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SWAZILAND CROPPING SYSTEMS RESEARCH AND EXTENSION TRAINING DESIGN STUDY

REPORT
SUBMITTED TO

USAID/SWAZILAND

BY

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The Consortium for International Development
represented by

Utah State University, Logan, Utah

and

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FOREWORD

The contents of this report were prepared by a team of agricultural scientists representing the Consortium for International Development under the USAID/CID Indefinite Quantity Contract No. AID/SOD/PDC-C-0217, Work Order No. 5. The team was composed of the following members:

Dr. Keith R. Allred, General Agronomist and Team Leader

Dr. William F. Farnsworth, Agricultural Education Extension Training Specialist

Dr. John D. Downes, Horticulturist and Cropping Systems Specialist

The first two team members listed are faculty members at Utah State University while the third is Professor of Horticulture at Texas Tech University. All are members of Universities which belong to the Consortium for International Development.

The team expresses its gratitude to all personnel associated with the USAID/SWAZILAND Mission for the efficient manner in which the team was assisted throughout the assignment. Special thanks is also given to the various Swazi Government Officials for the time and courtesies provided to us during our short but interesting work period in Swaziland.

Thanks is also extended to the friendly agricultural workers and other Swazi people contacted throughout our country travels for providing us with an insight into the agricultural potential as well as the customs of an interesting nation.

I.

GENERAL AGRONOMIST'S REPORT

GENERAL AGRONOMIST'S REPORT

PART 1: STUDY THE PAST AND PRESENT AGRICULTURAL RESEARCH ACTIVITIES TO DETERMINE WHAT RESEARCH IS AVAILABLE AND ADEQUACY OF RESEARCH TO SMALL FARMERS ON SWAZI NATION LAND (SNL).

A. Agricultural Research in Swaziland

1. Background

Agricultural research was begun in Swaziland with the establishment of the Research Division of the Ministry of Agriculture in 1959. It functioned under the direction of the Ministry until 1972 when it was transferred to the then University of Botswana, Lesotho and Swaziland. The stated objective of the transfer is to strengthen the University presence in Swaziland while maintaining a vigorous research service. In 1978 the division of research was again placed under the Ministry of Agriculture, from which it receives its direction at the present time.

Agricultural research in Swaziland traditionally has been directed at the needs of estates and large expatriate private land owners and has been carried out primarily by an expatriate research staff on research stations. This research system has remained unchanged in this regard since independence with Agricultural recommendations to Swazi Nation Land small farm operators being based on research that is more applicable to estate crops and large landholder operations.

2. Present Status of the Research Stations

The National Agricultural Research Center was established at Malkerns in March 1962. It now consists of approximately 400 hectares of land which are available for experimentation purposes.

The Malkerns Research Station is well situated in the Middleveld zone of the country where experimentation can be conducted on practically all temperate, sub-tropical and some tropical crops that are produced in Swaziland. The specific crops grown in the various regions of the country and research pertaining to them will be covered in another section of this report.

Physical facilities at the Station include:

a. a central administration building which contains office space for the Chief Research Officer and twelve Research Scientists (these include the presently authorized research positions at the station by the Ministry of Agriculture),

b. housing or living quarters for the research scientists and their families,

c. laboratory space for those scientists who are mainly involved with chemical analyses of plants and soils, including a relatively modern and well-equipped soil and plant tissue testing laboratory,

d. laboratory space for the entomology and plant pathology sections where testing can be done as well as the storing of collected specimens,

e. a two-room small but functional library which is stocked with many key reference books, periodicals and research reports,

f. a computer room containing a recently installed Hewlett Packer Model 9825A computer,

g. greenhouse facilities consisting of one greenhouse section,

h. a farm machinery shop equipped to handle the general repairs on most equipment operated at the station,

i. farm machinery and field equipment for land preparation, cultivation and crop harvesting including the usual tractors, discs, plows, cultivators, harvestors, etc., and

j. small sized plot equipment and hand tools.

Overall the physcial facilities for research at the Malkerns Station are adequate and are better than one would expect to find in many of the developing countries. After visiting the offices and laboratories it was concluded that they are quite adequate but might be touched up a bit to put them into top condition. The living facilities are adequate for the regular research staff but four or five houses would need to be constructed in order to provide sufficient space for the proposed USAID research scientists if they were to be housed at Malkerns. The greenhouse is small and consists of only one section. Although there may not be a great need for a large amount of greenhouse space in a country where crops can be grown out-of-doors throughout the year, it would appear to be beneficial to construct two more modern sections of the greenhouse to provide these sections for the cropping systems research team. These would need to be separated so two different temperatures could be maintained simultaneously or so experiments involving chemical treatments in one section would not adversely affect the other section.

Attention will need to be given to the farm machinery so that the various pieces of equipment are properly maintained and replacements are obtained for older or out-dated items. Provisions will have to be made for the purchase of plot type experimental equipment that can easily be transported to farmer field plots. This would involve a 3/4 ton pickup with a trailer, a small tractor with rototiller and other land preparation attachments, and plot harvesting equipment for maize and possibly other crops.

Library facilities and the availability of current reference books and periodicals are always in demand by eager research scientists. The library at Malkerns consists of two rooms, each about 15' x 24' in size. Each room is lined around the walls with shelves approximately eight feet high which are filled with reference books, research bulletins, periodicals and research reports. Most of the cataloged material is in English and comes from the English speaking countries of the world. It has the reputation of being the most complete agricultural library in Swaziland. As an example, there are currently being received over 120 titles of Research Journals, Abstract Journals and the like from English speaking countries of the world on a regular basis. Examples to point out the nature and quality of them include: Abstracts of Tropical Agriculture, Agricultural Administration, Agricultural News, Agronomy Journal, Australian Journal of Agricultural Reseach, Australian Journal of Soil Research, Crops and Markets, FAO Plant Protection Bulletin, Field Crop Abstracts, The Farmer, Horticulture Science, International Sugar Journal, Irrigation and Drainage Abstracts, Japan Pesticide Information, The Journal of Applied Ecology, Journal of British Grassland Society, Netherlands Journal of Agricultural Science, New Zealand Journal of Agriculture, Phytopathology, Plant Breeding Abstracts, Plant Pathology, Review of Plant Protection Research,

The Rice Journal, Rhodesian Journal of Agricultural Research, Rural Development News Swaziland, Rural Research in CSIRO, Science News, Soil Science, Soils and Fertilizers, Tropical Agriculture, Tropical Grasslands, Tropic Sciences, Weed Abstracts, World Crops and World Farming.

As can be seen from the above sample of titles, the library is receiving excellent reference materials. However, there are two problems that have come up since about October, 1978: the lack of a librarian to receive, catalog and file the newly arriving publications, and to see that current subscriptions are renewed and are not allowed to lapse due to lack of attention or funding. Arrangements need to be made for a short-term consultant librarian to put the library into proper order and to train someone as the future librarian. The Ministry of Agriculture should be encouraged to provide a librarian and also continue the journal subscriptions. If the latter is not possible, then arrangements for continuing the journal subscriptions should be part of the USAID assistance package. This will need to be determined at the project paper stage.

3. Branch Research Stations

Geographically the country can be divided into four major ecological zones, each extending generally from north to south. They are referred to as the Highveld, Middleveld, Lowveld and Lubombo starting on the western border and moving eastward in the country, respectively. These zones differ significantly in agricultural productivity primarily as influenced by altitude and rainfall as follows:

TABLE 1

Major Agricultural Zones of Swaziland

Zone	Altitude	Annual Precipitation
Highveld	1000 - 1800 M	1000 - 1750 mm
Middleveld	350 - 1000 M	750 - 1200 mm
Lowveld	60 - 375 M	500 - 800 mm
Lubombo	450 - 850 M	750 - 900 mm

In addition to the Malkerns Central Research Station, other research stations have been developed to cover the three main ecological cropping zones of the country. The second most important station is located at Big Bend and is representative of the drier Lowveld zone. Substations for the Middleveld zone are located at Nhlangano and Luve. Mangcongco and Hebron are substations representative of the Highveld, with the Hebron station being established in 1969. Initially a substation was at Vuvulane but it was discontinued at the end of the 1974-1975 season when the lease expired and the owners repossessed the land.

4. Objectives of Research Division

Stated objectives of the Research Division are the provision of practical economic recommendations for the production of field crops and vegetable crops and the improvement of veld and pastures. Research policy is established by a National Research Council. Priorities are defined and then the research officers have the obligation to develop programs within their areas of expertise to satisfy the priorities that have been established for the country.

5. Research Disciplines

Fourteen disciplines have traditionally made up the areas where agricultural research has concentrated its efforts. Each of these units within the Research Division has normally been headed by a professional officer with two or three supporting technicians and the usual laboratory and field laborers. These disciplines included:

a. Crop Agronomy: Investigations have centered around the introduction of field crops, variety evaluation, time of planting, population and spacing studies, herbicide usage and cultivation techniques. Crops tested include: maize, sorghum, winter cereals, groundnuts, beans, soybeans, cotton, castorbeans, sunflower, sesame, Irish potatoes and sweet potatoes.

b. Horticulture: Centered strongly around vegetabie variety evaluation, time of planting, spacing, fertilization and cultural techniques, a wide range of vegetables have been researched in most areas of Swaziland, both from the point of view of fresh production and for processing. Fresh vegetables tested were: carrots, cauliflower, cabbage, eggplant, peppers, onions and tomatoes. The crops for processing were: tomatoes, asparagus and youngberries. The adaptation of strawberry varieties was also studied. In addition, 18 other fruit and vegetable crops of less importance have received attention in the research program.

c. Veld and Pasture Management: Pasture studies constituted part of the original research effort but were discontinued in 1969. Then in 1974, after a break of five years, they were started up again. The three basic activities associated with this program were: a) plant introduction and testing, b) nutritional studies and c) evaluation of management techniques with ultimate testing of productivity on a field scale using livestock as the final yard stick.

d. Dryland Crop Production: This relatively new section was established at the Lowveld station to develop methods of crop production suitable for rainfed crops, or crops with minimal irrigation in the low rainfall region.

e. Soil Fertility and Crop Nutrition: The primary objective has been the definition of crop response to major and minor nutrients throughout Swaziland. Other investigations have involved lime, trace elements and organic manures. Between 1966 and 1973 some 800 trials were conducted with the plan of developing a model to improve the predictive accuracy of fertilizer recommendations relative to the various ecological zones of the country.

f. Soil Chemistry: This section has been responsible for providing back-up soil and plant analysis data for the other research sections, Ministry

of Agriculture and the private sector. It also includes a Soil Testing Unit.

g. Soil Physics: The broad terms of reference for this relatively new section are to evaluate the influence of soil physical structure on crop and pasture production and to describe optimum cultural techniques for the management of various soil types.

h. Plant Pathology: Both a research and service function are provided by this unit. As well as providing practical advice to farmers and controlling the country's phytosanitary regulations, research has centered on disease control in citrus, pineapple, cotton, rice, groundnuts, beans, gladioli, wheat and vegetables.

i. Entomology: Past studies have centered almost exclusively on citrus and cotton. However, efforts have also been made to catalog the pests of the major crops, to re-establish the national insect collection and to develop a systematic program to evaluate economic control of insect pests in the major crops.

j. Cotton Breeding: The cotton breeding section has concentrated its efforts on developing varieties with high yield, high ginning percentages and a lint quality suitable for the textile industries of southern Africa. While maintaining trials

on irrigated varieties, the main emphasis during recent years has been the development of cultivators suitable for rainfed production.

k. Cotton Entomology: Emphasis has been placed on the economic evaluation of insect control techniques, the development of application methods, and the role of new insecticides.

l. Biometry: This section was established to: a) assist in the design and analysis of the Division's field trials, b) provide assistance in agricultural survey and census work and c) provide lectures in biometry within the University.

m. Forestry Research: The Ministry of Agriculture provides facilities at Malkerns for the Forestry Research Unit which is funded by the forestry industry of Swaziland. Studies include the investigation of nursery techniques, slash disposal, natural seeding regeneration, disease control and needle analysis as an index of nutrition and growth curves of successive rotations.

n. Pineapple Research: This unit is fully funded by the pineapple industry and physical facilities are provided for research at the Malkerns Station.

B. Current Status of Research

Most of the disciplines mentioned generally were well represented in the research activities of the Division of Research, whether under the direction of the Ministry of Agriculture during the earlier years or under

the direction of the University between the years of 1972 until 1978. Since about October, 1978, research activities have dropped off considerably, and at the present time only a skeleton research staff remains. Apparently no research scientists are presently under contract with the Ministry of Agriculture. The Soil Chemist and Plant Pathologist are continuing some of their research activities on an interim basis. A few other research programs are being maintained by technicians who are still on the payroll of the Ministry of Agriculture, but they have only limited supervision.

This unfortunate situation can be attributed to: a) changes that took place within the organization scheme, b) the loss of trained research technicians who left the country after their contracts were terminated and c) lack of Swazis trained in research techniques who could be assigned to the positions that were vacated at the departure of the expatriate staff.

1. Experiment Stations

The land and physical research facilities continue to exist at Malkerns and Big Bend Experimental Stations as well as the substations at Nhlangano, Luve, Mangcongco and Hebron. With the limited staff and funds available to the Chief Research Officer, he is attempting to maintain some of the most critical and long-term research activities at the Malkerns Station such as: the liming experiments and the response of maize to pH and various fertilizer treatments. The soil and plant analysis laboratory continues to function along with the plant pathology laboratory. A Ph.D. student is continuing his studies at the Big Bend Station. The yield performance of promising cotton strains, cotton response to lime and fertilizer and methods of controlling verticillium wilt in cotton continue to be studied. Some of the technicians are continuing studies at the substations.

To provide for the continuity of the good research that has marked the fine work of the MOA so that it may make a continuing contribution to agricultural development in the country and service the needs of the extension service relative to technical developments, updating standard recommendations and providing the technology for increasing the effectiveness of RDA efforts in agricultural production, it is imperative that the Research Division of the MOA be quickly restaffed and its work continued and even expanded. This is needed in order to assist the extensive on-farm testing program which will be involved in the cropping systems research on the RDAs for use by the SNL farmers. Possibly a Plant Introduction Station should be established within the Research Division to facilitate evaluation of new species and forms that might become of importance to the agriculture of Swaziland.

The accompanying table shows where the main crops of the country have been tested.

TABLE 2

Crops and Research in Swaziland at Various Locations [1/] [2/]

Crops	Highveld Hebron	Highveld Mangcongco	Middleveld Nhlangano	Middleveld Malkerns[5/]	Middleveld Luve	Lowveld Big Bend	RDAs
maize	x	x	x	x	x	x	x
sorghum				x	x	x	
grain legumes [3/]				x	x	x	
oil seeds [4/]	x		x	x	x	x	
wheat				x			
triticale				x			
cotton		x	x	x	x	x	
tobacco			x	x	x	x	
potatoes	x			x		x	x
asparagus				x			
beans				x		x	
broccoli				x			
brussels sprouts				x			
cabbage	x			x		x	
carrots				x		x	
cauliflower				x		x	
mushrooms				x			
lettuce	x			x		x	
lima beans				x			
okra				x		x	
tomatoes				x		x	x
onions				x		x	
onion sets				x			
peppers				x			
squash				x			
strawberry	x						
tree fruit				x			

[1/-5/] See succeeding page for footnotes.

The following are footnotes for preceding table:

[1]Research has covered varieties and hybrids, cultivation, weed control, pest control, spacing, fertilizers, time of planting, mulching, no-till, curing and dehydration.

[2]With a number of crops up to five experimental sites have been involved in trials during a given year with testing for: variety evaluations, cultural studies, time of planting, pest and weed control, diseases, fertilizers, lime, etc.

[3]Includes kidney beans (bush and climbing), lima beans, soybeans, ground nuts, sugar beans, jogo beans, cowpeas, mung beans and dry beans.

[4]Includes safflower, sesame, soybeans, cotton seed, sunflower, rape, castor beans.

