfactory)	56 - 65	71 - 80	31 - 50	61 - 73
C−	Normal to poor	51 - 55	66 - 70	21 - 30	55 - 60
D	Poor	41 - 50	61 - 65	11 - 20	48 - 54
E	Very poor	31 - 40	56 - 60	1 - 10	42 - 47
E−	Exceptionally poor	≤30	≤55	≤0	≤41
	Pass ('normal' acceptable lowest)	40	60	(33)	53
	Group average ('normal' range)	57 - 68	72 - 83	31 - 53	62 - 76

An example of the results of an actual short course is given in Table 4.

TABLE 4. QUESTIONNAIRE RESULTS: FSSA short course on soil fertility and fertilization for agricultural officers (Example)

Candidate	Div**	Marks		Improvement Index	Overall Achievement		Remarks
		Before	After				
		%		%	%	Symbol	
1	Agr	62	94	84	92*	A+	Excellent
2	Agr	67	93	79	90*	A	Very good
3	Agr	67	90	70	85	B	Very good
4*	Agr	54	88	74	85	B	Very good
5*	Agr	73	90	63	83	B	Very good
6	Agr	68	89	66	83	B	Very good
7	Agr	65	87	63	81	B	Very good
8	Agr	80	89	45	78	C+	Good
9	Agr	66	84	53	76	C+	Good
10	HE	60	78	45	70	C	Reasonable
11	HE	43	73	53	68	C	Reasonable
12	Agr	60	73	33	63	C	Reasonable
13	Agr	62	73	29	62	C	Reasonable
14*	Vet	48	69	40	62	C	Reasonable
15	HE	38	67	47	62	C	Reasonable
16	HE	50	68	36	60	C−	Poor
17	HE	46	59	24	50	D	Poor
18	HE	43	55	21	47	E	Very poor
19	HE	42	54	21	46	E	Very poor
20	HE	37	53	25	46	E	Very poor
21	Agr	60	50	(−25)	31	E−	Extremely poor
Mean		56,7	75,0	42,3	66,8	C	
Standard deviation		12,2	14,7				

* Attended this course previously (before 1981).

** Agr = Agricultural Office; HE = Home Economics Officer (ladies); Vet = Animal Health Officer

Comments:

1. Sufficient time was devoted to the calculation of composition of mixtures.
2. Too little time was allowed for calculation of fertilization programmes. If the basic calculations under item 1 above is not grasped, no amount of time spent fertilization programmes will cure the deficiency.
3. It is the heterogeneous nature of the group that caused some candidates to lag behind. The pace was geared at the 'average' person. This group should have been split into two groups: (a) Agric officers (b) Home economics and Veterinary officers. Separate courses should be devised for the two groups. There could even be a third group, viz selected officers from the ranks of the Agric officers for a slightly more advanced course.
4. Question No 17 (crop production practices) was not clearly understood this time (confusion).
5. Candidate No 21 was somehow confused; rare and inexplicable.

(vi) *Merit*
The marks achieved by the officers were reported to the relevant Department of Agriculture for use according to their discression.

Four-day short courses

These extended courses were presented in two varieties, depending on the need:

(i) *With farmers:*
First three days the same as in the normal three-day course. The fourth day was attended by a selected group (10 — 15) influential and good farmers. The proceedings were conducted with the aid of an intepreter. The same subjects as during the first three days were covered in summary and in simplified form. The soil pit was also inspected. To the agricultural advisers this was a short revision. It also made them consider their jobs of how to explain matters to farmers. The proceedings were closed by a panel discussion in front of the audience between two agricultural officers and two farmers.

(ii) *Advanced course:*
Covering the same field as in the normal three-day course, this course was slightly more advanced, giving more chemiçal back-ground. The course was intended for future farm managers and included a short session on management principles and their application in this particular field.

Problems

Assignments

The main shortcoming of the three-day short course was that too little time could be devoted to group assignments and individual attention to officers attending the course.

Demonstrations and practicals

More attention could also be given to the demonstration of the practical application of the knowledge.

Extension

Although the course did not cover extension, this type of course cannot stand on its own. If not followed up the benefit might soon be lost. The officers attending the courses were all involved in extension and knowledge needs to be translated into practical terms.

Mathematics

With only about 20 — 30% exceptions, the officers were not adequately versed in arithmetic and simple mathematics to quickly grasp the calculations required to be done during the course. Some were at a disadvantage in that they found abstract thinking unusual. Arithmetic was done by memorising rather than understanding the calculations.

An alarming proportion of the officers did not really appreciate the meaning of the concept of percentages, although they could calculate a percentage.

Language and idiom

Although all officers were conversant with the English language and had passed the required school examinations, many did not understand the idiom of the language, and their vocabulary was very inadequate. Sometimes in discussions the officers explained concepts to one another when language difficulties slowed progress.

Motivation

In most cases officers were well motivated and even keen to further their knowledge. But there were disconcerting exceptions, where general discontent with their job situations influenced their attitudes.

Mixed groups

A complicating factor at many of the short courses was the wide spectrum of knowledge levels and comprehension of the officers attenting. The course was designed to cater for the qualified agricultural officer. Officers specialised in home economic, veterinary services or nature conservation could benefit by such a course, provided it was geared to their knowledge back-ground and their needs. Many of them were at sea in this course. Some of the older officers were not capable of grasping some of the concepts and were clearly not interested.

Recommendations

1. The *nature of the problems* cited suggests how improvements may be effected.

2. The *objectives* of the additional training of qualified officers would have to be more clearly formulated for the different groups.

3. *Courses* would then have to be designed to achieve the objectives for each group. Planning and design of courses should be done jointly by the Department of Agriculture and the external lecturers drawn from industry.

4. In the case of the qualified agricultural officers, working as extension officers in the field of crop production, the present *three-day short course* on soil fertility, plant nutrition and fertilization may be adapted to cover four days, as follows:

(i) *introductory course* of half a day for general orientation to be presented by the Department of Agriculture, and elementary mathermatics with special reference to the subject matter of the main session of the short course;

(i) *main course* (3 days as described previously, with slightly more emphasis on demonstrations and practicals and much more on group assignments and discussion of results;

(iii) *follow-up course* of about half a day covering practical application and economic implication in integrated crop production to be presented by one or more commercial firms, as well as guidelines regarding extension, to be presented by Department of Agriculture officials;

(iv) in addition to the *merit rating* ('overall achievement') concerning the three-day main short course, a *certificate of merit* could be issued to those with sufficient 'overall achievement' and judged by the panel of lecturers to understand the practical and economic applications for crop production.