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REPORT OF THE JOINT ECA/FAO/GERMAN FOUNDATION SEMINAR ON AGRICULTURAL INPUT FACTORS

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REPORT OF THE
JOINT ECA/FAO/GERMAN FOUNDATION SEMINAR 1/
ON
AGRICULTURAL INPUT FACTORS

Preface

It was at the suggestion of ECA that the German Foundation for Developing Countries devoted an International Seminar to agricultural input factors. ECA proceeded from the recognition that the technical factors distinguishing the relationship between input and output in the agricultural sector must become generally known before steps to plan and implement agricultural measures in Africa could be fruitfully taken. The organizers of the Seminar were aware of the divergences in input-output theories relating to agriculture. For this reason the Seminar directors considered it expedient to base the work of the Seminar on various scientific sources.

As its first task the Seminar set out to collect national statistics on production factors in the agricultural sector in African countries. The delegates presented agricultural statistics available for their countries and in this manner the basis for general study and evaluation was created. Working groups then undertook to improve this statistical material by providing pertinent information on those areas for which the required data had not been available.

The German and international experts responsible for the Seminar could not expect to arrive at results which would lend themselves immediately as a basis for planning in the countries participating. In the opinion of all participants, the Seminar nevertheless served its purpose. On the one hand, the importance to be attached within the framework of agricultural production policy to input-output relations was brought home

1/ Held from 30 August to 24 September 1965 in Ibadan/Nigeria and in the Federal Republic of Germany.

to the delegates from Africa. On the other hand, ECA and FAO learned from the Seminar the extent of desk work yet to be done before agricultural policy in the regions of Africa could be effectively co-ordinated.

At the closing session in Berlin it became clear that all participants were interested in continuing the dialogue. The task falling to scientific groups was stressed as being that of developing and co-ordinating input-output theories to the point where practical application could be made in the agricultural sector in developing countries. Not only the fruitful discussion on agricultural reality in Africa and the lively dispute over the "how" of agricultural progress, but also the courage of the participants, above all ECA and FAO, to undertake pioneer work within the forum provided by the German Foundation for Developing Countries contributed in large measure to the success of the Seminar.

We are indebted to all who took part in the Seminar: to the representatives of ECA and FAO for their splendid co-operation, to the other members of the directive staff and to the experts presenting working papers for their excellent contributions, to the delegates from twenty-six African countries for their outstanding team spirit and their open-mindedness, and to the University of Ibadan, in particular here to Professor Ayo Ogunshye and Miss Lalage Bown for their untiring efforts.

(signed)

Dr. Gerhard Fritz
Director General

German Foundation
for
Developing Countries

I. Purpose of the Seminar

1. The main purpose of the seminar was:

- (a) To determine what is known of the economics of modern technical inputs in African agriculture in terms of the physical and value responses to expenditures on them;
- (b) To identify those areas in which information vital to policy is lacking;
- (c) To propose a specific programme for obtaining required data through the co-operation of research institutions.

II. Participants

2. Thirty-three participants from twenty-four African countries, invited by ECA and the German Foundation for Developing Countries, took part in the Seminar. They were divided into 4 working groups as follows:

- (a) Fertilizer Working Group: 11
- (b) Irrigation Working Group: 7
- (c) Plant Protection Working Group: 6
- (d) Machinery Equipment Working Group: 9

3. Of the thirty-three representatives, thirty-two participated in the trip to the Federal Republic of Germany. Only one representative (Malawi) was not African. The list of participants is attached.

III. Discussion Leaders

4. There were four discussion leaders, namely:

Dr. F.W. Hauck, Regional Soil Fertility Expert, FAO,
Accra, for the Fertilizer Working
Group.

Mr. L. Horst,

Regional Water Development
Engineer, FAO Regional Officer
for Africa, Accra, for the
Irrigation Working Group.

Dr. F. Ahlgrimm,

Kuratorium für Technik in der
Landwirtschaft, Frankfurt,
Federal Republic of Germany, for
the Machinery Equipment Working
Group.

Prof. Dr. H. Heddergott,

University of Munster, Federal
Republic of Germany, for the
Plant Protection Working Group.

5. All four discussion leaders submitted their introductory papers, which were discussed in working groups. The discussion leaders also prepared the questionnaires, which were distributed to the participants in advance, and after being completed by them, brought to Ibadan. These questionnaires were to some extent a basis for the discussions in working groups.
6. The irrigation questionnaires were presented by 16 countries, namely: Mauritania, Senegal, Sierra Leone, Liberia, Ivory Coast, Mali, Upper Volta, Ghana, Niger, the United Arab Republic, Ethiopia, Uganda, Rwanda, Kenya, Malawi and Madagascar.
7. The fertilizer questionnaires were presented by 13 countries, namely: Liberia, Ivory Coast, Upper Volta, Niger, Nigeria, Chad, the United Arab Republic, the Sudan, Ethiopia, Uganda, Rwanda, Kenya and Malawi.
8. The machinery equipment questionnaires combined with plant protection questionnaires were presented by only four countries namely: Ivory Coast, Cameroon, Rwanda and Malawi.