[5]Several additional crops have been researched mainly at Malkerns but some have also been tested at one or more of the other stations. These crops include: avocado, grenadilla, pineapple, cucumbers, pumpkins, squash, citrus, forestry crops, gladiolus, youngberry, peaches, rice, Japanese radish, sweet potato, lucerne, pasture legumes, pasture grasses, pigion peas, sugar cane, pyrethrum, tea, deciduous fruits, pecan nuts, loquats, guava and mango.

2. Availability of Research Information

Our planning team has been especially impressed with the amount of agricultural research and the quality of research conducted in Swaziland particularly during the period starting about 1959 up until the present. It is recognized that much of the research effort has been directed toward solving the production problems of the larger farm holdings and has been done mainly on individual crops and only a limited amount has been devoted directly toward the small farmer on Swazi Nation Land.

The results of the research findings have been reported in several forms and copies are available for reference at the Malkerns Central Research Station Library. The following information indicates the kinds and number of the various research reports that have been written.

a. Annual Reports of the Agricultural Research Division, Swaziland Government and Ministry of Agriculture. These reports contain a rather complete summary of the research programs carried out by the Research Division for each fiscal year starting about 1959. Results from each of the research stations are included.

b. Advisory Bulletins. There are 18 advisory bulletins that have been prepared which deal with rather specific subject matter. The following are examples selected from the series:

No. 2. A Report on Cotton Eradication and the Close-Season with particular reference to Swaziland. N. Morton. Sept. 1974.

No. 3 Calibration of the "Safim" ox-drawn planter using planter keys. Tony Hodgson. May 1974.

No. 6 Notes on the Cultivation of Napier Fodder for Small Scale Farmers. A.R.T. Whitmash. May 1975.

No. 8 Some Principles of Irrigation. F.H. Siles and J. Browning. Dec. 1974.

No. 9 Vegetable Gardening in the Lowveld of Swaziland. D.H.M. Ffoulkes. Sept. 1975. Mimeo. 41 pp.

No. 10 Intensive Forage Production in Swaziland. A.R.T. Whitmash. June 1975.

No. 11 Pipe Tobacco Recommendations for Swaziland. C.E. Brook, et al. Jan. 1977.

No. 13 Cotton Pest Control Handbook. R.D.S. Clarke. Sept. 1978.

No. 14 Irrigating Cotton in Swaziland. J.D. Lea, et al. Sept. 1965.

No. 18 Veld Types of Swaziland. J. Pons. 1967.

c. Research Reports. There are 29 reports of research trials dealing with liming, fertilization, and specific crops such as maize, cotton, tobacco, jugo beans, etc. Examples are:

No. 7 A Report on the Maize Husbandry Trials. M.R.S. 1973-75. C.E. Brook. May 1975.

No. 19 Jugo Beans. J. Cumberland. March 1978.

No. 22 Summaries of Work on Soil Fertility. Malkerns Experimental Tests. M.J. Jones. August 1978.

No. 24 Magnesium at Malkerns Research Station. M.J. Jones. Jan. 1979.

No. 28 Trials at Swaziland Experimental Sites. M.J. Jones. April 1979.

d. Special Reports. There are a total of 26 special reports and 2 examples are:

No. 12 Report of Swaziland Rural Grain Storage Project. Sept. 1972 - April 1975.

No. 21 Crop Production Extension Project Grain Storage Section. Annual Report 1976.

e. Miscellaneous Reports. A total of 130 miscellaneous reports have been prepared including notes of visits of the research staff members to other countries for special meetings and seminars dealing with specific topics such as cotton, tobacco, canning industry up-date, etc. Selected titles include:

No. 49 Crop Production in Swaziland. By All Research Officers. 1965-66.

No. 50 Chemical Weed Control in Swaziland. J.D. Gibbs. 1966.

No. 64 Fertilizer Recommendations for Major Annual Crops. P.E. Latham. 1966.

No. 68 Fertilizer Recommendations for Vegetables. M.S. Armitage. Winter 1970.

No. 81 Why Lime? M.S. Armitage. 1972.

No. 82 Summary of Tomato Trials. M.S. Armitage. 1972.

No. 89 A Summary of Maize Variety Trials in Swaziland. 1960-1972.

No. 105 Wheat Situation in Swaziland, A Brief Outline of Production, Future Prospects and Production Restraints.

No. 126 Dry Land Winter Wheat Production. J. Cumberland. Nov. 1977.

No. 128 Improving Dry-land Crop Production in Low Rainfall Regions of Swaziland. K.D. Shepherd. Feb. 1978.

No. 130 Maize Seed Size Grades for the Safim Ox-drawn Planter.

f. Advisory Bulletin No. 1. Third Edition. March 1977. This is especially valuable since it was prepared by the Research Division Staff of the Agricultural Research Division Swaziland, U.C.S. Faculty of Agriculture and contains current recommendations in the selection and production of field crops, horticultural crops and pasture varieties. This publication is used as a basic reference on crop production by field workers, extension field officers and others working in agricultural production.

3. Adequacy of Research to Small Farmers on Swazi Nation Land

As can be noted from the above-listed references to research results obtained in Swaziland, a great deal of useful information is available to farmers involved in crop production. Granted, most of it is geared to the

large-farm operation. However, much of the information could very well pertain to the small farmer on Swazi Nation Land. The main constraint would appear to be the accessability of the research results in an understandable and usable form. Therefore, the results of research need to be prepared in simple terms which relate directly to small farms. Some of the publications have been written specifically for use by small farm holders.

Research recommendations which could be most beneficial to the farmer on a limited amount of land would be maize varieties, liming and fertilization practices, time and depth of planting, and use of improved seed or hybrid seed in the case of maize.

It must be noted that the research has been obtained from trials involving individual crops. Little, if any, research appears to have been done on cropping systems involving the production of maize intercropped with squash, beans or other staple food crops. Information concerning other mixed cropping systems utilized on a regular basis by the Swazi farmer is lacking.

In order to effectively serve the crop production needs of the small farmer on Swazi Nation Land, a new approach to research is needed which will get at the fundamental relationships of the cropping systems utilized by these farmers. Some questions that need to be addressed include:

a. what crops are best to be grown,

b. which varieties of those crops provide the greatest return,

c. what liming practices need to be followed,

d. what fertilizers are required for economical returns, in which combinations and in what amounts,

e. when should the crops be harvested for retention of highest nutritive value,

f. how should the crops be stored,

g when and how should the crops be marketed, and

h other important considerations.

These questions need to be answered not only for individual crops, as has been done in the past, but also for systems involving inter-cropping and mixed-cropping systems.

Answers to these and other important questions related to economical crop production for the small farm operation can be obtained through a systematic cropping systems research approach involving:

a. designed experiments conducted under controlled conditions at Swaziland research stations under the direct supervision of qualified research scientists,

b. on-farm field research trials under the direct supervision of the researcher,

c. on-farm trials under the direction of the extension field officer but in cooperation with the extension field officer and research scientist, and

d. on-farm field research trials and demonstration trials under the direction of the farmer but under the supervision of the extension field officer.

PART 2: DESCRIBE CROPPING SYSTEM RESEARCH TRAINING NEEDS IN CONTEXT OF SWAZILAND'S TOTAL AGRICULTURAL SITUATION.

A. Staff Positions Available

The Chief Research Officer at the Malkerns Central Research Center indicated the Ministry of Agriculture has authorized the filling of twelve research positions which are in addition to his own position. They are very similar to the old positions and include the following: Dry Land Crops Agronomist, Plant Pathologist, Cotton Breeder, General Crops Agronomist, Pasture Agronomist, Soil Fertility Specialist, Soil Physicist, Soil Chemist, Horticulturist, Research Entomologist, Cotton Entomologist and Biometrician.

It was mentioned that staff members are presently functioning in three positions, namely the Dry Land Crops Specialist, Plant Pathologist and the Soil Chemist; however, we obtained the impression the University contracts for these people have expired and they are waiting for formal approval by the Ministry of Agriculture before being offered positions. The other positions were advertised internationally several months ago. Applications that were received have been screened and recommendations for hiring qualified applicants have been sent to the Civil Service Board for action, but final approval for hiring the research scientists to fill those positions has not yet been received.

Private industries are continuing to fund the forestry and pineapple positions on the same basis as they have in past years. These two researchers continue to maintain an office at Malkerns but do not become involved in station research.

An additional beneficial resource for the development of agricultural research and extension training is the Seed Multiplication Project under the

auspicisus of the Food and Agriculture Organization of the United Nations. This project provides a manager and two staff members for the improvement and distribution of crop seeds.

B. Potential for Developing Future Staff

The general outlook for developing Swazi research scientists for the short-term (1 to 3 years) is not very promising. However, for the longer term (5 to 10 years) it would appear to be possible provided the Ministry of Agriculture and the University of Botswana and Swaziland under the direction of the Government of Swaziland could agree on this as a high-priority item for the future development of the nation and would cooperate in identifying potential candidates for research training in specific designated fields of study.

The Faculty of Agriculture at the University is responsible for training students in the following disciplines: B. Sc. Degree in Agriculture, B. Sc. Degree in Agricultural Education, General Two-year Diploma in Agriculture, Diploma in Agricultural Education, Diploma in Animal Production and Health, and Diploma in Home Economics. In addition, a one-year "Certificate in Agriculture" Program is provided at the University under the direction of the Ministry of Agriculture.

Projections have been made on student enrollment in the various faculties of the University at the B.Sc. Degree level and for the number of students graduating with the B.Sc. Degree over a five-year period starting in 1979-80 and include only the Swaziland National students.

TABLE 3

Projections of Swaziland National Students in Agriculture, 1979-1984

Agriculture	1979-80	1980-81	1981-82	1982-83	1983-84
B.Sc. Enrollments	14	20	26	34	42
B.Sc. Graduates	4	5	7	10	14

Source: University College of Swaziland Bulletin of Statistics, Development Planning Unit, October 1979.

These enrollment figures are for the four-year course leading to the B.Sc. Degree and include students with interests in all of the various aspects of agriculture. Each student in each of the graduating classes would likewise have varied professional interests.

The two-year diploma program has a considerably larger agricultural enrollment than the B.Sc. Degree program. These students select from four different majors: General Diploma in Agriculture, Diploma in Agricultural Education, Diploma in Home Economics, or Diploma in Animal Production and Health. For the year 1978-79 the number of students enrolled in each of these areas and the number of diplomas awarded are presented in the following table.

TABLE 4

Enrollment of Swazi Nationals in the University of Botswana and Swaziland in the Diploma Program During 1978-79

Agriculture	First Year Students	Second Year Students	Total	Diplomas Awarded
General Diploma in Agri.	19	21	40	21
Diploma in Ag. Educ.	20	19	39	16
Diploma in Home Econ.	20	18	38	16
Diploma in Animal Prod.	15	15	30	15
Total	74	73	147	68

Source: University College of Swaziland Bulletin of Statistics, Development Planning Unit, October, 1979.

Since there are so few Swazi students who obtain the Bachelor of Science Degree, there needs to be some mechanism for encouraging more to attend the University with a major in Agriculture. Apparently, one of the limiting factors is the inability of the students or their families to pay the high cost of a University education and the present number of Government scholarships is limited. Therefore, the review team recommends that USAID, through this Cropping Systems Research Program, provide for sufficient scholarships at the Bachelor of Science Degree and Master of Science Degree levels to train sufficient research scientists in agriculture to satisfy the needs of the program. It will likely be necessary to start at two levels for the selection and training: students who have received their Diploma Awards and students who have graduated with the Bachelor of Science Degree.

Students who have the B.Sc. Degree with an aptitude and interest in furthering their studies to the Master of Science level need to be identified. They should be provided a scholarship to study in a specified discipline in agriculture at a University in the United States. A number of promising students who have completed the Diploma Program and have an interest in research should be identified and provided scholarships to study for the B.Sc. Degree in one of the following ways: at the University of Botswana and Swaziland, at another good African University, or at a University in the United States. Of course, the first choice of study for these students should be Swaziland but the other possibilities should not be ruled out since the students attending other universities would obtain a different perspective on agricultural development from their experiences in other countries. The trained students to the Bachelor of Science level would then return to Swaziland to receive experience in agriculture. After two or three years at home the most promising ones would be sent out for further training at the Master of Science level so they could specialize in a designated field of Agricultural Science.

PART 3: HELP IDENTIFY GOALS, OBJECTIVES AND TARGETS, AND ASSIST IN DRAFTING PRELIMINARY PROJECT PROPOSALS DETAILING TECHNICAL ASSISTANCE, COMMODITIES AND CONSTRUCTION REQUIRED IN ORDER TO HAVE IMPACT UPON SMALL FARMER PRODUCTIVITY.

A. Research Portion of Cropping Systems Research Project

1. Construction of Physical Facilities

a. Four or five homes, three-bedroom, for members of the research team. These are to be constructed as needed at Malkerns.

b. Headhouse and two sections of research greenhouse. To be constructed at Malkerns Research Station in a location and configuration acceptable to the Chief Research Officer. The headhouse would be approximately 15' x 46' and each section of the greenhouse would be about 20' x 30' in size.

c. Storage shed for storing plot-type equipment at Malkerns for the team members. This would be about 15' x 20' in size.

d. Storage sheds at each of four key RDAs, approximate size of 12' x 15'.

2. Project Vehicles

a. Pickup trucks 3/4 ton, two each.

b. Transport trailers of two-wheel type for moving research equipment, two each to go with the 3/4 ton pickups.

c. Camper shells for the 3/4 ton pickups for protection of tools, harvested plot samples, etc., two each.

d. Pickup truck 1/4 ton for station and in-country travel to plots where large equipment is not required, two each.

e. Station wagon for use of Chief of Party and transport of team members to meetings as needed.

3. Project Equipment and Supplies

a. Replacement farm tractor -- about 70 hp diesel, with necessary farm implements for efficient utilization.

b. Research small plot equipment -- need about 10,000 dollars.

c. Laboratory equipment -- need about 5,000 dollars.

d. Laboratory and greenhouse benches, etc., about 2,000 dollars.

e. Office equipment needs to be provided for the Chief of Party, the secretaries and all staff members.

f. Office supplies need to be budgeted at about 1,000 dollars per year.

g. Printing and publication expenses of research and extension publications to benefit the farmer, about 5,000 dollars.

h. Other miscellaneous items as needed.

B. Proposed Cropping Systems Research Staff

a. Chief of Party -- Capable administrator who is willing to coordinate the croppings systems research along with the extension training and extension on-farm demonstration functions of the project.

b. Cropping Systems Research Specialist -- Agronomist skilled in cropping systems research and willing to conduct this type of research at all

levels including at the research stations using factorial experiments under strictly controlled conditions, on-farm research using simplified field research techniques, and on-farm testing in cooperation with the extension field officer.

c. Cropping Systems Research Horticulturist -- skilled in cropping systems research involving inter-cropping as well as multi-cropping and rotational cropping systems using similar research techniques as the Agronomist and often in cooperation with the Agronomist.

d. Soil Fertility and Irrigation Expert -- skilled in experiment station and on-farm research involving fertilization, liming and irrigation techniques, and willing to cooperate with both the Agronomist and Horticulturist in designing and implementing cropping systems research to benefit the small farmer on SNL.

e. Production and Marketing Economist -- able to assist in the economic evaluation of the overall project and its economic impact on the income of the small farmer on Swazi Nation Land and on the economics of the nation.

PART 4: IDENTIFY CONSTRAINTS THAT ARE TO BE CONSIDERED BY THE PROJECT PAPER DESIGN TEAM.

A. Research Related Issues to be Addressed By the Project Paper Design Team

a. Determine the Ministry of Agriculture's plans and schedules for filling the approved research positions in the Research Division of the Experiment Station System.

b. Willingness of the Government of Swaziland officials, including Ministry of Agriculture and the University of Botswana and Swaziland, to identify promising students at the B.Sc. graduate level first and second at the Diploma completion level for future training as research scientists.

c. The possibility of forming proper linkages between members of the Faculty of Agriculture and the Ministry of Agriculture Research Staff in cooperatively developing the cropping systems research concept for Swaziland.

d. Determining the availability of present station housing, office and laboratory facilities to the USAID Research Team in order to decide the exact amount of construction needed for the program.

e. Determine specific greenhouse space needs along with location and best configuration of the proposed greenhouse facility.

f. Determine more specifically what research farm equipment, both large-scale and small-scale, is available at the Research Stations and which items need to be replaced or what items need to be purchased to fill the voids that exist.

g. Formation of proper linkages between the Cropping Systems Research staff and Extension personnel in the RDAs where cropping systems research is to be conducted.

h. Determine the availability of farm equipment in the RDAs where cropping systems research is to be conducted and the willingness of Extension personnel to make the equipment available and also assist in developing the concept of on-the-farm research to help the small farmer of Swazi Nation Land.

i. At the beginning of the assignment the Project Paper Design Team must clearly define the objectives of the cropping systems and supporting research efforts to be accomplished and carefully plan and develop the strategies, field experiments, sampling procedures, laboratory work, statistical methodology and economic analyses so that an integrated team approach can be realized.