IV. Opening session

9. The Seminar started on 30 August 1965 in Ibadan, Nigeria, with two papers presented by Dr. E. Gorzelak from the Economic Commission for Africa and Dr. T. Troscher, State Secretary, Wiesbaden, Germany. These papers are attached.
10. Dr. Gorzelak delivered the opening address on behalf of Mr. Robert K. A. Gardiner, Executive Secretary of the United Nations Economic Commission for Africa. The nutritional deficiencies and rising food imports in Africa - despite the efforts being made by the respective governments to bridge the gap - still require that more attention be devoted to the study of crop responses to modern technical inputs, namely, fertilizers, plant protection, irrigation and mechanization. By physical and value responses to expenditures on certain inputs we mean the input-output coefficients between expenditures made on the inputs and the returns yielded by them. Knowledge of these coefficients is indispensable to economic planning. Modern economic planning means choosing the best variant from among many possible variants based on calculations which have been made with the assistance of input-output coefficients.
11. Modern agricultural planning, to which Dr. Troscher's paper was devoted, requires the thorough knowledge of statistical data, among other input-output coefficients.
12. The reports of four working groups were written by the discussion leaders. Each report summarizes introductory paper, statements, content of questionnaires and the discussion during the working sessions.
13. The following countries were represented in each discussion group:

(a) Fertilizer Working Group:

Chad, Ethiopia, Ghana, Ivory Coast, Liberia, Malawi, Nigeria, Senegal, Sudan, the United Arab Republic, Uganda;

(b) Irrigation Working Group:

Ghana, Liberia, Madagascar, Mauritania, Senegal, the United Arab Republic, Uganda;

(c) Plant Protection Working Group:

Central African Republic, Congo (Brazza.), Congo (Leo.), Gabon, Nigeria, Upper Volta;

(d) Machinery Equipment Working Group:

Cameroon, Mali, Nigeria, Niger, Rwanda, Sierra Leone, Togo.

14. As the discussions in each group were held for half of the day only, many participants from other groups voluntarily attended the sessions of two or even three different groups.

V. Fertilizer Working Group

15. Fertilizer Consumption in Africa. The fertilizer consumption in Africa in 1959/60 was 400,000 metric tons and 1963/64 850,000 metric tons of plant nutrients. This represents 4.3 per cent of the world consumption. The United Arab Republic uses about half of the total African consumption. The target figure for Africa in 1980, calculated by F.W. Parker, is 8.6 million tons plant nutrients which is 21.5 times the quantity consumed in 1959/60. In 1959/60 1.6 kg. plant nutrients per hectare of arable land were used in Africa. The target for 1980 is 34 kg. of plant nutrients per hectare.
16. The FAO Fertilizer Programme has produced experimental results in West Africa since 1961. The technical and economic aspects of the fertilizer use in agriculture have been investigated. Summarized technical and economical results are presented as follows:

Ghana

- Maize: NPK 22.5-22.5 kg./ha. gives a 62 per cent increase over control and a value cost ratio (VCR) of 2.3.
- Rice: NPK 22.5-22.5-22.5 kg./ha. gives a 182 per cent increase over control and a (VCR) of 7.5.
- Yams: NPK 22.5-22.5-22.5 kg./ha. gives a 51 per cent increase over control and a VCR of 4.0.
- Ground-nuts: P 45 kg./ha. gives a 59 per cent increase over control and a VCR of 4.7.

Nigeria (West and Midwest)

- Maize: The combination of nutrients did not prove economic on local varieties. It pays however on improved varieties. NP and K at 22.5 kg./ha. give an average increase of 30 per cent over control and a VCR of between 1.8 and 3.4.
- Rice: PK at 22.5 kg./ha. with an increase of 31 per cent over control and a VCR of 3.6.
NPK at 22.5 kg./ha. with an increase of 28 per cent over control and a VCR of 2.1.
- Yams: NP at 22.5 kg./ha. with an increase of 38 per cent over control and a VCR of 7.5.
NPK at 22.5 kg./ha. with an increase of 33 per cent over control and a VCR of 4.5.

Senegal

- Rice: N 22.5 kg./ha. gives an increase of 35 per cent over control and a VCR of 5.2 (unsubsidized) and 9.3 (subsidized).
N 45 kg./ha. gives an increase of 61 per cent over control and a VCR of 4.5 (unsubsidized) and 8.2 (subsidized).

NPK 45-45-45 kg./ha. treatment with 82 per cent increase over control gave the highest increase but it was less economic.

Millet:

N 22.5 kg./ha. gives an increase of 65 per cent over control and a VCR of 4.4 (unsubsidized) and 7.8 (subsidized).

NP 22.5 kg./ha. gives an increase of 79 per cent over control and a VCR of 2.4 (unsubsidized) and 4.2 (subsidized).

NPK 22.5 kg./ha. gives an increase of 87 per cent over control and a VCR of 2.3 (unsubsidized) and 3.7 (subsidized).

Ground-nuts:

6-20-10 (135 kg./ha. NPK) gives an increase of 27 per cent over control and a VCR of 2.8 (unsubsidized) and 4.0 (subsidized).

Morocco

Out of 920 demonstrations 87 per cent showed a positive economic return and value cost ratio of 2.1.