PART 5: ANTICIPATED ACCOMPLISHMENTS BY RESEARCH TEAM DURING THE FIVE-YEAR PROJECT.

Achievement of the project purpose can be measured by the following capabilities or programs anticipated to be accomplished or to exist in Swaziland at the end of the five-year period.

a. A coordinated cropping systems research program that is functioning at the experimental research station level and through on-farm trials.

b. Completed test results from 15 to 20 factorial experiments conducted under the direction of the research team at Malkerns Central Research Station involving relationships between sole-cropping, inter-cropping, multi-cropping and rotational cropping systems.

c. Results from 10 to 15 factorial experiments conducted at out-lying research stations as determined by the need of testing certain cropping systems research in different ecological zones.

d. Results from 50 to 60 on-farm research experiments conducted in four or five selected RDAs throughout the country in cooperation with personnel from the extension service.

e. Annual reports, one for each year, summarizing the research findings from parts b, c and d above.

f. Information based on research results available to the extension component of the project for the

preparation of 8 to 10 extension type bulletins or pamphlets suitable for distribution to small farmers on SNL through Extension Field Officers.

g. Some five Swazi students identified and trained or in training in specified fields of agriculture as related to cropping systems research at the Master of Science Degree level. Major training specialties might include, but not necessarily be limited to Agronomy - field crops, Agronomy - soils and irrigation, Horticulture - fruits and vegetables, Agricultural Economics - production and marketing, Weed Science, Entomology, and/or Plant Pathology.

h. Up to 30 Swazi students identified and trained or in training to the B.Sc. level in Swaziland, some other African nation or overseas who have potential to become research scientists following field experience and additional future education to the Master of Science Degree level.

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II.

CROPPING SYSTEMS SPECIALIST'S REPORT

CROPPING SYSTEMS SPECIALIST'S REPORT

Agro-Ecology of Swaziland

Swaziland is a landlocked country of 17,500 sq km lying between 25 and 28° S latitude in southeast Africa. It is bordered on the east by Mozambique and elsewhere by the Republic of South Africa. The country is divided into four main topographic regions on a north to south axis.

Highveld: N-S strip on the western escarpment of the South African plateau. Altitudes range from 1000 to 1800 m. The topography is characteristically broken mountains with plateau areas. Soils are predominantly deep red and yellow ferrites on an ancient granite base. Climate is humid with rainfall between 1000 and 1750 mm annually, much of which falls between September and April. Climax vegetation is subtropical evergreen forest with a present vegetation of short upland (sour) grass. Area of the region is approximately 5200 sq km. Forestry is most important industry. Some farming.

Middleveld: N-S foothills to the east of the highveld encompassing approximately 4900 sq km. Topography is undulating and broken with altitude ranging from 350 to 1000 m. Soils typically ferallitic and ferruginous tropical overlying granite. Climate sub-humid with annual rainfall of 750 to 1200 mm, falling mainly in the summer (October to April). Rainfall is lower and more erratic in the eastern area. The climax vegetation is mixed forest shrub which has given way to tall mixed grassland and open woodland. Agriculture is a complex mixture of ranching, mixed rainfed and irrigated field crops and horticultural crops.

Lowveld: N-S strip east of the Middleveld embracing about 6000 sq km of gently undulating topography ranging in altitude between 60 and 375 m above sea level. Climate is sub-arid with restricted and erratic rainfall of 500 to 800 mm annually. Drought hazard is marked, but frosts

frequently occur in drainage lines during winter (June to August). Soils are derived from granite and Karroo sediments in the west and basic igneous rocks in the east. The original subtropical savannah climax has given way to sparse woodland, thorn scrub and tall grass (sweet veld). Cattle ranching, sugar cane, citrus, rice and cotton under irrigation are the main agricultural activities.

Lubombo Plateau: N-S strip on the eastern border. Topography rolling with deeply incised gorges, with altitudes ranging from 450 to 850 m. Predominantly red and brown ferruginous soils derived from rhyolites and basalts. Climate is frost free with annual rainfall of 750 to 900 mm annually. Climax vegetation of mixed scrub forest has given way to mixed grassland and thorveld. Area of the region is about 1400 sq km. Main agricultural activities are ranching and mixed cropping.

PART 1: CROPPING/FARMING SYSTEMS USED BY SWAZI SMALL FARMERS ON SNL, INCLUDING DRYLAND AND IRRIGATION FARMING.

A. Present Systems

Swazi cropping/farming systems on the SNL[1] consists of communal livestock grazing (chiefly cattle and goats), small scale poultry, negligible pork production and mixed crop production on cultivated land. The cultivated land is fenced or otherwise set aside from the grazing land during the cropping season, which normally corresponds with the rainy season.

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[1] SNL is Swazi Nation Land, owned by the nation rather than privately, and comprises a good portion of the country. It is allocated by local chiefs to individual families who live scattered on homesteads rather than in communal villages. The land is theirs to use and pass to their offspring but cannot be sold or traded.

At the end of the cropping season the crop land reverts to communal pasture, the livestock grazing the crop residues.

Land allocated to individuals for cultivation and other forms of management accounts for only about 12% of the total SNL in the country as a whole: 10-11% in the Highveld and the Lowveld, 15% in the Middleveld and only 6% in the Lubombo. The rest of the SNL is unallocated communal grazing land, or where too hilly or mountainous serves as source of fuelwood, etc. Uses of the homestead land is indicated in Table 5.

TABLE 5

Land Use Patterns on SNL Holdings.
Hectares and Percentage of Area in Various Uses.

	Total Ha	Cropland	Fallow	Potentially Productive	Woods	Other
Swaziland	106,397	79.6	14.5	1.0	0.05	4.9
Highveld	19,195	81.1	10.3	3.5	0.20	6.4
Middleveld	45,281	81.1	14.6	0.6	0.02	3.7
Lowveld	38,086	77.3	17.0	0.4	-	5.3
Lubombo	3,833	84.9	9.3	0.4	-	5.4

About 4/5ths of the total holding area is planted with crops, 1/7th is fallow, 1/20th is occupied by houses, cattle sheds, wasteland, etc., 1% is potentially productive land, and woodland is almost negligible.

From 98 to 100% of the homesteads in all the regions grow crops, and nearly half of them keep some land fallow. However, in the Lubombo region, only one-fourth of the holdings, and in the Lowveld two-fifths, have fallows. The percentage of holdings having some potentially productive land differs from over 2% in the Lowveld to about 11% in the Highveld. About 1% of the holdings in the Highveld and much less in the Middleveld

have some woodland. The bulk of the cultivated land (including cropland and fallow) is found in the Middleveld and the Lowveld, and most of the potentially productive land lies in the Highveld and the Middleveld. Extension of the cultivation in the country will, among other things, depend on reclamation of fallows in the Middleveld and the Lowveld and cultivation of potentially productive land in the Highveld and the Middleveld.

Average size of holdings in the different regions varies from a high of 4.51 ha in the Lowveld to 2.36 ha in the Middleveld, 2.08 ha in the Highveld and 1.98 ha in the Lubombo, with a national average in the SNL of 2.74 ha per homestead. The bulk of the cropland is subsistence crop production. Only 1/20 of the holdings in the country produce mainly for sale, and crops are the main commodities sold. The holdings producing mainly for sale are chiefly those having 5 ha or more, and their income is derived from crops, livestock and other products. The major source of income on holdings producing mainly for home consumption is off-farm employment in nonagricultural sectors. In the country as a whole about 25% of holdings sell some produce. The types and relative volumes of agricultural commodities sold are indicated in Table 6.

The major crops grown on the Swazi Nation Land are maize, groundnuts, cotton, jugo beans, sorghum, beans, pumpkins, sweet potatoes and tobacco. Orchard crops (citrus, avocado, banana, mango, etc.) are found to be rarely grown except for a few scattered trees. Sugar cane and pineapple are also scarcely found. Vegetables are grown only on a small fraction of the area as garden crops.

TABLE 6

Sales of Agricultural Commodities[a/]

	Commodity	Unit	High-veld	Middle-veld	Low-veld	Lubombo	Total Swaziland
1.	Maize	Bags[1]	12,557	22,008	5,943	2,462	42,970
2.	Cotton (Lint)	Bale[2]		1,191	2,713	240	4,144
3.	Groundnut (in shell)	Bags[3]	200	3,070	1,711	268	5,249
4.	Jugo Beans	Bags[3]	197	2,815	697		3,709
5.	Beans	Bags[1]	278	2,297	122		2,697
6.	Sorghum	Bags[1]	119				119
7.	Tobacco	M. Tons	4	165			169
8.	Potatoes	Bags[4]	1,216	2,873			4,089
9.	Sweet Potatoes	Bags[4]		3,119			3,119
10.	Tomatoes	Kg.		5,751			5,751
11.	Cabbages	Bags[5]	466	3,587	1,518		5,571
12.	Peas (Green)	Bags[1]	119				119
13.	Pawpaw	Number		457			457
14.	Banana	Kgs.		6,793			6,793
15.	Avocados	Tray[6]		152			152
16.	Cattle	Heads	977	3,811	6,165	2,184	13,137
17.	Goats	Heads	232	1,469	2,162	69	3,932
18.	Sheep	Heads	302		152		454
19.	Milk	Litres		12,270	6,487		18,757

	Commodity	Unit	High-veld	Middle-veld	Low-veld	Lubombo	Total Swaziland
20.	Pigs	Heads		38			38
21.	Poultry	Number		1,914	1,800	901	4,615
22.	Horses	Number	47				47
23.	Tshwala	Litres	6,087	68,076	5,201	15,861	95,225

a/ Agricultural Sampling Census (Swazi Nation Land) 1971/72. GOS, Central Statistical Office, P.O. Box 456, Mbabane, Swaziland, S.A p. 24.

[1] of 200 lbs or 91 Kg.

[2] of 400 lbs or 182 Kg.

[3] of 200 lbs or 91 Kg.

[4] of 33 lbs or 15 Kg.

[5] of 44 lbs or 20 Kg.

[6] of 12 lbs or 5.4 Kg.

TABLE 7

Contributions of Different Region to Crop Areas[b/]

Crops	Total Area, Hectares	Percentage Area Contributed By			
		Highveld	Middleveld	Lowveld	Lubombo
All Crops	84,691	18.0	43.4	34.8	3.8
Maize	62,311	19.5	45.3	30.8	4.4
Groundnuts	4,945	12.0	52.2	29.9	5.9
Cotton	3,933		14.1	83.6	2.3
Jugobeans	2,814	17.4	39.3	42.3	1.0
Sorghum	2,566	19.2	24.0	55.8	1.0
Beans	2,083	15.7	52.7	31.3	0.3
Pumpkin	2,893	17.3	30.1	51.2	1.4
Sweet Potatoes	924	18.1	70.3	11.0	0.6
Tobacco	308	15.6	63.3	20.8	0.3
All Other Crops	1,915	25.0	43.0	28.9	3.1

B. Regional Variation in Cropping Pattern

About 80% of the total area under crops in the country is found in the Middleveld and the Lowveld. These two regions contribute about 98% of the country's total cotton area and 80-84% of the area under all other major crops except maize and pumpkins.

Mixed cropping is traditional among Swazis, both on SNL homesteads and otherwise. As indicated, maize is the basic staple food crop grown on all homesteads, often inter-cropped with pumpkins, groundnuts, beans or

[b/] Agricultural Sample Census (Swazi Nation Land), Central Statistical Office, GOS, 1971/72, Mbabane.

sweet potatoes. The bulk of the cropping is rainfed, irrigation being limited to hand watering if required to keep crops alive after transplanting where water is not too far to hand carry, or more extensively in the rare area where diversion of part of a stream is possible. In the Lowveld some small holding patches of maize and sugar cane are irrigated. Dryland farming during the dry season is restricted to some cotton planted near the end of the rainy season, pigeon peas, sesame and sorghum. Wheat, grown during the dry winter season, is irrigated.

Kraal manure is used on the larger holdings where livestock management makes this feasible, and some fertilizer is used by many Swazi farmers on SNL homesteads.

A survey (Agr. Census SNL 1971-72) showed the following fertilizer and pesticide usage among farmers (Table 8).

TABLE 8

Percent of Holdings Using Fertilizers and Pesticides

Region	Fertilizers	Pesticides
Highveld	63.7	53.3
Middleveld	34.6	25.8
Lowveld	4.4	4.9
Lubombo	15.6	17.9
Swaziland	34.0	27.4

These data suggest that Swazi small farmers on SNL have begun to utilize intensive inputs, and by now, 1980, costs and prices permitting, usage may have increased. Use of fertilizers appears to be highest on maize, tobacco and cotton as shown in Table 9.

TABLE 9

Quantity of Total Fertilizers Per Hectare of Total Planted by Crop and Region (Packets/ha)

Crop	Swaziland	Highveld	Middleveld	Lowveld	Lubombo
Maize	1.3	3.6	1.1	0.3	0.6
Cotton	0.8	n/a	4.3	0.3	
Beans	0.9	0.1	1.7		
Groundnut	0.2	0.2	0.3		0.1
Tobacco	2.3		3.6		
All Crops	1.2	3.5	1.1	0.2	0.5

C. Agricultural Research in Swaziland

The present Research Division was initiated by the Ministry of Agriculture (MOA) by the establishment of the research sites at Malkerns and Big Ben and four district plots at Nhlango, Luve, Vuvulane, Mangcongco. A fifth plot was added at Hebron in 1969, and the Vuvulane plot was repossessed by the Swaziland irrigation schemes at the end of the 1974-75 season.[1] The extensive coverage is necessitated by the widely divergent topographic, agro-climatic and soils regions of the country. In 1971 the Research Division was transferred to the University of Botswana, Lesotho and Swaziland (UBS) to strengthen the University's presence in the country and to formalize ties between the faculty and research. This association continued until 1978 when the GOS returned the Research Division to

[1] Annual Report of the Agricultural Research Division 1976-77 University of Botswana and Swaziland. Sept. 30, 1977. p. 2-3.

the MOA (actually April 1, 1978). In this transfer many research positions at the Malkerns Station remain unfilled as of this date (February 1980), jeopardizing continuity of the excellent research that has been done by both the MOA and UBS. As part of the general research scheme there are units for which government, the University and industry are jointly responsible. Cotton breeding and entomology continue to operate. Citrus entomology ceased operation in 1975 but the Citrus Research Committee remained operational as a forum for discussion of all matters related to the citrus industry. The forestry research unit and pineapple research continues, wholly supported by these industries; the Malkerns Station providing office accomodations only.

The overall aims of the research division are to find new methods of improving crop and pasture yields, to reduce production costs, and to reduce damage and losses from pests and disease. Research programs, defined in consultation with government and the farming community, are designed primarily to address the more immediate agricultural problems. Results emanating from past research have been largely responsible for improved productivity in Swazi agriculture.

There has been almost no research on cropping systems or farming systems in Swaziland, except for work very recently begun by the MOA at the Malkerns Research Station and by Dr. Sam Aggrey in cooperation with SNL farmers. However, research on cropping systems in the tropics and sub-tropics has been reported by Hildebrand, and by Fumigalli and Waugh from Guatemala, Gull et al. from El Salvador, and from a number of investigators in IRRI in the Phillipines, the International Institute of Tropical Agriculture in Nigeria, Harwood in Asia, etc.; and this information, combined with the excellent research on sole cropping in Swaziland by the

MOA and UBS, could be readily utilized in formulating additional systems of cropping for experiment station and extensive farm testing. The better adapted varieties and hybrids, proper planting dates, pest and weed control, etc., for sole cropping are pretty well identified in the MOA-UBS research reports and advisory bulletins, but further research as indicated will be required to determine the best crop combinations, proportion and systems for maximizing results most useful to the SNL farmer.