As the FAO Fertilizer Programme is not yet finalized the following conclusions should be considered as preliminary:

17. The total average yield increase of all experiments carried out within the FAO Fertilizer Programme in West Africa is 65 per cent over non-fertilized plots. For comparison, the average increases in 1962 in the Near East Fertilizer Programme with comparable quantities of fertilizers per hectare, was 42 per cent. In Northern Latin America, the average increase of 83 per cent over control has been achieved by a double dose of fertilizers on an average.

The **biggest** West African average increase in 1962 was in Ghana (79 per cent over control). This was about 10 per cent less in Senegal and 30 per cent less in Nigeria.

18. Trials carried out with increasing doses of the three plants nutrients NPK show that under average conditions the biggest increase of yield is achieved by the first 20 kg. per hectare of each plant nutrient. There is a further considerable increase between 20 and 40 kg/ha which is usually also economic but the yield curve flattens considerably between 40 and 60 units of plant nutrients and is almost horizontal between 60 and 80 units. As soon as improved varieties are used and the methods of cultivation improved, and of course also in irrigated areas, bigger quantities of fertilizers per hectare are justified.
19. The results in all West African countries, with a few exceptions, show that two plant nutrients give a higher increase than one and that three plant nutrients give more than two. In the forest, N gives the main increase but there is a further economic increase with an addition of P. In the savannah, the P effect is the biggest but the addition of N gives a further increase. The increases by combinations of NK and PK are lower. When NP is combined with K, there is a considerable economic increase in 60 per cent of the trials.
20. Under shifting cultivation, fertilizer application showed advantageous effects from the first year after clearance of the land.
21. Out of 5613 three-and four-plot fertilizer demonstrations in West Africa, 80 per cent showed positive economic returns to at least one treatment, and the average VCR of the best treatment was 3.6. Out of 1219 nine-plot trials 99 per cent showed positive economic returns and the average VCR of the best treatment was 7.3.

The statements presented on the basis of the filled-in questionnaires give the indication that favourable value cost ratios have been achieved also in the following countries: Kenya, Malawi, Sudan, Chad, UAR, Uganda. The value cost ratios are in

general more favourable on export crops but also positive on crops used in the countries. In some cases (for instance Chad) favourable value cost ratios have been achieved by using one plant nutrient only instead of 2 or 3.

22. The profitability of fertilizer use can be influenced as follows:

- (a) By improved application of the fertilizer, for instance, by using it plant by plant instead of broadcasting. Split doses of nitrogen have given 30 per cent yield increase in Nigeria when using 3 times 20 kg/ha N instead of 60 kg./ha N in one dose. The difference in the sources of the plant nutrients can also influence its effects.
- (b) The improvement of the other input factors can increase considerably the effect of the fertilizer. Examples have been given from Sudan (irrigation of the Gezira scheme) and from Nigeria (improved maize varieties).
- (c) The price of the fertilizer paid by the farmer can be lowered by higher concentration of the plant nutrients especially by the use of compounds instead of mechanical mixtures, by subsidy of different types and by credit for fertilizer purchase at low interest.
- (d) Fair prices for agriculture products and a well working marketing system can considerably increase the profitability of the fertilizer use.

23. The following reasons have been given for the need of an increased fertilizer use in Africa:

Fertilizer is needed for increasing the productivity per hectare and per person, to balance as far as possible the lack of organic matter, to maintain an increased fertility of newly cleared land, to make the transition possible from low yielding shifting cultivation to continuous cultivation, for combination

with the other input factors like: improved varieties, plant protection, mechanization, irrigation, to reduce and eliminate imports of agricultural products in order to save foreign exchange, to improve the living standard of the farmers.

24. Fertilizer Supply: The supply problem usually exists only for the big number of small farms which are producing by far the biggest part of the food in Africa. The main obstacles to the use of fertilizers in small farms are: lack of adequate technical information, inadequate extension services, lack of the other input factors, lack of adequate supply and marketing systems, lack of credit, unfavourable relationship between the price of crops and cost of fertilizers.

25. In many cases the extension service although not a sales organization has to start selling fertilizers. Under a normal development the sales are taken over gradually by commercial organizations, private firms and agricultural supply and marketing co-operatives. The co-operatives for supply and marketing prove especially efficient in areas with small farms.

It has been strongly recommended that an intensified research and experimental work should produce much more detailed information on fertilizers as an input factor in all countries interested. Further on the introduction of fertilizer into practical agriculture requires a strong initiative for improving the soil analysis service as a basis for fertilizer recommendations and extension work in all its aspects. For this development, the experience of the technical assistance organizations is urgently needed.

26. Local Fertilizer Production: At present fertilizers in Africa are produced only in the United Arab Republic, Morocco, Rhodesia and Uganda. The other countries depend on importation. Plans for fertilizer production exist in several countries. One of the main problems is the still low or very limited consumption,

which makes it impossible or at least doubtful to run a modern fertilizer plant economically.

VI. Irrigation Working Group

27. A summary of the basic inputs (breakdown of capital investments) derived from the questionnaires is presented in the attached Table 1. It should be borne in mind that most of the figures given in this table are tentative.

28. During the discussions the following points were raised:

- (a) Irrigation in general: From the country statements it became evident that in many countries irrigation development was looked upon as an important means of safeguarding or diversifying agricultural crop production.