Agricultural research capabilities can be maintained and improved by filling the vacancies in the MOA Research Division with well-trained professional personnel, preferably with field experience and some with cropping systems experience either as consultants, two-year appointees or as permanent staff, supplying them with the equipment, facilities and technician assistance to conduct on-station studies to develop the better systems for the four agro-climatic regions of the country, and to test them under SNL farmer conditions by extensive farm tests using the methodology developed by the groups mentioned above who have been involved in cropping systems research in the tropics and sub-tropics in Africa, and South and Central America, and Asia. The experimental designs developed by Fisher, extended by Yates and modified by Hopp for intensive farm tests would be most useful in conducting such research and farm testing, followed by economic analyses as employed by Hildebrand and others alluded to above (see list of references at the end of this section). Numbers of scientists and specific equipment is covered in the report of the General Agronomist.

D. Present Technology Packages and Research Needs to Improve Them

The various Advisory Bulletins issued by the MOA as listed by the General Agronomist and at the end of this section should be adequate for

sole and most mixed or cropping systems, but research with the svstems may well uncover unanticipated problems not encountered in sole cropping which will necessitate some modifications of the sole cropping information now available as determined by field research.

The Extension Education Specialist and agree with the General Agronomist that the technology packages alluded to above will suffice for present pre-service and in-service training of extension agents, but they will no doubt have to be augmented by new information developed in the course of cropping systems research.

E. Recommendations on Cropping Systems Research to Increase Small Farmer Productivity

AID should assist GOS in carrying out the cropping systems research outlined below over a period of five to six years to assist small SNL farmers to increase their agricultural productivity.

The General Agronomist's report lists the personnel requirements for the proposed research as well as supplementary equipment and facilities. It might be well to utilize one or more of the experienced experts in cropping systems research alluded to previously in this report, either on a contract hire or consulting basis to assist in designing, planning, executing and analyzing the results of research projects on cropping systems.

Systems can be studied and developed at the established experiment stations and in on-farm tests simultaneously or in phases or steps as suggested by Fumagalli and Waugh. A large number of factors can be accommodated in the station systems development research while one or two different treatments of a set of many treatment pairs may be tested in the field on a large number of SNL farms. By conducting field tests in this

way a broad basis for inference is provided, the more important components of the systems can be identified, their consistency in performance evaluated and interdependency estimated. Moreover, in the simpler designs, estimates of the percentages of farmers in a given area who may expect to benefit from the new systems can be obtained and information on acceptance measured.

It takes good farming to impress a farmer. If not enough is known about farming practices, which is frequently the case in new areas, incorporate the farmer into the technological system and learn from him. Once confidence in the technology has been established, further tests are indicated as a means of getting the technology into the hands of the farmer without exposing him to too much risk, since the technology has been validated in the farmer's area (Fumagalli and Waugh).

a. Factors to be included: Varieties, lime, fertilizers (NPK, Zn, Mo, Mn) placement, timing, crop combinations and rations, time of planting, multiple cropping, rotations, weed control . . . all at two or more levels in as many factorial combinations as appear necessary and ca be managed.

b. Methodology: Complete or fractional replicate factorial experiments following the allocation and analytical procedures as outlined and specified by Henry Hopp, R.A. Fisher, Francis Yates, and others, utilizing extension officers and other MOA and experiment station or other qualified personnel to determine levels and methods of applying the experimental variables, randomizing the treatments among farms and regions, to supervise and

assist farmers in installing the experiments, caring for crops, collecting the data and indicating particular constraints encountered in the course of the experiments, and social-economic facts which may be used in modifying the experiments or treatments to be more generally useful to the farmer-user. Not more than two to four treatments per homestead will be needed or can be accommodated on the small area available.

The analytical process should include in order:

a. Factorial Analysis of Variance with coefficients of multiple determination to learn which factors are related to major deviations from the norm, and which are interdependent (interactive). This also will be used to test the consistency of mean differences among levels where this is appropriate. Differences within and among regions may be estimated and related to environmental and other conditions. Partitioning of variations into variance components will further aid in the analysis and interpretation.

b. Multiple regression AOV (stepwise and full) to learn coefficients and standard errors of coefficients, comparison of beta weights, formulation of estimating equations and using deviations to estimate applicability under various constraints, to estimate optimum rates of inputs under varying cost/price conditions and in cost/benefit analysis.

c. Integration of the conclusion from above into improved cropping systems and testing these by further field tests, linear programming and cost-benefit analyses, again considering the socio-economic constraints, modifying (or circumventing them where feasible) as required to make the system acceptable and workable.

The suggestions for systems listed below are felt to be amenable to the present farming or cropping systems carried on by SNL farmers. They may provide improved physical returns per unit of land thus benefiting family welfare and nutrition, and where acceptable some of them may provide cash crops above family needs or indeed be grown primarily for the market economy.

a. Beans intercropped with maize. Maize may be either local or hybrid, or preferably both for comparative purposes, with pole kidney beans compared to pole lima beans relay seeded after the maize has reached a height of 60 cm or so. Unlike the dwarf or bush beans, the pole varieties will not suffer from shading by the maize to the extent that photosynthesis is measurably reduced, and the pole types will produce pods over a long period of time for family use and sale. Pods are borne high off the ground avoiding pod rots and yields normally exceed those from bush beans. Lima beans once established are more heat and drought tolerant than kidney beans, and

may be more favorably adapted to the middle and lowvelds than the kidney beans, but possibly less well-received in the highveld. Pumpkins may be planted at the edges of the maize-bean fields, again among the maize hills. The beans should be planted in the maize rows or beside them as has been done since time immemorial by the American Indians and later by early white settlers in the Western Hemisphere. Beans remaining on the vines when the corn nears maturity may be used as green pods, green shelled or allowed to mature for dry beans.

b. Early transplanted cabbage may be followed after harvest by plantings of swiss chard or other hot weather greens, both crops maturing in the time required to mature maize from seed sown at the beginning of the rainy season. The maize is to be planted in strips and the cabbage and greens in separate, contiguous strips on the north and east side of the maize to reduce shading of the cabbage and greens to a minimum.

c. Cowpeas planted in separate strips alongside maize rows may provide some nitrogen for the rotation sorghum or maize crop following the next season. Both crops planted at the beginning of the rainy season will mature in time for regular harvest, the unwanted green peas being allowed to mature on the vines and harvested for dry

peas. Bush kidney beans for green pods and/or dry beans may be substituted for the cowpeas but kidney beans do not nodulate as well as cowpeas and fix considerably less nitrogen ordinarily.

d. In the Middle and Lowvelds tepary beans (Phaeolus acutifolius), because of their superior heat and drought tolerance, ought to be tested as a crop alongside maize strips. Teparies are short-season crops once their day length requirements (short) have been met, and thus might follow a quick growing vegetable tolerant of lower temperatures and moderate to high rainfall during the fore part of the rainy season. Teparies should be planted midway thru the rainy season to mature in the beginning of the dry season. Teparies produce an excellent forage of hay with fine stems, equivalent to alfalfa in feeding value, and could supplement pastures for dairy stock during the dry season provided the beans are established when the dry season begins.

e. For cash crops strawberries and asparagus may be good test crops probably in the Highveld, as normally strawberries follow asparagus in order of maturity and harvest season, providing there is a domestic or export market for asparagus. Labor

requirments and costs of production could be greatly reduced by not bedding up the asparagus for blanched shoot production and cutting shoots below ground as is traditional in Europe, but leaving the land flat and hand snapping green spears as is done for the American market. Green spears are made less fibrous, higher in pro-vitamin A, and snapping injures none of the other crown buds as does cutting. Soybeans are intercropped between asparagus rows in Japan and some other countries by seeding near the end of the asparagus harvest season.

f. Other export crop possibilities with least problems in preparation for shipping, and least likely to degrade intolerably in transit and marketing abroad, include potatoes, tomatoes, sweet potatoes, carrots, dry beans, cowpeas, groundnuts, cabbage, selected herbs, green and red peppers (including dried spice peppers), onions (both green and dry bulbs), cucumbers, summer squash, pumpkins and winter squashes (acorn, turban, field, butternut, hubbards).

g. AID scientists, in cooperation with GOS-MOA scientists, ought to test the adaptability of: a) some grain legumes other than those mentioned above, in connection with multiple cropping schemes. These might include: broad bean

(Vicia fava), hyacinth bean (Dolichos lablab), mung bean (Phaselous aureus), chick peas (Cicer arietinum), pigeon peas (Cajanus indicus), English peas (Pisum sativum), runner bean (Phaselous coccineus), etc.; b) root crops such as cassava (Manihot utlissima), taro or dasheen (Colocasia esculenta), jicama, parsnips, radishes, etc.; c) vine crops such as chayote (Secchium edule), netted and honeydew melons, etc.; d) greens such as amaranthus, Chinese cabbage, kale, collards, jute mallow (Corchorus olitorius), Malabar spinach (Basella alba), New Zealand spinach (Tetragonia expansa), etc.; e) other allium species such as shallots, chives, leeks; f) oil seeds such as sesame, soybean, sunflower and safflower which may be used directly as food seeds, in other foods, sources of cooking oil, or in feeds; g) maize/cassava intercropping forms the basis of many food crop production systems in humid and subhumid regions of Africa (1978 Report, International Institute of Tropical Agriculture, Ibadan, Nigeria, p. 69). This combination is highly productive and exhibits better land utilization efficiency than sole crop production of either crop. This system is well adapted to small, nonmechanized farms.

PART 2: PLANT INTRODUCTION AND PRELIMINARY EVALUATION FOR ADAPTABILTY AND USE IN CROPPING SYSTEMS.

In addition to determining the optimum (maximum net economic returns) from intensive inputs such as lime, fertilizers and hybrid seed, various crop combinations and labor, a program, perhaps on a limited scale, should be initiated to introduce crops that have been successfully produced elsewhere in the tropics and subtropics, but have not been tested in cropping systems in South Africa, selecting particularly those that have extra nutritional value such as legumes or which fit in well in mixed cropping systems. For example, lima beans (*Phaseolus lunatus*) are more tolerant of heavy rainfall, are more drought resistant (being deeper rooted), heat tolerant, and much less daylength sensitive than kidney beans (*Phaseolus vulgaris*). Some of them are also less attractive to weevils and other pests of dry beans. Tepary beans (*P. acutifolius*) have been grown along with indigenous lima beans by the natives of the Sonoran Desert regions of Mexico and the USA for millenia as staple food crops. Teparies are very tolerant of drought, mature a heavy seed crop in a very short time, are resistant to many insects and diseases, both in the field and as dry beans, are highly nutritious (25-30% protein) and very palatable. There are white and colored cultivars. The runner beans (*P. coccineum*) is another native of the Western Hemisphere which has been utilized by native Americans for centuries as a supplementary food crop. It is one of the few cross-pollinated beans, is perennial under subtropical and tropical conditions and produces a large starchy root that is edible and high in protein, as well as an annual seed crop. It is also a very attractive ornamental and temporary shade when trellised.

There are also in the US maize hybrids for specific growing areas and seasons. Some of them are short-season varieties adapted to mountainous regions, and some of these might be useful in the Swaziland Highveld. Others are mid-season and other long-season hybrids. Argentina also grows some of the large kernel varieties which are preferred by Swazis as mealies. Some of this germ plasm might be useful.

A national plant introduction and trial station, if affordable, would be a valuable adjunct to agricultural research. Hopefully some breeding work aimed at improving crops for the country's use, rather than for compiling pheotypic information, could be a planned part of the activities of the plant introduction station.

PART 3: JOB DESCRIPTIONS FOR RESEARCH SCIENTIST POSITIONS TO CONDUCT CROPPING SYSTEMS RESEARCH AT THE MALKERNS RESEARCH STATION AND ON SNL SMALL FARMS.

A. Chief of Party

An agronomist with preferably some background in agricultural economics and experience in supervising several people including clerical staff and subordinate technicians, and an ability to work well with his staff and provide effective liaison between his group, the MOA, UBS, RDA heads, etc.

B. Cropping Systems Technical Team

One broadly trained field crop agronomist with experience in experiment station and off-station field trail research in cooperation with farmers (extensive farm tests and demonstration trials).

One broadly based horticulturist with considerable experience in vegetable production involving a broad range of cool-season and warm-season crops, including grain legumes, root crops, maize and vine crops.

One agriculturist with a farm background and experience in production economics, crop budgeting and statistical methodology relative to economic analysis (chi square, multiple regression, linear programming, margin analysis).

One applied biometrician with practice and experience in analysis of variance of extensive farm test designs, (fractional replicate factorial, partially conformed) interpretations of results in physical as well as mathematical terms, regression analysis and covariance.

C. Summary of What the Mission Should Expect to Accomplish in Five Years

a. Develop and test several applicable and economically feasible cropping systems amenable to the SNL farmers' constraints.

b. These cropping schemes should improve the self-sufficiency of the SNL farmer over most of the country and provide some surpluses for cash income from sales.

c. The agronomic feasibility and economic evaluation of various cropping systems should be published along with base data collected for use by other students in training and researchers in other parts of the world who are working on cropping systems and other phases of agricultural development in developing countries.

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iii.

ICULTURAL EDUCATION AND EXTENSION

AGRICULTURAL EDUCATION AND EXTENSION TRAINING SPECIALIST'S REPORT

Preface

At the request of USAID/Swaziland, I have, in a two-week time period, made a partial analysis of the Swaziland Agriculture Extension Section of the Ministry of Agriculture. In general, I found a strong desire on the part of the officials of the government of Swaziland to have a vigorous, effective agriculture extension organization. This is a commendable situation and should lead to achievement of their goal. Efforts to more effectively translate research findings to farm family educational level, increasing the practicality, quality and quantity of extension field officer training and increasing the availability of teaching resources for field officer use are all very commendable.

By definition, extension is an educational function concerned with changing human behavior in terms of knowledge, attitudes and skills. A viable agricultural extension service must be able to respond to client needs with learning experiences for the clients that enable them to make informed decisions and thereby more successfully cope with life's challenges and problems.

The following items identify essential elements of an effective agricultural extension service.

a. The staff is competent in technical subject matter.

b. The staff is competent in skills to identify and involve local leaders in the program development processes.

c. A close linkage exists between agricultural research personnel and programs and extension personnel and programs.

d. A competent staff of subject matter specialists link research results with field extension programs.

e. The administrative and supervisory staff are competent.

f. A clear line of authority from field officers up to the top administrative officer exists and is understood by all staff.

g. The roles and relationships of all organizational positions are clearly stated and effectively communicated throughout the entire organization.

h. Organizational objectives are clearly stated so that employees and clients know and understand them and can relate to them.

i. Adequate financial resources for salaries, operating supplies, transportation, etc., are available to support staff and programs.

j. A system for evaluating staff performance and program effectiveness exists and functions. Staff sense rewards for excellence in job performance.

k. Effective reporting of program performance to supporting officials and clients occurs sufficiently frequent to retain their interest and support.

have had the above items in mind during my assessment of the Swaziland Agricultural Extension Service, along with its preservice and inservice training programs and back-up research and information resources. While some of the elements of the Swaziland Agricultural Extension Service are weak and others perhaps are entirely lacking, I am optimistic for its future. The leadership of the Ministry of Agriculture, USAID, UNDP, other donors and the faculty and students now in training for extension field officer work are desirous of making the system function effectively. That desire, coupled with patience and persistant hard work, can make the Swaziland Agricultural Extension Service evolve into an effective educational force that is capable of supporting local citizens in their quest for development and satisfying rural life.

PART 1: STUDY AND ANALYZE THE PRESENT CERTIFICATE TRAINING COURSE IN AGRICULTURE WITH RESPECT TO COURSE CONTENT, AGRICULTURAL EDUCATION, ADMINISTRATION, PHYSICAL FACILITIES, TEACHING STAFF, TEACHING AIDS AND EQUIPMENT NEEDS INCLUDING LINKAGE TO RESEARCH AND FEEDBACK FROM EXTENSION AGENTS.

A. Introduction

Agricultural education and extension operations are not new activities for Swaziland. Agricultural crop extension has been in operation in some form since 1939 while livestock extension has functioned since 1914. However, agricultural extension today in Swaziland is viewed by some "as one of the weakest elements in the Rural Development Area Program and unless vigorous measures are adopted to realize drastic improvement in this area, the Swaziland government's objectives of improving productivity and incomes in the SNL cannot be realized." (Glenn T. Magagula, PhD Thesis, University of Maryland, 1978, p2, Thesis Abstract).

The role of agricultural extension in Swaziland is education. Specifically, the purpose is to improve the level of living of rural families through educational procedures. (Victor Pungwayo Interview, February 1980).

B. Organizational Structure

The organizational structure of agricultural extension in Swaziland is fragmented. Extension is dispersed among several units of the Ministry of Agriculture without formal linkage to either the College of Agriculture (where extension administrators and supervisors are being trained) or the research functions of the Ministry of Agriculture (see Figure 1, page 67 of this report). Agriculture Extension activities and programs occur under the direction of Rural Development Area Project Managers. In non-RDA project areas, extension activities are under the direction of District Agriculture Officers. Extension field officers are generally supervised by staff who completed the University Diploma program and may not have had extension field officer experience. Neither have they had very much special training in supervision, or extension methodology for program planning, execution, evaluation and reporting.

There are at present about 106 extension field officers employed by the Ministry of Agriculture to conduct crop extension programs. There are also 55 assistant extension officers and 8 senior extension officers. This constitutes a total of 178 extension staff in the Ministry of Agriculture. A noticeable absence from the organizational structure is a position for staff training and development.

A major expansion effort is in progress to extend the RDA program to cover more of the SNL. Ministry of Agriculture officials have a goal of

doubling the present number of extension field officers so that the ratio of field officers to SNL homesteads approaches 1:200.

There are in Swaziland about 42,000 homesteads (USAID Country Development Strategy Paper, January 1980, p. 6). Assuming the Ministry's goal of 1 extension field officer for every 200 homesteads, 210 extension field officers are needed, about double the present number.

At present, the extension field officer training program, known as the Certificate Training program, is under the direction of the Ministry of Agriculture. The Ministry rents the training facilities from the College of Agriculture, University of Botswana and Swaziland and employs the teaching staff. A careful selection process screens the numerous candidates. About 1800 candidates have applied for the training program each of the past 2 years. By using written examinations and aptitude tests, about 120 candidates were selected for interviews and training. Following the interviews, the top 40 students were selected each year. Table 10 is presented to show the time needed to have enough trained field officers to provide a ratio of 1 extension field officer for each 200 homesteads.

TABLE 10

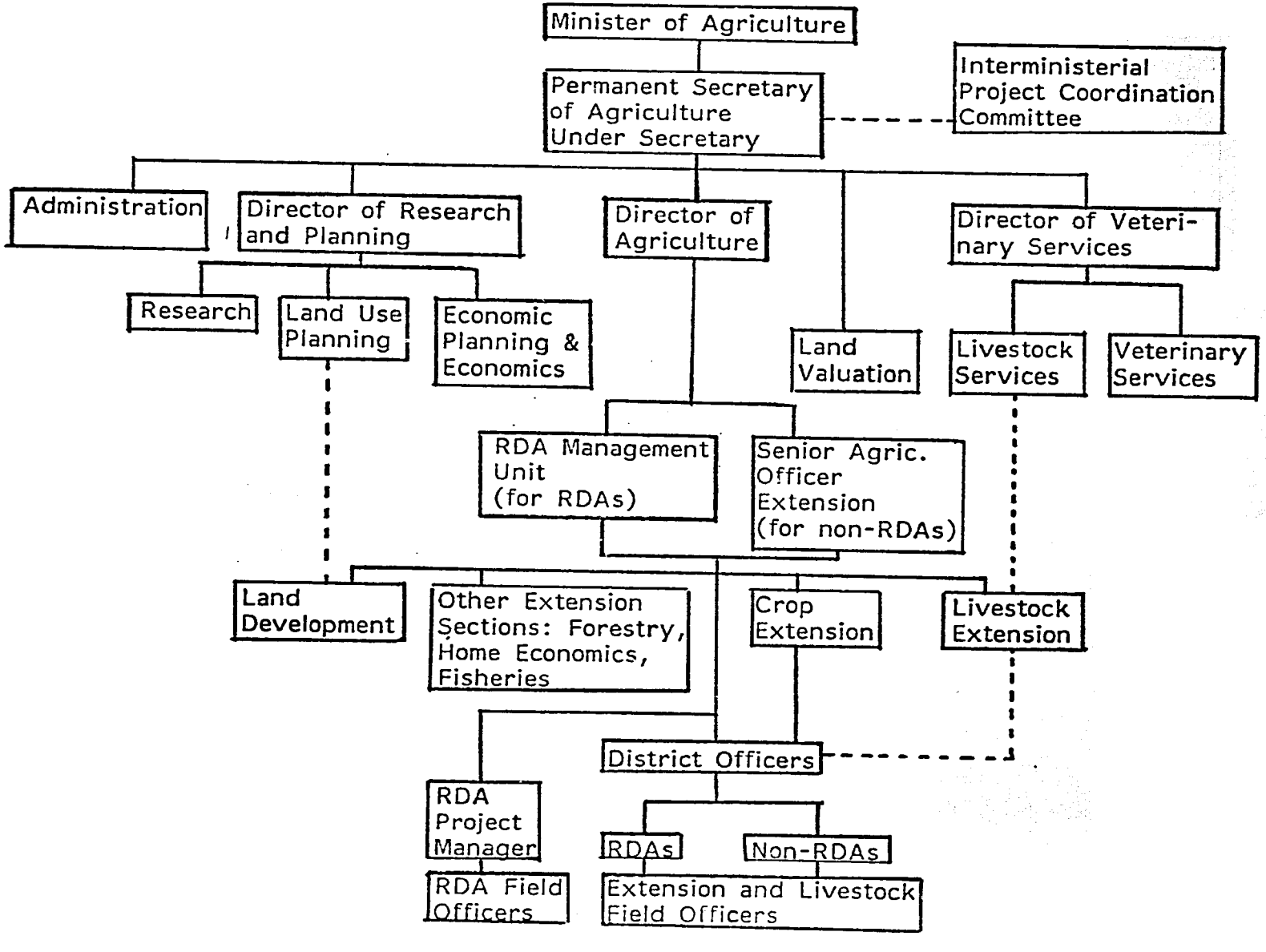
Training Projections

Year	No. Field Officers of Given Year Jan. 1	Less 10% Attrition Per Year	Total	Plus 40 New Certificate Graduates Per Year	Total Field Officers as of May 31 of each Year (Projection)
198[illegible]	106	11	95	40	135
198[illegible]	135	14	121	40	161
198[illegible]	161	16	145	40	185
198[illegible]	185	19	166	40	206
198[illegible]	206	21	185	40	225

FIGURE 1

Ministry of Agriculture

Organization Chart
August 1978



The 10% annual attrition rate is an estimate based on opinions within the Ministry of Agriculture. A study should be made to establish the exact attrition rate. Some respondents felt the rate may be as high as 15%. If that is the case, additional time would be needed to reach the goal of 210 extension field officers.

Based on some reports, the agricultural extension organizational structure in Swaziland causes some problems. Field specialists and extension field officers sometimes compete with each other rather than support each other in farm visits and in program planning, execution, evaluation and reporting. Staff competancy is weak because there is no clear, strong linkage for program support from research staff. Teaching resources available to extension field officers are lacking.

There seems to be a lack of subject matter specialists supporting the field officers in the program development processes (planning, delivery, evaluation, etc.). Supervision of field officers seems to need strengthening. A system of evaluating staff performance is lacking as is also a reward system for meritorious job performance.

However, in spite of these and other constraints, agricultural extension in Swaziland is alive and moving forward. My purpose is to assess the present Certificate Training Course and to recommend what might be done to strengthen the program.

C. Assessment, Ministry of Agriculture Certificate Training Program for Extension Field Officers.

The position of Extension Field Officer is the entry level for those of the Agriculture Extension Service who work directly with rural farm families who are involved in crop production.

The extension field officer needs competency in two basic skill groups -- production and utilization of agricultural products and extension

program development processes. His contacts with farmers will include the production and utilization of both crops and livestock. Program development skills include identifying and involving local farm and community leaders in program planning, execution, evaluation and reporting.

The Certificate Training Program consists of five terms extending through 44 weeks of instruction. As University "breaks" and holidays are observed by Certificate Training participants, a full year is involved. Classes generally go from May 1 of each year to the end of April in the following year. This training course was re-introduced in 1977 for the specific purpose of providing trained manpower to support the expanding rural development program.

The course caters to men and women over the age of 18 who have a minimum qualification of Junior Certificate (Form III). Selection of candidates results from the following process:

a. All candidates are given a written examination and an aptitude test (the latter for those not having had one earlier in school).

b. High-scoring candidates are interviewed by a committee comprised of representatives of the Ministry of Agriculture and the University (College of Agriculture) of Swaziland. Those who complete the certificate course become Field Officers for the Ministry of Agriculture Extension Service. The course, if followed as planned, is 60% practical training and 40% theory. A summary of courses taught and time allocation by department is presented in Tables 11 and 12.

TABLE 11

Courses Taught in the Certificate Training Program

Term	Duration In Weeks	Department	Course	Lecture Periods (Each of 40 Min.) Per Week	Practical Periods (Each of 40 Min.) Per Week
1	12	Crops	Princ. of Crop Prod.	2	-
			Vegetable Prod.	-	3
		Animals	Princ. of Animal Production	1	-
			Animal Practice	-	6
		Land Use & Mech.	Tractor Driving	-	3
			Carpentry	-	3
			Building	-	3
		Econom. & Exten.	Ag. of Swaziland	1	-
		Basic courses	Communications (English)	5	-
			Biological Sc.	3	3
			Ag. Math.	3	3
2	8	Crops	Veg. Production	2	3
			Crop Production	-	3
		Animals	Animal Breeding	2	-
			Dairy Practical	-	3
			Fish Production	1	-
		Land Use & Mech.	Surveying	3	3
			Mechanization	1	-
			Tractor Maint.	-	3
		Economics & Exten.	Conservation Economics	- 1	3 -
			Extension	2	-
		Basic Courses	Communications	2	-
			Biological Sc.	3	3
			Ag. Math	3	3

Term	Duration In Weeks	Department	Course	Lecture Periods (Each of 40 Min.) Per Week	Practical Periods (Each of 40 Min.) Per Week
3	8	Crops	Crop Production	2	3
			Fruit Production	1	3
			Crop Protection	1	-
			Grain Storage	1	-
		Animals	Animal Feeding	3	-
			Beef Production	2	-
			Animal Practical	-	9
		Land Use & Mech.	Surveying	1	3
			Mechanization	3	3
		Econ. & Extension	Economics	2	-
			Extension	2	-
		Basic Courses	Communications	2	-
		Crops	Crop Production	1	6
			Crop Protection	1	-
			Soil Science	1	3
			Forestry	1	-
		Animals	Dairy Production	2	-
			Disease Control	2	-
			Poultry Practical	-	6
			Pig Production	1	-
		Land Use & Mech.	Mechanization	3	6
			Metalwork	-	3
		Econ. & Extension	Economics	2	-
			Extension	1	6
			Visits	-	6
		Basic Courses	Communications	2	

Term	Duration In Weeks	Department	Course	Lecture Periods (Each of 40 Min.) Per Week	Practical Periods (Each of 40 Min.) Per Week
5	8	Crops Animals	Crop Production	3	3
			Poultry	2	-
			Sheep, Goats & other animals	2	-
			Veld & Pastures: Practical	-	6
		Land Use & Mech.	Mechanization	3	3
			Irrigation	-	3
			Land Use Planning	1	-
		Econ. & Extension	Economics	2	-
			Extension	1	6
			Visits	-	6
		Basic Courses	Communication	2	-
			Human Nutrition	2	-

TABLE 12

Time Allocation by Department in the Certificate Training Program

BC = Basic courses

C = Crops courses

A = Animal courses

LUM = Land Use and Mechanization courses.

EE = Economics and Extension courses

	Number of 40 Minute Periods					Total/ Term
	BC	C	A	LUM	EE	
TERM 1 (12 weeks)						
Theory	132	24	12	-	12	180
Practical	72	36	72	108	-	288
TERM 2 (8 weeks)						
Theory	64	16	24	32	24	160
Practical	48	48	24	72	-	192
TERM 3 (8 weeks)						
Theory	16	40	40	32	32	160
Practical	-	48	72	48		168
TERM 4 (8 weeks)						
Theory	16	32	40	24	24	136
Practical	-	72	48	72	96	288
TERM 5 (8 weeks)						
Theory	32	24	32	32	24	144
Practical	-	24	48	48	96	216
TOTAL THEORY	260	136	148	120	116	780
TOTAL PRACTICAL	120	228	264	348	192	1152
GRAND TOTAL	380	364	412	468	308	1932

Considering the amount of time available, this Certificate course provides an introduction to agricultural and program development. There is not sufficient time for in-depth study of either theory or its practical application by the students. However, if competent supervisory staff were available to give close guidance and help to the new field officers for their first two or three years of work, I believe the program would be more successful. The major weakness in the training program results from only 8% of the total time being given to extension methods (program development processes and teaching methodology). Program development processes with client groups is the heart and soul of successful extension education. This weakness could be overcome without changing the course content if supervisors of field officers were skilled in the program development processes and in supervising and coaching the field officers under their direction.

Another apparent weakness in the Certificate Training Program is failure to acquaint the trainees with the concepts and procedures of cropping systems research and how they might meaningfully be part of the program at the field level. Field officers should learn about cropping systems research work if they are to help find cooperators, help establish the test plots, invite neighboring farmers to observe the test plots during the growing season, serve as on-site representatives of the researcher(s), assist with harvesting, share research results with local producers by getting them to field day activities, and place printed results into their hands. These experiences would help prepare the field officers to set out demonstrations in subsequent years that would teach the things learned from the research activities. Therefore, this added training is crucial for field officers when cropping systems research occurs in their area.

Considering the educational level of people interested in becoming extension field officers and of client groups, I do not see other changes needing immediate attention in the Certificate Training Program. However, I do feel it is highly desirable for the field officers to return to school after two to three years' experience to obtain additional training in crop and livestock production and program development processes. This could be a modified Diploma Course, to give emphasis to those things the students recognize as weaknesses in their work performance. I recommend considerable feedback be obtained from field officers and their supervisors before firming up the modified Diploma Course curriculum.

D. Assessment of Training Facilities, Teaching Aids and Equipment

1. Training Facilities

The training facilities and resources were reviewed with some of the training staff at the training center. Housing and dining facilities for the 40 students seem to be adequate. I visited informally with several of the students. Their morale was high, enthusiasm for the training experience was exciting and they expressed a great desire to successfully complete their training and to start working with rural people. One student expressed himself thusly: "My calling is to teach rural families how to increase their farm production and to improve their standard of living." There seemed to be no shortage of hand tools or other similar equipment for student field use.

2. Teaching Staff

The teaching staff appears to be dedicated and able to do the kind of instructing desired. Four people constitute the core staff, but an additional 17-20 people come to teach specific subjects during the year. These

people come from the Ministry of Agriculture, University faculty, private industry, etc. I have not observed any of the staff in actual teaching conditions, so I do not make any assessment of their capabilities or effectiveness.

Mr. Enoch Chiya (Ministry of Agriculture) is director of the program. He has about 20 years of practical extension work, much of it in the field. He completed his Diploma level training in Agriculture at Fort Cox, South Africa. Two of his Swazi assistants hold Agriculture Diplomas from the University of Botswana and Swaziland and a third assistant, Mr. George Cummins, is an experienced vocational agricultural science teacher who earned an MS degree in Vocational Education from Iowa State University, USA. Considering the time allowed and depth and breadth of training to be given, I feel good about the core faculty. They appear to be conscientious in making concepts and skills practical to the needs of the students.