Note: The whole framework of irrigation in which many different factors such as climate, social conditions, engineering problems, level of agriculture, etc., play a role, could only be touched upon briefly during the discussions. In spite of the lively interest of the participants to discuss these factors, the schedule did not permit to go into detail.

- (b) Input factors: The knowledge of input factors of irrigation in Africa being extremely limited, it was hoped to collect enough additional information from the results of the questionnaires, to be able to have an adequate basis for discussion.

SUMMARY OF RESULTS OF QUESTIONNAIRES

BREAKDOWN OF CAPITAL COST

COUNTRIES & TYPES OF PROJECTS ITEM	LIBERIA 2 rice projects Delta 250 ac. each	SENEGAL Rice in Casamance	MALI Vegetables Rice	MAURITANIA Rice Vegetables	NIGER Sprinkler Vegetables	Pumped Dykes	Water Con- servation	MADAGASCAR	IVORY COAST				
1. Surveys and investigations		15,000 (9)	5,000 (3)	15,000 (9)	5,000 (3)	20,000 (12)	30,000 (18)	10,000 (6)	30,000 (18)				
2. Planning									30,000 (18)				
3. Water Supply system		100,000 (59)		50,000 (30)		40,000 (24)	60,000 (35)	20,000 (12)	25,000 (15)				
4. Drainage				20,000 (12)		30,000 (18)	60,000 (35)	100,000 (60)	200,000 (120)				
5. Land clearing				35,000 (20)		70,000 (41)	100,000 (60)		50,000 (30)				
6. Land Levelling								10,000 (6)	100,000 (60)				
7. Farm roads		1,000 (0.6)		5,000 (3)		5,000 (3)							
8. Machinery (pumps, etc.)			200,000 (118)	30,000 (18)	90,000 (53)	70,000 (41)	40,000 (24)						
9. Equipment (pipes & gates, etc.)				400,000 (235)					45,000 (27)				
10. Others				20,000 (12)	110,000 (65)		20,000 (12)	35,000 (20)	40,000 (21)				
TOTAL	CFA/ha. 310,000	50,000	220,000	116,000	205,000	405,000	50,000	245,000	170,000	50,000	300-350,000	150,000	460,000

Note: 1. Costs are given in CFA/ha. (\$/ac. in brackets).

2. The figures should be considered as indicative only.

29. An attempt was made to discuss the information available, but because of the limited knowledge, results were unsatisfactory.
30. The country statements gave a good picture of the situation regarding irrigation in the countries concerned and were followed by lively discussions.
31. The late distributions of the questionnaires with the consequent limited results in facts and figures, did not permit a detailed analysis of input factors on irrigation. On this subject the following conclusions were reached:
 - (a) The capital investment in different schemes showed a wide range in costs per area irrigated (£30 - 275/ac. or 50,000 - 460,000 CFA/ha.).
 - (b) This range not only reflects the different types of environmental conditions governing the capital cost, but also whether construction is done by local or foreign enterprises.
 - (c) Many countries are not in a position to postpone irrigation development until the training of local technical personnel has reached a level which would make it possible to calculate planning and execution of irrigation schemes by their own staff. Consequently, these countries are obliged to use foreign consulting engineers and contractors, which implies higher costs.
32. The present meeting should not be considered in itself, but as a starting point for future exchange of views and experiences and intensified international co-operation in this field. A meeting on irrigation in Africa should be held at a suitable date and FAO and ECA are being requested to study the possibilities of organizing such a meeting.
33. The participants should be asked to complete the questionnaire with respect to irrigation upon returning to their home country

and to mail them to the FAO Regional Office for Africa in Accra or to the Economic Commission for Africa in Addis Ababa. The information resulting from these questionnaires should be evaluated and analyzed by experts of ECA and FAO and distributed to the African countries.

34. It is recommended that inter-country exchange visits of irrigation officers be organized in order to broaden their views and experiences.

VII. Plant Protection Working Group

35. The participants of the working group presented a short summary of the main points concerning pest control, the organization and legislation of the official plant protection service and the difficulties arising from the fact that each African country has special plant protection problems. As far as the pure economic side of plant protection is concerned, some members of the group dealt with the relations of the use of pesticides and plant protection equipment to farm management and farm accounting. In consideration of their social aspect, the important problems of labour saving and labour simplification were also discussed. All participants stressed the importance of a carefully balanced correlation between chemical, biological and integrated pest control.
36. It was underlined by several speakers that in the field of plant protection introduction of modern chemicals and technical application methods must always be adapted to the local conditions. Mechanization should only be introduced step by step conforming to local conditions. Most interesting comments were advanced on problems of residues, biological and integrated pest control, use of gamma rays and chemicals for the sterilization of males and the subsequent eradication of pest species in isolated regions, and on the possibility of controlling plant diseases and pests by breeding resistant varieties of cultivated

plants or introducing a "sound" crop rotation. Besides, special problems concerning plant quarantine were discussed.