3. Teaching Aids and Equipment

The most useful and readily available reference manual for extension field officers is "Advisory Bulletin Number 1," published by the University College of Swaziland, Agricultural Research Division, in March, 1977 (3rd Edition). Class instruction relates closely to this manual so that students have skills to use it when on the job. However, some feedback indicates the Bulletin is too advanced for some extension field officers and most farmers. Having reviewed the Bulletin, I perceive a need to provide a new Bulletin or several fact sheets with contents aimed at the farmer's level. Also, more in-service training for extension field officers should be conducted so that they can make the necessary adaptations for applying the information to the farm operator level.

There is a noticeable lack of teaching aids in the possession of extension field officers. The Certificate Training Faculty access some of the University resources and create some teaching aids for their own use. However, there is almost a complete absence of audio-visual teaching resources for the Certificate Course Training Program. The University 16 mm movie projector is used occasionally, but there are few films available for use. There are no overhead, film strip or slide projectors, screen or tape player. There is no equipment for video-tape use. The classroom has windows on both sides but no curtains, blinds or shades for darkening the room.

The Ministry of Agriculture is not producing any fact sheets or leaflets that could be used in the teaching classroom. There is an adequate supply of hand tools and ox-drawn farm equipment for student use in the practical training. However, I did not see any soil augers that are so essential in teaching students to determine soil moisture content.

There does not appear to be any flip chart teaching resources, either for the faculty or for the field officers on the job. This situation ought to be changed whether the number of students is 40 or 80.

PART 2: DETERMINE AND RECOMMEND WHAT IS NEEDED TO IMPROVE EXISTING CURRICULUM, EXPAND PLANT FACILITIES, TEACHING STAFF AND TRAINING EQUIPMENT TO DOUBLE OUTPUT FROM PRESENT LEVEL OF 40 STUDENTS PER YEAR BY AN ACCEPTABLE DATE.

A. Physical Facilities

If the number of students in the program were doubled from 40 to 80 per year, many additional items would be needed, such as:

a. Five new offices with furnishings.

b. Another large classroom capable of handling 40 students (about 30 feet by 60 feet). This item may not be essential as the existing room is not used all of the time every day. One section could use it while the other is on field work, etc. However, afternoon indoor instruction in hot weather is difficult.

c. Dormitory facilities for 40 students (recommend 4 students per room in rooms about 15 feet by 18 feet as now used at the university) plus bathroom and shower facilities.

d. About 10-15 hectares of land for additional student project work is needed. Present land quantities for student project work is inadequate.

e. More hand tools (double the amount now available) such as hoes, rakes, spades, sickles and oxen-drawn equipment for plowing and planting will be needed.

f. Another bus to transport students on field trips (to handle 40 students at one time) will be needed.

g. A shop to perform carpentry and metal work, maintenance activities, and to store farm produce, seeds, fertilizers, tools, etc. will be needed.

B. Teaching Staff

If the number of students were increased from 40 to 80 at the Certificate Training Center, the present director feels the following additional staff would be needed:

a. Teaching Staff	-	A crop agronomist lecturer
	-	An animal production lecturer
b. Technical Staff	-	A crop production technician
	-	An animal production technician
	-	A mechanization technician
	-	A technician to help with farm budgets, farm records, bookkeeping and cost estimating, etc.
c. A Typist	-	A typist for office work plus typewriter, desk, etc.

These technicians would only double the number now at work with the program. The existing staff is now fully occupied. Considering the time schedule for reaching 210 extension field officers as shown in Table 10, and the time required to develop the USAID project for implementation and added construction time, the needed number (210) will be nearly satisfied before the construction and new facilities could be ready for use. I therefore do not feel a need to double the number of Certificate Course students in a given year unless the conditions and goals already described are changed. I feel there is a greater need to strengthen the quality of existing extension field officers by increasing the quality and quantity of supervision and the quantity and quality of the teaching resources available for field officers to use.

PART 3: MAKE RECOMMENDATIONS ON HOW USAID COULD ASSIST IN EXPANDING AND IMPROVING THE QUALITY OF SWAZILAND'S IN-SERVICE AND CERTIFICATE LEVEL AGRICULTURAL EXTENSION TRAINING PROGRAM.

A. In-Service Training

As most Swazi extension field officers have received a minimum amount of subject matter and skill training through the Certificate Course Program and/or the Diploma Program; on-going, coordinated, well-planned and frequently executed in-service training is very important. In-service training, to be of most value, should relate to the needs of those to be trained. It should be timely, practical and sufficiently frequent to enable field officers to perform their extension roles in a professional manner. The following recommendations are therefore given:

a. Create a new staff position within the Ministry of Agriculture to be entitled, "Staff Training and Development Officer." This person should work under the direction of and be responsible to the Director of Agriculture (the position currently occupied by Mr. Victor Pungwayo). This is a staff position without line responsibility or authority except as he directs the staff of the Information Section.

   This position initially should be filled by an expatriate who is skilled in the extension program development processes, supervision and administration. Two or more Swazi extension employees eligible for graduate level study in the UK or in the USA should be sent for MS degree training in

adult education, extension management and supervision. On their return, one of them would replace the expatriate Staff Training and Development Officer and the other would join the University College of Agriculture faculty to teach extension principles, practices and methods to Diploma and Certificate trainees. They should collaborate with and support each other in their respective assignments. The expatriate ought to remain in Swaziland at least a year after these two Swazi nationals return in order to help them get hold of their work assignments. He should provide "shadow leadership" to the Swazis, advising and consulting, but not making decisions for them during their first year back on the job.

b. A committee of six people should be organized to work under the chairmanship of the Staff Training and Development Officer. The committee could be composed of:

1. Two extension field officers, one working within the RDA system and the other from outside of the RDA system.
2. Two extension specialist field officers or assistant extension officers, one who is working within the RDA system and the other who is working outside of the system.

3. Two senior extension officers, one from within the RDA system and the other from outside of the RDA system.

In selecting these six committee members, I recommend two or three of them be women. The committee would be called the "Extension Staff Training and Development Committee" or the ESTD Committee. This committee would receive all requests for in-service training from extension employees and all proposals to offer in-service training. The committee's role is one of coordinating and scheduling the training events, not necessarily conducting the training. The committee should be responsible to see that training policies are complied with, that training is timely and that staff-expressed training needs get prompt attention. The committee would be responsible to see that an annual in-service training calendar is developed and distributed to all extension staff so that everyone knows what training is being offered, when, where, for whom and by whom.

c. A [illegible] in-service training policy should be developed and communicated in writing to all people concerned with supervising and directing agricultural extension programs and staff. The

policy should include statements of training objectives, roles and relationships and amount of official work time allocated for in-service training. At the outset, I recommend that at least 5% of the annual work year (about 13 days) be a minimum time allowed for in-service training.

d. The most skilled resource people available should be used to plan and present the subject matter at in-service training programs. Such instructors could include University College faculty, Ministry of Agriculture Research Division staff, Extension specialists or appropriate leaders from the private sector. The scope of subjects for in-service training should be as broad and as varied as the needs, interests and roles of those to receive the training. Thus, supervisors could receive training to help them develop management, supervisory and teaching skills including how to plan and implement programs and how to involve local leaders in the planning phase of program development, etc. Extension field officers and specialists could receive agricultural subject matter training, etc. Supervisors and field officers should consult with each other before submitting to the ESTD Committee their in-service training requests for extension field officers.

e. The ESTD Committee should consult with top extension administrators within and without RDA's before finalizing and announcing the annual in-service training calendar.

f. A special form ought to be developed for staff to use in requesting in-service training and another form on a different colored paper ought to be developed for staff to use in proposing in-service training.

g. An annual report summarizing the in-service training offered and results obtained should be prepared by the Extension Staff Training and Development Officer and shared with the Director of Agriculture and top RDA and non-RDA extension administrative and supervisory staff. In this manner, the supervisory staff are involved in and informed of the entire annual in-service training program from the planning stage through execution, evaluation and reporting.

h. An annual extension conference of two to four days' duration ought to be conducted to build staff acquaintance and morale, to share success stories and experiences and to receive general instructions and counsel from Ministry of Agriculture officials and other leaders. The scheduling of the annual extension conference should be done by the ESTD Committee and with approval of

the Director of Agriculture six to eight months before the conference is held. Perhaps the annual conference could be held at the Agriculture College campus during a semester or term break when the students are home on vacation. This could provide housing and meeting facilities at a reasonable cost.

B. The Certificate Training Program

The apparent goal of the Certificate Training Program is to give the participants an acquaintance with minimum subject matter relating to Swazi agriculture and livestock production so that they may start working as extension field officers. There is so much to cover in only one year that I am reluctant to suggest any major change in the current curriculum. I do suggest for consideration by the course directorship that little time is devoted to some items such as "fisheries" and they may not receive much use by the majority of class members when at work. Perhaps such courses could be eliminated to allow more time for extension methodology in program planning and teaching. Secondly, I suggest workshop or active learning experiences be used to the maximum extent possible when teaching program development processes. These abstract concepts come alive in case study experiences.

In summary, considering the time limitations, I feel more benefit will result from a strong, vigorous in-service training program than from making extensive adjustments in the Certificate Training curriculum. Also, by providing more audio-visual teaching resources for instructor use (including flip charts, slide-tape programs, film strip projectors and video tape programs through a betamax or similar system) the quality of instruction could increase dramatically.

PART 4: STUDY AND ANALYZE THE MINISTRY OF AGRICULTURE'S PRESENT PRODUCTION CAPABILITIES WITHIN THE AGRICULTURAL INFORMATION SECTION TO PRODUCE EXTENSION MATERIALS AND PUBLICATIONS IN ADEQUATE QUANTITIES AND RELEVANT QUALITY ON A TIMELY BASIS.

Parts of the agricultural information section of the Ministry of Agriculture and cooperatives are in states of near dormancy. Mr. Robert Twala, Senior Agriculture Officer, is currently directing the operation. The position of Agriculture Officer - Training was occupied by an Israeli expatriate, but he departed Swaziland a few months ago and the position remains vacant. Other positions in the section include: two publication editors (one a Swazi and the other a Peace Corps Volunteer from the USA), a farm broadcaster, a photographer, a projector operator, two visual aids specialists (one of whom received graphics art training at the University of Indiana during 1979) and a typist. There are nine positions in total, and all are filled except for the Agriculture Officer - Training.

There is very little being produced by the section except for radio newscasts and the work of the mobile projectionist. The latter leaves Mbabane on Mondays and returns on Fridays. He has a 16 mm Bell and Howell movie projector, a portable generator and an open pick-up truck. He meets extension field officers and shows films to rural audiences. The extension field officers are usually present to answer question or to give added instructions and lessons. He does not have very many films and most are old. The newest film is six years old. He does borrow films from UNDP, FAO and USIS as opportunities present themselves. He has a lot of success in attracting audiences in the rural areas. He frequently has 300 to 400 people in his audiences. He has a log book and faithfully records all showings, the number in attendance and where the events took place.

The photographer has some camera equipment, a dark room and small developing equipment which is assessed as being too small for the job to be done. There is a slide sorter, drafting table, small opaque projector, hot press, a Gestetner duplicating machine (model 473), three typewriters, a small addressograph machine, a small paper cutter, some graphic art paints and very little paper. The farm broadcaster also has a portable tape recorder, which he uses to make radio programs. That summarizes the available equipment.

Staff morale is low as their resources are limited and very little material is being produced. The young graphics artist would like to be busy, using the new skills he developed while studying in the USA last year.

I perceive that the low product output is partly responsible for the lack of teaching resources available to extension field officers. This section of the Ministry needs close study by the Project Paper Team. It seems to me this section ought to have an off-set printing capability with related equipment to photocopy, make printing plates, collate and bind, etc. They ought to be publishing small bulletins or single page fact sheets for field officers to use with their education programs for rural audiences. Obviously the research people and other technicians of the Ministry could benefit from this section if the resources and skills to produce printed matter were available. This section could greatly increase their support to field operations if they had trained personnel and equipment to produce video tape programs. The projectionist ought to be equipped with portable TV monitors (at least two) and a small portable video tape player (such as a betamax unit). Two TV cameramen with editing equipment and skills could produce programs with local settings

and stories to depict the work of cropping systems researchers, and show recommended farming practices. There are numerous ways to use such equipment that permit showing and re-showing current programs at very low cost.

In summary, the personnel part of the information section is stronger than the resources available for their use. I recommend this section be up-graded through additional training and providing resources to enable them to produce printed materials, radio programs and video tape materials at a level that is acceptable to rural Swaziland residents and in quantity equal to the needs of extension field officers and other educational programs including support for the Certificate Training Program and the Agriculture Research Division.

PART 5: BASED ON STUDY OF EXTENSION ACTIVITIES, RECOMMEND ASSISTANCE FOR STRENGTHENING AGRICULTURAL EXTENSION INFORMATION.

I recommend that USAID:

a. Provide a trained, experienced expatriate extension information specialist who is also skilled in extension program development processes and administration. He could give leadership to a dynamic in-service training program and direct the Ministry of Agriculture Information Section.

b. Send two or more BS level Swazi agriculture students to the USA for MS degree-level training in adult education, agriculture information, extension program development and supervision.

c. Assist the Ministry of Agriculture Information Section in acquiring a complete off-set printing capability (press and related equipment) so that the Ministry can publish research findings, extension (farmer level) fact sheets, flip charts and other support teaching resources for extension field officers, instructors of the Certificate and Diploma courses, research personnel, etc. The acquisition of such equipment must be followed up with the training of personnel to professionally use it.

d. Support a vigorous in-service training program for extension field officers, middle management, support staff, etc.

e. Assist with the acquisition of equipment for an effective audio-visual learning resources production department (including slide-tape, TV and video tape capabilities).

If the output of Certificate level graduates is to increase from 40 to 80 students per annum, then I also recommend USAID help to acquire the additional resources as indicated in PART 2 of this report.

PART 6: ISSUES AND SPECIAL PROBLEMS TO BE MORE CAREFULLY STUDIED IN DETAIL BY THE USAID PROJECT PAPER TEAM.

The USAID project paper team should:

a. Carefully study the curriculum of the Certificate Training Course for seasonality and sequentiality of subject matter presented.

b. Interview some of the course alumni of the past two years and identify strong and weak parts of the training program.

c. Find a way to increase the amount of time available to teach more of the skills needed to implement extension program development processes and teaching methodologies. See the attached Appendix C, "Programming in the Cooperative Extension Service, a Conceptual Schema." If a simplified version of the schema is deemed applicable to Swaziland, then devise ways and means for its inclusion in the new Cropping Systems Research/Agriculture Education Project.

d. Explore in detail Swaziland government goals for expanding agriculture education for adults and primary and secondary school students.

e. Assess Swazi budget capabilities and include in the new project such assistance as is necessary to assure success of the program.

f. Study the organizational structure of the Ministry of Agriculture to find ways for closer linkage between the agriculture research division, extension subject matter specialists and extension field officers.

g. Study in detail ways and means for making research findings more readily available and useful to extension field officers in their educational programs with farm families.

h. Resolve with Ministry of Agriculture officials the feasibility of and their willingness to establish an off-set printing press and related equipment in the Information Section. This effort must include consideration for employing and training additional personnel to operate the equipment.

Resolve such questions as where the equipment would be placed, policies regulating its use and control, etc.

j. Resolve with Ministry of Agriculture officials the feasibility and willingness to establish and support an expanded audio-visual aids learning-teaching resource center with needed equipment in the Information Section. How much progress will they agree to and support?

k. Resolve with the Ministry of Agriculture their willingness to establish and support a vigorous in-service training program for Swaziland extension staff at all levels (from field officers up to middle management and administrative staff) such as is suggested in PART 3A of this report.

Establish a detailed list of all equipment to be acquired for the printing and audio-visual production units to be established in the Information Section of the Ministry of Agriculture.

m. Determine the kinds and amounts (quantity) of audio-visual equipment needed by the faculty of the Certificate Training Program.