37. In most African countries great efforts have been made to organize a really effective, scientific and technical plant protection survey. However, success of these endeavours has not everywhere been attained because in some countries certain functionaries in their respective ministries do not recognize the great economic importance of pest control, or they are not able to realize the practical pre-conditions for its accomplishment.
38. In most African countries there are well-equipped scientific institutes or research stations. However, as pointed out by some speakers in the course of the discussions, some of these research institutes cannot apply the results of their scientific work. The main reason for this handicap is the lack of sufficient numbers of medium personnel which could ensure a permanent and fruitful contact between the research institutions and the farmers.
39. Development of an effective agricultural extension service closely connected with the research stations must be regarded as a decisive part in further endeavours to increase food production. Extension services should be a real help to the rural population as a means of mass education. One of the best means to strengthen the farmer's confidence in official extension services is the laying out of demonstration plots. Within the framework of official agricultural extension organizations the so-called forecasting and warning service is of particular importance.
40. There is only a comparatively small assortment of pesticides available in the markets of African countries, mainly the insecticides: DDT, BHC, Aldrin, Endrin, Thiodan, Dieldrin, Chordan, Parathion, Malathion, Dimethoate, Dipterex and Mineral

Oils; fungicides on the basis of copper compounds, Zineh and TMTD and some nematicides, acaricides, rodenticides and herbicides in smaller quantities. The supply of pesticides is usually adequate at least for the treatment of the main crops but there is an urgent need of some special compound.

41. All possible precautions must be taken in close co-operation with the responsible health authorities to ensure that any danger either to the applier of chemical compounds or to the consumer of the harvested products is eliminated. In areas where the population is still not accustomed to handle chemicals, dangerous materials should be prohibited.
42. As far as possible, selective insecticides and acaricides which do not kill predators and parasites of pests are to be given preference in order to spare the beneficial antagonism of pests. For the same reason, biologically favourable dates should be chosen for their application.
43. An urgent problem in some African countries is the necessity of official testing and approval of pesticides. This important task should not be left to private associations or firms.
44. Generally, it may be stated that the supply of plant protection equipment is very limited in the countries concerned. High power equipment (motorized sprayers, dusters, or atomizers) is usually only available in large plantations owned by the government, rural co-operatives or in privately owned machinery stations. Airplanes or helicopters are mainly used by contractors. There is complete lack of simple plant protection equipment suitable for small farmers. Usually all plant protection equipment is imported.
45. Many African countries, due to the social structure of the rural population, need simple and lightweight implements to be used either by hand (tins for seed treatment, traps for rodents or birds, simple hand dusters or hand sprayers for small plots)

or, in some cases, in connexion with animals. Use of equipment by pest control teams supplied by co-operatives or government machinery stations is generally recommended.

46. International co-operation is already effective with regard to some pests (locust, weaver birds, etc.), plant diseases (Virus, fungus and bacterial diseases), breeding of resistant varieties (of cultivated plants) or weeds control (water-hyacinth, etc.), but co-operation among African countries should be promoted as rapidly as possible and be expanded to many more problems of plant protection.

VIII. Machinery Equipment Working Group

47. Reports were received from the participants of six countries namely: Sierra Leone, Nigeria, Togo, Cameroon, Niger, Mali and Uganda. In all of them, emphasis was placed on the mechanization of family farms. It was considered of higher importance to make the work easier for the farmer, to raise the productivity of his work and to increase the yields and the quality of crops for a better nutrition of the population, than to discuss the mechanization problems of the plantations with cash crops for export. Discussion of the mechanization of handling the agricultural products in industries, as in mills, oil presses, dairies, etc., was eliminated because of shortage of time.
48. The discussion was limited to mechanization of yield work. Without going into specific and sometimes very important details concerning only one or a few of the mentioned countries, the main items of the present standard of mechanization are:
- (a) In the region of tropical rainfall, it is very difficult to replace the manual labour by animal or motor power. It is also difficult to use the ploughs and other tillage implements under the system of shifting cultivation where stumps and other forest residues remain in the soil.

Besides, oxen and cows as draught animals cannot be kept on account of the tsetse fly. In addition of hand-tools, the only implements being used are sprayers and dusters of different kinds.

- (b) As diminished forest density makes clearing and tilling easier, and when raising and keeping of cattle becomes possible, as it now is in the Savannah districts, animal draught power will gradually replace manpower in tillage, cultivation and transport work. By this mechanization, the work of the farmer is not only simplified but the productivity of his work can be considerably increased. If the farmer can, by manual work alone, cultivate 2 to 5 acres, by using animal draught power this area can be increased up to 40 acres.
- (c) The very low cash income of the farmer very often makes the purchase of draught animals and implements difficult, if not impossible. In this respect, government loans and other facilities are offered.
- (d) The number of tractors and their use in relation to it is limited. Tractors are used on larger, mostly government-owned estates, where cash crops are grown. But in some countries, farmers can rent tractors from government-owned tractor stations for clearing and tilling operations. Co-operative ownership and use of tractors are not wider spread till now.

In Togo 100 members of a group for mutual assistance clear and cultivate in the Savannah yearly 4 acres each with 10 tractors and the respective implements also for sowing and harvesting cotton. In Uganda, where group farming is sponsored by the Government, groups of fifty farmers clear their land with five tractors. In Sierra Leone rice fields are tilled and cultivated by tractors, while in Niger the

tractor is excluded from the Government programme of promoting mechanization in agriculture, as price and maintenance costs are considered too high to make tractors work profitably.

49. The limited use of tractors is due mainly to the relatively high price which the single farmer, or even a group of farmers, cannot afford. Only the government can buy and maintain tractors. Besides, the handling and repairing of tractors require a technical training and workshops with an adequate supply of the necessary spare parts. These pre-conditions are usually non-existent.

50. The training of farmers in the use of animal drawn implements may be useful. In Mali there are such training schools. The two best pupils of every course receive a pair of oxen and the necessary implements as a reward, with the obligation to instruct the farmers in their village.

51. The future possibilities of mechanization were discussed in the group with the following results:

- (a) Promoting mechanization is considered not only possible but necessary. Many factors must be borne in mind if mechanization is to be successful, that is to say, profitable. In the near future the animal draught level and the respective work procedures must be placed on the first plan. At a later date the tractor level may be approached on a broader scale.

The profitability of mechanization on the animal draught as well as on the tractor level cannot be estimated accurately at the present time. Conditions are too diverse and experiences too few; besides an exact method of calculating the rentability has not yet been developed.

(b) The factors to be considered in promoting mechanization may be divided into technical, educational and financial:

(i) Technical factors: Before recommending a certain mechanization process to the farmer, it should be thoroughly tried out in experimental stations or other institutions equipped for this task.

The effects of this process on the soil and on the crop must be observed, so that on the basis of a judgement on the performance of the implements used, a recommendation may be given to the farmer.

The work of testing should be done in connexion with the manufacturers of the implements or with their representatives, so that any improvement considered necessary may be known to the manufacturer and effected. This is the more necessary as most implements are not constructed for African conditions.

The practice in Niger, where under the Government's mechanization programme a light, middle and heavy unit of implements for animal draught are recommended to the farmer according to soil and crops, offers a good example of the result of research and testing work.

This work should be supplemented by experiments on how the present methods of tilling and cultivating the crop should be adapted to the functions of the new implements.

Hand tools should be included in the programme of testing and improving.

The wear and tear of the implements should also be tested, so that the right choice of spare parts can be made.

A small selection of implements with equal functions makes the introductory work easier and reduces the need for keeping a large supply of spare parts. This of course also applies to tractors and traction implements.

The practical testing must consider and estimate the economy of the mechanical process under investigation.

- (ii) Educational factors: The training of farmers is necessary when a mechanical process is ready for practical farming. It may be done by experimental stations, schools, or field-service officers.

This training is recommended for all works on the animal draught level.

The training is indispensable for the tractor level mechanization, for without a thorough technical knowledge of the tractor and its accessories, and without being familiar with the handling, maintaining and repairing of them, the use of tractors is doomed to failure from the very beginning. A training centre on the use of tractors and their accessories should have workshops and the necessary equipment.

The organizing of co-operative work must also be considered as an educational task, although it does not consist of technical training only.

- (iii) Financial factors: The governments promote mechanization by various means. The financial support of the government is required to put into effect the technical and educational measures mentioned above. The acquisition of a tractor is, as mentioned before and with few exceptions, only possible with government funds.

The introduction of animal draught implements can be facilitated by financial support of the government as well. Long-term loans and low interest rates can be considered as appropriate means. On the other hand, all subventions should have a time limit, as permanent subsidies have no educational value.

In order to lower the prices of machines and implements governments may also reduce import taxes.

52. It must be emphasized that these statements and recommendations are the result of discussions held in four meetings only and are mainly based on the reports of six countries. They are not complete nor can they claim application for the whole of Africa. For that a more thorough investigation and much more time would be necessary.
53. During the Ibadan period, Mr. G.A.E. Ogbe, Conservator of Forests, Benin City, Nigeria, lectured on the subject "Agri-Forestry Techniques for Raising Plantations". The paper is attached. At the conclusion of the lecture, a lively discussion among the participants took place.

IX. Study Tour through the Federal Republic of Germany

54. The study tour through the Federal Republic of Germany lasted from 8 to 24 September 1965. It started in Upper Bavaria, with visits to rural areas in this state, and ended with the final session in Berlin.
55. The study tour was divided into five parts, as follows:
1. Upper Bavaria as an agricultural region,
 2. Industrial centre of Ludwigshafen and Mannheim,
 3. North Rhine-Westphalia with the capital, Bonn,
 4. Niedersachsen, Hanover and Braunschweig,
 5. Final sessions in Berlin.
56. In Upper Bavaria the visiting group was able to get acquainted with the grazing system of land usage in mountainous conditions. Milk cows are kept during spring, summer and autumn on the cultivated pastures, being fed in the cowsheds in the winter months. Ninety per cent of the agricultural land is left as pastures and only 10 per cent is devoted to crop production. Annual yields of milk per cow are as high as 4,000 litres.

57. The group visited two farms: one milk cattle farm which is very efficient, very well managed and equipped with the necessary machinery, and the second one recently established along the lines of a settlement scheme. It was possible to discuss the economic conditions of farming in a highly developed, industrialized country. The group also visited the co-operative dairy producing the "Emmentaler" export cheese and the so-called "Machinery Ring" established by farmers as a free enterprise with the purpose of lending machines. At the end of the Bavaria portion of the tour the group visited the Agricultural Branch of the German Foundation in the vicinity of Munich, and the State Ministry of Food and Agriculture in Munich, where high officials answered many relevant questions.