PART 7: THE EXPATRIATE STAFF AND WHAT THEY MAY BE EXPECTED TO ACCOMPLISH IN FIVE YEARS' WORK IN SWAZILAND.

a. The Crop Agronomist lecturer: The occupant of this position is expected to be part of the core teaching staff in the expanded Certificate Training Program and the University College of Agriculture. He would help evaluate and adjust the curriculum as agreed upon by the director of the training program, develop new teaching resources for the Certificate Training Program and for field officer use, and assist with the development of video and slide tape programs relating to crop production.

b. The Animal Production Lecturer: The occupant of this position will perform a role similar to that described for the crop agronomist, but will deal with animal production subject matter rather than crop production.

c. Staff Training and Development Officer: The occupant of this position will give leadership to the development and implementation of an in-service training system and program for staff at all levels of the agriculture extension organization. He would establish the organizational structure of the system and implement in-service training so that the Swazi nationals, on their return from training, may effectively continue its operation. He

will also organize and operationalize a printing press and audio-visual production capability within the Information Section of the Ministry of Agriculture. He will guide the development and training of Swazi nationals so that they effectively operate and maintain their equipment and produce teaching materials via printed matter, video tape and slide tape media. They will also support the research functions of the Ministry of Agriculture. He may need short-term specialized help to implement the development of the Information Section.

IV.

APPENDICES

APPENDICES

APPENDIX A

Contacts Made in Swaziland by PID Design Team

1. Government of Swaziland

a. Ministry of Agriculture

Mr. Arthur Khoza	--	Permanent Secretary
Mr. Victor Pungwayo	--	Director of Agriculture
Dr. Austin Khoza	--	Director Veterinary Services
Mr. Frank Buckham	--	Chief Research Officer, Malkerns Research Station
Mr. Robert Twala	--	Senior Agricultural Officer, in charge of Extension
Mr. Mike Davis	--	Director RDA Program
Mr. Patrick Lukhele	--	Senior Agricultural Officer with RDA Program
Mr. T. K. Maseko	--	Soil Chemist, Malkerns Research Station
Mr. Enoch Chiya	--	Director of Certificate Program
Mr. George Cummins	--	Technical Advisor, Certificate Training Program
Mr. Ephraim M. Ngwenya	--	Project Leader Northern RDA

b. Ministry of Education

Mr. Justis Nsibandze	--	Permanent Secretary

c. University of Botswana and Swaziland

Mr. T. O. Dlamini	--	Dean, College of Agriculture
Dr. Sam Aggrey	--	Professor of Crop Science
Dr. I. Haque	--	Professor of Crop Production
Dr. Glenn T. Magagula	--	Professor of Agricultural Economics
Dr. Berry Challens	--	Professor of Agricultural Education

2. United States Government

Mr. Richard C. Matheron -- United States Ambassador

a. U.S. Agency for International Development

Mr. Julius E. Coles	--	Director of USAID/S
Mr. Ted D. Morse	--	Assistant Director
Mr. Willie F. Cook	--	Agricultural Development Officer
Mr. Eugene Morris	--	Capital Development Officer
Dr. Larry E. Saiers	--	Program Officer
Mr. William R. Charleson	--	Human Resources Development Officer

b. Others

Mr. Mike Cox	--	Research Superintendent, Libbys Pineapple Company
Dr. J. Cordell Hatch	--	Professor and Coordinator of Radio-TV-AV Services Pennsylvania State University

APPENDIX B

Members of the Project Identification Document (PID) Design Team

Mr. Eugene Morris	--	Project Design Officer, USAID/S
Mr. Willie F. Cook	--	Technical Officer, USAID/S
Dr. Larry E. Saiers	--	Economist, USAID/S
Miss Carolyn Barnes	--	Sociologist, REDSO/EA
Mr. Stafford Baker	--	Engineer, REDSO/EA
Dr. John D. Downes	--	Cropping Systems Specialist, CID/TTU
Dr. William F. Farnsworth	--	Agricultural Education Extension Training Specialist, CID/USU
Dr. Keith R. Allred	--	General Agronomist and CID/USU Team Leader

APPENDIX C

PROGRAMMING IN THE COOPERATIVE EXTENSION SERVICE

a conceptual schema

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A Conceptual Schema For Programming in The Cooperative Extension Service

The Concept of Programming

Programming is a complex and all-pervasive concept that is used to explain and describe the individual and collective efforts of professional Extension staff members and volunteer lay leaders in planning, executing, and evaluating educational programs. Its connotation and usage vary among the 50 state Extension services and 3150 county Extension services.

The tendency has been to refer to any single program activity that may involve one or more staff members and/or leaders within the Service as programming. The limited research findings on Extension programming lend credence to the connotation and usage accorded the concept. Most of these research efforts have been focused on functions concerning leader involvement in program planning and various aspects of teaching-learning situations generally enumerated in teaching plans and plans of work. This narrow view of the concept has tended to delimit its potential utility as a facilitating and unifying force in the Cooperative Extension Service.

Role ambiguity, the evolvement and maintenance of semi-isolated staff groups, the lack of effective linkage between staff development programs and specified competencies needed by staff members to maximize their program effectiveness, the dependence of professional staff members on prescriptive program strategies or procedures, and stereotyped images of publics possessed by Extension staff members are symptomatic of Extension staff members' lack of understanding of programming in its total context.

The position advocated by the authors of this treatise is that programming encompasses all of the planned and coordinated educational activities of professional staff members, volunteer leaders, and the actual learners in designing and effecting educational strategies that should culminate in desirable changes in the patterned behavior of people and the alteration of systems. That is, the members of every level of the Extension organization, as well as members of the publics toward whom their change efforts are directed, have complementary roles to perform in effective programming. The reciprocal directional flow of program inputs is both vertical and horizontal. Situational factors at the teaching-learning level and at other points in the organization at which decisions are implemented must be continually considered in directing and redirecting the programming efforts of the organization. Specifically, problems or needs experienced by staff members, leaders, and learners at the several operational levels should be considered as essential inputs in the decision-making process. Conversely, the comprehensive and specialized perspective possessed by those at the higher administrative and program levels of the organization (i.e., administrators, supervisors and specialists) should positively influence program decisions taken and actions effected at the program implementation levels.

This conceptualization of the programming process in the complex community-based adult education organization, such as the Cooperative Extension Service, has its origin in concepts, theories, and principles contained in the behavioral sciences. The Cooperative Extension Service is viewed as a dynamic, responsive system oriented to the delivery of educational programs designed to satisfy or fulfill the constantly changing needs of many diverse publics. An Extension Service is a system composed of actors applying their intellectual and material resources in concert to improve the socio-economic status of people. As situations within which people live and interact change—so must the posture of the Extension Service change. The objectives, the procurement and structuring of resources, and the management of these resources within the Extension Service must be subject to continuing scrutiny and modification to assure relevancy and maximal return in terms of the changing needs of people. In addition, as changes in the social patterns of publics occur, the educational strategies employed by professional change agents must be modified.

The Scope of This Paper

It has been rather clearly established that programming is a dynamic decision-making and decision-implementing process that encompasses the individual and collective efforts of professional staff members at all levels of organization, leaders and the actual learners in generating programs designed to alter people's behavior and structured systems.

The ubiquitous nature of programming, occurring as it does at all levels of organization, presents problems of conceptualization. However, the limited research findings specific to Extension programming and the wealth of concepts, theories, and principles derived from the behavioral sciences can be cast into a heuristic conceptual schema that is viewed by the authors as a useful way of thinking about and endeavoring to acquire a more thorough understanding of programming as it occurs in the Cooperative Extension Service.

Figure 1 is a conceptual schema for planning, implementing, and evaluating program decisions and actions in an educational, task-oriented organization that functions in a voluntary setting. Because of the tentativeness and exploratory nature of research conducted to this point, the four macro phases and their respective elements contained in the schema are set forth for heuristic purposes.

THE INSTITUTION AND ITS RENEWAL PROCESSES

An educational institution (i.e., Cooperative Extension Service) exists to facilitate desired changes in its clientele and in their social environment in concert with available resources. It is not static, but one in which adjustments are continually being made in its structure and processes as it adapts to meet or serve the needs of its relevant publics in a changing social environment.

The extent to which positive results are obtained through the programming efforts of the Cooperative Extension system is contingent upon many variables. Among these is the degree to which there is established or defined a systemic framework within which staff members are expected to function.

Staff members need to examine, understand, and accept the structure of the educational system through which their programs will be generated and conducted. Staff members must become thoroughly knowledgeable of and committed to the philosophy of the system, which

The institution and its renewal processes	Linking the institution to its publics through need analysis and leader involvement	Program design and implementation: Long-range program	Program design and implementation: Plans of work	Program design and implementation: Activating plans of work	Program evaluation and accountability
Understanding and commitment to the structure of the institution (i.e., Cooperative Extension Service): • Philosophy • Objectives • Roles • Relationships Knowledgeable about and skilled in management. • Staffing • Staff development • Supervision • Accountability Understanding of and commitment to a tested conceptual framework for programming • Linkage of institution to its publics through need analysis and leader involvement • Program design and implementation tailored to the needs of Extension's publics. Understanding of and commitment to continuous institutional renewal.	Study, analysis, and mapping of county and/or area. Identification and analysis of subsystems within county and/or area. Identification of target subsystems. Identifying and interfacing with leaders of target subsystems. Formation of leadership systems representative of target subsystems. Needs identification and analysis specific to target subsystems. Relating needs of target subsystem to the larger system and identifying macro needs common to two or more subsystems.	Specification of macro needs. Delineation of macro objectives. Designation of strategies for obtaining objectives.	Delineating, ordering, and sequencing micro needs. Specifying instructional level objectives. Selecting and organizing learner activities. Formulating plans for evaluation.	Mobilizing and utilizing resources. Monitoring the teaching-learning process. Reinforcing learners. Revising and redirecting activities based on feedback.	Determining program outputs Assessing program inputs. Utilizing evaluative findings for program revisions, institutional renewal, and accountability to publics, funding sources, and to the profession.

FIGURE 1. A CONCEPTUAL SCHEMA FOR PROGRAMMING IN THE COOPERATIVE EXTENSION SERVICE

provides a general framework for the behavior of its members; macro objectives, which delineate the ends to be accomplished by the system; policies, which guide and help to regulate individual and collaborative behavior of staff members in achieving the ends of the system; roles which specify required responsibilities of individual staff members and job groups in achieving the objectives of the educational system; and relationships, which provide a basis for linking the efforts of individual staff members and job groups in attaining maximal program impact.

Another significant factor for achieving educational effectiveness is the extent to which staff members become knowledgeable about and skilled in management processes that will yield maximal results as specified in the macro objectives of the system. It is imperative that careful attention be given to the recruitment of staff resources, the development of staff resources, the application of supervisory practices that will facilitate achievement of the macro objectives of the educational institution, and the development and utilization of a viable accountability system.

A third requisite is the extent to which staff members understand and are committed to a tested conceptual approach for generating and effecting programs of change with their many and diverse publics. Such a conceptual framework would include basic concepts, theories, and principles derived from the behavioral sciences about planned change, linkage with publics through need analysis and leader involvement, and the design and implementation of programs specifically tailored to the perceived and analyzed needs of these distinctive publics.

A fourth variable of import to program success is the acquisition of a keen sensitivity and commitment to objective, systemic analysis for facilitating system responsiveness and renewal to the constantly changing needs of its publics. In a society where needs of clientele and patterns of thinking, feeling, and acting are in rapid transition, the system must be renewed by making adjustments in its structure and processes to accommodate adaptation to its changing social environment.

To facilitate effective functioning of the system (i.e., Cooperative Extension) in achieving its mission, it is important that continuous attention be given to the socialization of its professional members and the leaders of its publics. It is imperative that staff members and lay leaders be afforded a continuing opportunity to provide inputs that will cause the system to be more responsive to the actual needs of its publics. The foregoing processual tasks are advanced as possible means for achieving these ends, and hence increase the potential effectiveness of the total system as a dynamic instrument of change.

1. *Change agents must become thoroughly knowledgeable of and committed to the structure of the educational institution through which its programs will be effected, giving particular attention to philosophy, objectives, policy, roles, and relationships.*

The degree to which professional educators understand and identify with the basic structural elements of the complex Cooperative Extension system is related to the following: (1) the manner in which the philosophy of the system is diffused among its members and commitment secured; (2) the opportunity provided the professional staff in helping define and modify the educational objectives for the system that clearly indicate the behavioral changes sought in various clientele groups; (3) the opportunity provided staff members to contribute to decisions taken with respect to the definition and establishment of policies to guide program efforts; (4) the manner in which roles of staff members are defined and communicated to all concerned; and (5) the manner in which the expected relationships between various staff groups are established and these groups know and understand them.

Philosophy. The total staff of the Cooperative Extension system must become thoroughly knowledgeable of and committed to its philosophy. The philosophy of an institution is its "value framework" that has evolved over an extended time. Constant effort must be expended to make the value framework of an institution more consistent, more comprehensive, and more workable than before.

The philosophy of Extension is that people must be assisted within a democratic framework. This philosophy reflects the firm conviction that people adjust to change most rapidly in a democractic environment in which self-expression, self-direction, and self-improvement are encouraged. This development can best be accomplished through a program of purposeful continuing education in which people, through their own initiative, identify and solve problems directly affecting their welfare. To this end, Extension starts with people where they are by helping them to attain a more satisfying way of life. If one accepts the proposition that the philosophy or value framework of an institution influences the behavior of its members, then every educational system should develop a functioning and articulate philosophy, communicate it to its members, and take necessary action to seek commitment.

Objectives. Just as change agents must understand and be committed to the philosophy of the system, objectives or ends must be understood

at all levels of the system. To begin with, there must be some understanding of the macro objectives of the total system. These are the broad objectives which have their origin in the contemporary needs of the institution's publics and which constitute the framework within which all decisions and actions about the institution's program must be linked.

Not only must macro-level objectives be understood, but staff members must understand the objectives of various subsystems (i.e., job groups) such as those of district supervisory staffs, specialist groups, administrators, and those at area or county levels. By being knowledgeable about the objectives of various subsystems, individual staff members can grasp the potential roles of such groups and their complementary linkage, and hence make better utilization of such resources in the performance of their expected roles.

Staff members' understanding and acceptance of the macro objectives of the educational system and objectives of subsystems contained therein does not result from edict, but rather through the deliberate and continuous involvement of the staff in their formulation.

Policy. An important means for attaining the objectives of the system are carefully delineated policies which guide and help to regulate individual and collaborative behavior of staff members. Policies provide guides to the decisions and actions of staff members as they engage in purposeful and planned interaction aimed at attaining the objectives set forth for the system.

Staff members must have a working knowledge of all policies and understand the degree of flexibility contained in each.

Role. The expected roles of staff members have their origin in the macro objectives of the system and the objectives of their parent subsystems that must be subordinate to and contributory to the macro objectives. The roles played by people in any system are interrelated. This necessitates that the activities of various staff positions and groups must fit and mesh together in the pursuit of the macro objectives of the system if maximum results are to be attained.

A common problem in most complex educational systems is that too little attention has been given to the clear definition and linkage of roles to objectives. This factor has tended to stifle the effectiveness of staff efforts in relation to the attainment of the macro system objectives. As systems expand their scope and consequently enlarge their staffs, the roles of staff positions and groups and the interrelationship of these roles in terms of the ends sought by the organization tend to become hazy and incoherent. Staff activities may become fragmentary, and often individual staff groups—because of lack of frequent and continuous interaction with their counterparts in pursuit of the macro objectives of their parent institution—begin to function as autonomous units. The need for planned and deliberate staff involvement in the continuous redefinition of their roles, as well as those of their colleagues, is apparent if the efforts of the occupants of individual positions and the several staff groups are to be effectively focused on the objectives of the organization.

Relationships. Within the general social system (i.e., Cooperative Extension Service) are a number of formal and informal subsystems. Certain leadership patterns, power relationships, role relationships, behavioral expectations, and attitudinal patterns exist within the small subsystems as well as in the larger system. Each of the subsystems, although intimately related to each other and to the larger system, also has an established pattern of operation.

In the complex Cooperative Extension system, these subsystems may include specialized staff groups that are housed in close proximity to the central organization and operational (field) units located some distance from the central office. Because of this factor, programming must occur at the various levels of the organization. The real challenge is that of having these subsystems identify with the general social system, but at the same time permitting them sufficient flexibility to make and implement decisions at their respective levels of operation. Although plans are made and implemented at the several levels of organization, it is of utmost importance that they be coordinated and effectively related to the overall plans of the general organization.