58. The second part of the study tour was an industrial one. The group visited two large factories: BASF, Ludwigshafen, and John Deere-Lanz, Mannheim. The first one produces, among other products, fertilizers and pesticides (about 600,000 metric tons of Nitrogen per year) and the second one tractors and agricultural machinery. The information obtained and the discussions which took place during these visits demonstrated the role of fertilizers and machines in agricultural production. The group was interested in the price proportions between agricultural and industrial products as a means of production in the Federal Republic of Germany. One must state that agricultural products enjoy preferred prices all over the world. On the other hand, however, the cost of German agricultural products is very high because of the large quantities of small units manufactured. The group also visited the agricultural experimental station "Limburger Hof" belonging to the BASF factory.

59. During the third portion of the study tour the group was received by the Federal Ministry for Economic Co-operation in Bonn, where information was imparted by the State Secretary of this Ministry. The information was devoted to the activities of the Federal Republic of Germany in the field of economic assistance and co-operation with developing countries. The group visited the German Agricultural Information Centre and the Plant Protection Office, both situated in Bad Godesberg.

Advisory service in German agriculture is very well organized. Its priority task is to acquaint all farmers with the full magnitude of science research and progressive farming practice.

60. In the Niedersachsen State of the Federal Republic two research institutions were visited by the group: The Federal Biological Institute for Agriculture and Forestry and the Research Centre for Agriculture, both in Braunschweig.

The Federal Institute has two branch divisions: one in Berlin and one in Braunschweig. The Braunschweig branch employs 100 scientists and deals with phytopathology basic research.

The Research Centre for Agriculture has as its assignment the conduct of research and the fostering of international co-operation, in the sphere of agriculture and related sciences. The institutes work in the following research fields; soils, plants and animals, agricultural engineering and management, and marketing.

61. Two sessions were held in Berlin, one of them devoted to a lecture and subsequent discussion on the subject, "The Minimum Cost Combination in Agriculture in the Different

Stages of National Economic Development, with Special Reference to Developing Countries in Tropical Areas"

(the lecturer was Professor Dr. Bernd Andreae, Berlin - paper attached), and the second to the evaluation of the whole Seminar and to discussion of the possibilities of further co-operation.

X. General Conclusions and Recommendations

62. The participants to the Seminar expressed their gratitude to ECA for its very fruitful initiative and to the German Foundation, which organized and financially sponsored the Seminar as well as the study tour through the Federal Republic of Germany and Berlin.

63. The participants agreed that on the whole the organization of the Seminar was excellent. The subjects for discussion were very well chosen (fertilizers, irrigation, machinery equipment and plant protection).

The discussion leaders were qualified and prominent experts, their introductory papers very instructive and the discussions by the working groups very interesting and fruitful. The participants enthusiastically co-operated with the discussion leaders, there was complete harmony and collaboration among them, and they stressed the conviction that they have received new ideas and have gained by the experience during the Ibadan Seminar and the study tour through Germany.

64. Concerning the study tour the participants unanimously agreed on the excellent organization and choice of objects which were shown to them. They also wish that in future seminars more time be devoted to discussions on the particular subjects connected with the visits made. As the group

consisted of English-or French-speaking participants, a great deal of time was consumed in interpretation, and taking this into consideration, the programme was a bit overcrowded.

65. At the suggestion of participants, the questionnaires were collected to have them completed and returned to ECA, where the resulting information should be analyzed and distributed among them.
66. It was agreed that the Seminar brought some results as far as fertilizers and irrigation are concerned; some input-output coefficients were collected and presented; but this favourable situation does not exist for mechanization and plant protection. Concerning irrigation, further studies are necessary and participants recommended that ECA and FAO carefully study the possibilities of organizing, at an appropriate time, a meeting entirely devoted to irrigation in Africa, to which the group of experts working in the field of irrigation should be invited. This would permit the collection of more information on input-output coefficients.

XI.

Programme

Seminar Period I in Ibadan, Nigeria

Location: University of Ibadan, Faculty of Arts

Monday, 30 August

4 to 7 p.m.

- Plenary session (a) Opening of the Seminar
(Arts Lecture Theatre) (b) Presentation of the delegates
(c) Introductory papers:
1. Dr. Gorzelak, ECA, Addis Ababa
2. Dr. Troescher, Wiesbaden

Tuesday, 31 August

8.30 a.m. to 12 noon

- Working groups (a) Fertilizers
(b) Machinery

5 to 7.30 p.m.

- Working groups (c) Irrigation
(d) Plant Protection

Wednesday, 1 September

8.30 a.m. to 12 noon

- Working groups (a) Fertilizers
(b) Irrigation

5 to 7.30 p.m.

- Working groups (c) Machinery
(d) Plant Protection

Thursday, 2 September

8.30 to 10.30 a.m.

- Working groups (a) Plant Protection
(b) Fertilizers

11 a.m. to 12.30 p.m.

- Plenary session (c) "Agri-forestry techniques for raising plantations"
G.A.E. Ogbe, Chief Conservator of Forests, Benin City

5 to 7.30 p.m.

- Working groups (d) Irrigation
(e) Fertilizers

Friday, 3 September

8.30 a.m. to 12 noon

Working groups (a) Plant Protection
(b) Irrigation

5 to 7.30 p.m.

Working groups (c) Machinery
(d) Fertilizers

Saturday, 4 September

8.30 to 10.30 a.m.

Plenary session General informatory
talk on Germany and
introduction to the
study tour

Sunday, 5 September

All day

Excursion to Ife
and Oshogbo

Monday, 6 September

8.30 a.m. to 12 noon

Plenary session (a) Working group reports
(b) Discussion on the
possibilities of
international co-
operation

8.30 to 10.00 p.m.

Senior Staff Club (c) Reception given by
the German Foundation
for Developing
Countries

Tuesday, 7 September

8.30 to 10.30 a.m.

Plenary session Closing of the first
Seminar period

6.05 and 9.00 p.m.

Depart with charter flights of Nigerian
Airways for Lagos

Wednesday, 8 September

1.50 a.m.

Depart with Lufthansa LH 701 for
Frankfurt

8 a.m.

Arrival in Frankfurt

10.05 a.m.

Depart with Lufthansa LH 101 for Munich

11.10 a.m.

Arrival in Munich

Continue by bus to Garmisch Partenkirchen

Study Tour through the Federal Republic of Germany

Thursday, 9 September

Morning

Visit Dairy Co-operative
Unterthiengau

Afternoon

Visit Family Farm Happel,
Saalenzang

Informatory talk with agricultural
extensionists of the Agricultural
Office Kaufbeuren and members of
Machine Pools in Weicht, rural
district Kaufbeuren

Friday, 10 September

Morning

Visit Agricultural School in
Weilheim

Afternoon

Visit Agricultural Development Centre
of the German Foundation for
Developing Countries in Feldafing

Visit to the Bavarian Ministry for
Food, Agriculture and Forestry

Saturday, 11 September

Free

Sunday, 12 September

Free

Monday, 13 September

Trip to Mannheim

Tuesday, 14 September

Morning

Visit BASF, Ludwigshafen
(production of fertilizers and
pesticides)

Afternoon

Visit Agricultural Experimental
Station "Limburger Hof"

Wednesday, 15 September

Morning

Visit workshops of the firm John
Deere-Lanz, Mannheim, Windeckstr. 90

Afternoon

Sight-seeing tour of Heidelberg

Thursday, 16 September

Depart for Cologne

Friday, 17 September

Morning

Reception at the Ministry for
Economic Co-operation, Bonn

1 p.m.

Official Lunch at the Beethoven Hall,
Bonn, with Herrn Walter Scheel, Federal
Minister for Economic Co-operation and

Continuation:

Friday, 17 September

1 p.m.

representatives of German Ministries
and diplomatic missions of the African
countries

Afternoon

Visits to embassies in Bonn

Saturday, 18 September

Morning

Visit German Agricultural Information
Centre, Bad Godesberg, Heerstr. 124

and
Visit Plant Protection Office, Bad
Godesberg, Mittelstr. 99

Sunday, 19 September

Afternoon

Depart for Hanover

Monday, 20 September

All day

Visit Federal Biological Institute for
Agriculture and Forestry in Braunschweig,
Messeweg 11-12

Tuesday, 21 September

All day

Visit Research Station for Agriculture
in Volkenrode/Braunschweig, Bundes-
allee 50

6.10 p.m.

Depart for Berlin with flight BE 1363

7 p.m.

Arrival in Berlin

Seminar Period II in Berlin - Tegel

Wednesday, 22 September

Morning

Free

Afternoon

Sight-seeing tour of West Berlin

Thursday, 23 September

Final lecture:

"Farm Organization and Costs of Farm
Management in Different Stages of
National Economic Development"

Prof. Bernd Andrease, Berlin

Friday, 24 September

Evaluation of the Seminar and closing
session

Saturday, 25 September

Departure

XII.

List of Participants

A. Staff

Dr. F. Ahlgrimm +
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Professor Dr. B. Andreae +
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Dr. F.W. Hauck +
Regional Soil Fertility Expert
Food and Agriculture Organization of the United Nations
P.O.B. 1628, Accra

Dr. L. Horst +
Regional Water Development Engineer
FAO Regional Officer for Africa
FAO, P.O.B. 1628, Accra

Professor Dr. H. Heddergott +
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Dr. G.A. Jawando
Agricultural Economist
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Mrs. Dipl.Pol. H. Vomstein +
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H. Thederan +
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Mr. Dipl.Pol. B. Kind
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+ Persons marked with asterisks did not accompany the Seminar group on the study tour.

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Genève

Mlle. M. Croset +
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K. Hornberg
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B. Participants

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agricole est Batouri
Batouri

REP. CENTRAFRICAINE

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REPUBLIQUE DU CONGO

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Inspecteur phytosanitaire
Direction générale des services agricoles
du Congo
Brazzaville

REPUBLIQUE DEMOCRATIQUE
DU CONGO

Léonard Mukendi
Ingénieur-agronome
Directeur général INEAG
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HAUTE-VOLTA

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