The task confronting the large complex educational system is that of establishing relationships between and hence linking the programs of its several subsystems. Direction provided by the general social system is meaningful only to the extent that the staff groups at the various levels of the system understand and can adapt to their specific situations. It is not enough to have the professional leadership understand and accept proposed changes; ultimately, the people who are to be affected by the change also must understand and accept it.

Professional and lay leadership must understand the proposed change, its anticipated effects on on-going programs, and accept it if maximum system impact is to be felt at the operational level. Essentially, the proposed change is never accepted in its totality. Rather, the desirable aspects of the change (as perceived by the adopters) are integrated into or related to their on-going program activities.

2. *Change agents must become knowledgeable about and skilled in management processes that will yield maximum results as specified in*

the macro objectives of the educational system (i.e., Cooperative Extension), giving particular attention to staffing, staff development, supervision, and accountability.

The extent to which the objectives of a system are achieved will depend to a large measure upon the processes through which resources are identified, attained, and managed. Of crucial importance are staffing, staff development, supervisory, and accountability processes and practices utilized by the system.

Staffing. The identification and selection of staff members who have the training, background, competencies, and potential capacity for growth required of the job to be performed, is of paramount importance to the viability and success of the Cooperative Extension Service. Unless careful attention is given this process at all system levels, then management will have to be satisfied to expend enormous amounts of energy on training. Conscious and deliberate efforts must be made to seek and secure county personnel, specialists, supervisors, and administrators who have the qualities and competencies that are in consonance with the philosophy and objectives of the system.

Staff Development. Dynamic systems are those that provide opportunities for the continuous self-renewal of its members based on their needs as the system adjusts its objectives to the changing needs of its publics. Even if the most competent personnel are recruited into the system, the system can quickly become reified and obsolete, unless these individuals are afforded continuous opportunity for self-renewal. Staff members at all levels should have the opportunity to define their training needs and be given the opportunity to engage in in-service and graduate education as part of, and requisite to the changing requirements of and hence performance of their roles.

Supervision. An organization may bring into its system the most competent personnel available, and provide a comprehensive and intensive training program. But, unless its members are given an opportunity to function, the system may lose much of its potential effectiveness. Change agents must learn to share leadership and develop the capacity of colleagues and subordinates to function. Not only must leadership be exercised and a teamwork approach followed, adequate guidance must also be provided. People generally want to know if they are performing adequately and want assistance in marshalling and applying resources to achieve. The change agent, through the application of appropriate supervision styles, can enhance the system's effectiveness immensely.

Accountability. In the long run continuing and increased funding and support for educational programs is positively related to the demonstrated efficiency and effectiveness of the system. Educational systems have always been accountable to their relevant publics, their parent institutions, funding agencies, and legislative bodies at the local, state, and federal levels. But, more than ever before, there is a demand for accurate manifestations of output in relation to the objectives of the system and to the efficient utilization of resources to achieve desired results.

Change agents must understand the significance of accountability and commit energy and resources to means by which the system can demonstrate to publics and funding agencies that desired results are being obtained. Accountability is dependent on the development and utilization of evaluation systems that measure the expected behavioral changes in individuals and groups.

The evaluation system must not only measure the behavioral changes that result, but also provide measures of effective application of learned behavior in the real social world. Finally, the system must provide some measure of whether desired changes have occurred in the social and economic patterns of relevant publics. The "proof in the pudding" is whether the program has reached its micro teaching level objectives and macro system objectives--assuming that objectives have been based on real needs.

In addition to the utilization of systematic evaluation systems, appropriate means must be established and utilized at all levels of the educational institution for reporting results in a form that demonstrate a degree of effectiveness. The Cooperative Extension Service SEMIS reporting system is an example of a concerted effort to collect, analyze, and report data illustrative of its educational effort. However, this effort must continuously be tested, studied, and revised to facilitate maximum results.

The accountability process requires the system to (1) identify the real needs of relevant publics, (2) develop program designs to meet needs, (3) package program delivery systems for effective implementation, (4) develop realistic and feasible evaluative systems, and (5) establish meaningful systems through which results may be disseminated to those to whom the educational system is accountable.

An increased emphasis on the accountability process can have functional consequences for the improvement of the Cooperative Extension Service's program, its processes by which programs are developed and implemented, and its systemic structures through which the needs of relevant publics may be met.

3. *Change agents must understand and become committed to a tested conceptual frame-*

work for generating and effecting programs of change with their many and diverse publics.

Change agents must understand the total setting within which Extension programs are generated and effected. They must acquire and utilize a tested conceptual framework that enables them to identify the needs of their publics, to obtain a commitment from such publics to act, and to design and implement programs that will produce substantive changes in the learner and his social structure.

4. *Change agents must acquire a sensitivity and commitment to objective systemic analysis for facilitating system responsiveness and renewal to the constantly changing needs of its publics.*

Systems that have become institutionalized to the extent that they are satisfied with the *status quo* will find that contemporary society does not slow its pace to maintain social balance. In such situations, the system may find itself working desperately to survive during periods of rapid change.

To cope with this condition, members of the system must build in system renewal processes. There must be constant vigilance of, and a well-developed sensitivity to, the changing world in which the system operates. Sensitivity to the needs of the people that the system serves and the willingness to change structures and processes within the accepted philosophy of the system will ensure viability. Those organizations that are content to follow the same objectives year after year are not likely to remain viable educational forces.

The general process by which renewal operates is: (1) by intensive involvement of professionals and lay leaders in developing programs; (2) through intensive and open dialogue, confrontation, and coping with problems affecting the structure and processes of the system; (3) a thorough understanding of prior and present historical bases, programs, and clientele; (4) sensitivity to needs and the potential for meeting needs; and (5) understanding change, the societal influences, and how to cope with change. Only when system members can objectively study themselves, the system, the program, and the environment in which they function can adjustments be made within the system and adaptation made to the social environment for maximal effectiveness.

LINKING THE INSTITUTION TO ITS PUBLICS THROUGH NEED ANALYSIS AND LEADER INVOLVEMENT

Extension programs have their origin in the felt (perceived) and analyzed needs of the Cooperative Extension Service's public. Contingent upon the perceived mission of a given Cooperative Extension Service, these publics could conceivably constitute the total population or specified aggregates of people within a designated geographic or political entity.

The determination of the needs of Extension's perceived public is the most challenging, perplexing, and necessary task confronting the professional Extension staff member. Research findings on motivation, learning, and change underscore the absolute necessity of focusing the voluntary-oriented educational organization's programs on the perceived (felt) needs of its target publics if the attention of such groups toward change is to be obtained.

These studies further emphasize that the retention of the interest and commitment of these publics to change will depend to a large measure upon the immediate and continued satisfaction that they experience with respect to the gratification or fulfillment of perceived needs.

Man's needs are determined by a multitude of psychological, social, and cultural factors. The origin and intensity of such needs are related or linked to systems of patterned interaction and processes of socialization through which man acquires a distinctive life style. The life style of a given individual is the psychological, social, and cultural manifestation of cumulative behavior (covert and overt) that has been learned slowly and sometimes painfully throughout his life span in responding to stimuli encompassed in his social environment.

The expansiveness of man's social environment and hence his degree of socialization are directly related to the experiential opportunities afforded him during his life span. Social environment includes both cultural and social forces. Culturally, man's life style is a manifestation of learned behavior acquired in the process of growing up. It includes not only his way of making things and doing things, but also his pattern of interaction with others, attitudes and values fostered, beliefs and ideas possessed, and the feelings with which he responds.

Socially, man's learned behavior, his life style, and hence his needs are influenced by expectations and normative standards imposed upon him by primacy, peer, reference, and social groupings with which he identifies.

The import of cultural and social forces on man's behavior cannot be overly emphasized. To cope with man's needs, it is imperative that the professional change agent understands how they are linked to his cultural heritage. The needs of an individual are meaningful to a given person to the extent that he perceives that their fulfillment will help him achieve greater equilibrium with his defined cultural context and social environment. Too, the influence of peer and

social groups on one's needs must be taken into account in diagnosing needs. That is, the expectations of peer and social groups on the behavior and needs of the individual may be more dominant than any other single factor.

Intervention in the lives of people through educational programs developed and promoted by agencies such as the Cooperative Extension Service requires that change agents understand the culture (way of life) of the individuals or group that they are attempting to change, and to have access (entree) into the distinctive social grouping in which such culture is nurtured and maintained.

The existence of definable social groupings in American society is all-pervasive. Man's identity with such groupings commences with the cradle (family) and extends throughout his life span. They (social groups) have their origin in two social processes, namely, differentiation and evaluation. These groupings are established and maintained through patterned interaction (social relationships) of members of the group and their adherence (conformity) to mutually agreed upon norms and standards that result in shared goals, beliefs, values, attitudes, customs, and sentiments.

A significant element of such groups is the evolution of influentials as leaders who wield considerable influence on the behavior and actions of individual members, as well as the total collective group. These persons acquire their positions of influence through reputation, heritage, as well as a host of other means. They mirror the values, beliefs, and sentiments of their followers. Their leadership positions may be of a formal or informal nature. These leaders generally possess the authority or power to grant or deny access to their respective group.

In maintaining one's position within such grouping, the average person continually strives to measure up to the expectations of his peers and the leadership contained therein. His intrinsic motives are oriented toward the preservation of a way of life to which he is accustomed and which makes sense to him as well as to the expectations of his peers.

It is apparent from the foregoing discussion that representatives or change agents of the Cooperative Extension Service cannot take lightly the task of relating programs to the needs of their publics.

Simply put, the content of programs designed to effect change in established behavior patterns of man cannot be determined as a result of hunch or hearsay. Too, they cannot assume that what is good for one sector of the population will be good for other sectors. Rather they must possess the ability to differentiate between or map publics, their needs, the sources of such needs, and social-cultural factors which may facilitate or impede participation of such publics in programs designed to help them satisfy or fulfill needs.

Change agents must be capable of identifying the leaders of target publics (social groups) to establish effective linkage with these leaders through meaningful dialogue and the delivery of programs that will result in the immediate gratification of intrinsic needs. Only after intrinsic needs experienced by a given public are satisfied can the change agent expect any success in having such publics cope with extrinsically motivated needs. That is, Extension agents must begin their program efforts with people where they are in the initial stages of the change process rather than attempting to call people's attention to needs with which they may be unfamiliar or in which they have little interest.

Extension (change) agents must recognize that the socialization process is slow and arduous, and that its beginning commences with the perceived needs and motives of the learner in his social environment. Both the potential learner and change agent must be involved in the diagnosis and identification of needs that will ultimately constitute the basis for an educational program.

From an operational context, several important and necessary tasks can be inferred for the professional change agent in determining the needs of his publics for inclusion in the Extension program. The foregoing processual tasks are suggestive, and no claim is made regarding their inclusiveness or completeness. They are set forth merely for the purpose of providing the change agent a framework for thinking about the job that confronts him.

1. *Change agents (county or area Extension personnel) must become intimately acquainted with and knowledgeable about the social system (i.e., county or area) within which educational programs are to be effected that will result in desirable changes in the patterned behavior of individuals and alteration of systems contained therein.*

County Extension staffs or other appropriately designated unit staffs at the operational level must become thoroughly acquainted with their respective counties or areas within which their collective efforts are to be directed toward the development and implementation of educational programs. That is, county staffs or their appropriate counterparts must acquire a comprehensive cognitive map of their respective systems. Such a cognitive map must encompass more than a mere knowledge of political or geographic boundaries. It must include a thorough knowledge and understanding of the people who reside within the county or area,

including their psychological, social, cultural, and economic characteristics.

A common fallacy of many professional adult educators is to assume that all people residing within a given area or county are homogeneous. Although people may be tied together spatially and in terms of a common government, numerous differences between and among people may and often do exist with respect to life styles, heritage, socio-economic status, culture, patterns of interaction, and normative standards.

Recognition of these differences is the first essential in mapping strategy for identifying needs and ultimately tailoring programs to the needs of the many and different clientele groups or publics that could conceivably reside within a county or area.

2. *Change agents (county or area Extension personnel) must identify and map the subsystems (social groupings) within the larger social system (county or area), giving particular attention to the inferred or defined mission of such groups, their membership, patterns of interaction, values, beliefs, sentiments, norms; leadership, and social-cultural origin and heritage.*

A second logical stage to macro mapping of the county or area is the discernment of distinctive patterns of interaction between and among people residing in the county or area. These patterns of interaction are reflected in social groupings that are comprised of aggregates of people bound together by common goals, life styles, values, beliefs, sentiments, and heritages. The behavior of these groups is generally governed and regulated by normative standards that are enforced by their membership and leaders. Entree into these groups requires the exhibition of understanding and empathy by the professional. Equally important is knowing about points of access, namely, the leadership of the groups.

The importance of knowing about and understanding the differences that exist between these groups is highlighted by the fact that their needs and hence their readiness to participate in externally contrived programs will vary. For example, variations in the socio-economic status and the cultural heritage of social groupings cannot be taken lightly in designing programs for these groups. Nutrition programs planned for one particular group may not be compatible with the needs and interests of another group.

Numerous distinctive social groupings could exist within a county. The identification of such groupings based upon special interests, ethnic factors, socio-economic status, religion, culture, etc., is paramount to the potential and probable success of county Extension staff members in effecting programs that will yield maximal change in the patterned behavior of their publics.

3. *Based upon a thorough diagnosis of the subsystems and their perceived relevancy to the mission of the parent organization (Cooperative Extension Service), change agents (county or area Extension personnel) must determine target systems.*

The present or potential relevancy of the numerous subsystems or groupings within a county will be determined by the professional change agents' perception of the mission of their parent organization. That is, the objectives and resources of the Cooperative Extension Service will need to be considered in sorting out those subsystems toward which professional change agents at the operational level should direct their efforts.

This sorting out or screening process should ideally culminate in the delineation or definition of target subsystems. It is reasonable to assume that, as the mission of the Extension Service changes, efforts will be expended by its professional staff members in redefining target systems.

4. *Change agents (county or area Extension personnel) must identify the leadership within each of the target systems and set about to interface with this leadership through informal and meaningful dialogue. Such dialogue should be characterized by the exhibition of empathy and understanding on the part of the professional change agent, and should be initially focused—and perhaps over an extended period of time—on a discussion of needs as perceived by leaders of the given system.*

Entree by county Extension staff members into the targeted systems will require their identifying closely with the formal and informal leadership of these systems. The absolute necessity of this task to determining the needs of the group and to obtaining their commitment to participate in programs focused on their needs is underscored by the authority and power vested in leader figures within the system or group.

Practically all of the diffusion studies to date suggest that informal leaders hold the key to the adoption of practices by the majority of their followers. The likeness of the leader in covert and overt characteristics to the total membership of his grouping is striking. The maintenance of positions of leadership in such groupings is contingent to a rather large extent upon the soundness of their judgment as perceived by the followers in helping them safeguard and maintain their welfare.

The identification of leaders by professional change agents is not sufficient; rather they must

consciously strive to establish communication with these persons through informal and meaningful dialogue. The dialogue should be characterized with the familiar as perceived by the leader(s). That is, the inputs of leaders into such initial conversations should be dominant. The change agent (County Agent) is characterized as a listener in the initial stages of such dialogue. The professional should strive to exhibit as much empathy as possible.

Only after a "positive" two-way relationship is established should the change agent begin to interject external information inputs into the dialogue. Such dialogue should not be restricted to a single meeting, but ideally should be continued through the period of time required to establish a meaningful relationship between the leaders and professional staff members.

5. *Through continuing dialogue with the leaders about their perceived needs of the target system, change agents should work toward establishing a communication system that, over time, could lead to the formation of a formal or informal leadership system closely allied with the public institution.*

The maintenance of a satisfying dialogue with the leaders of each target system, over time, should result in the establishment of effective two-way channels of communication. The acquisition of confidence by the leaders of the target system in the change agent and his capacity to deliver programs specific to their needs is an important ingredient in the establishment of such a communication system. This complex could and should ultimately lead to the actual formation of a leadership system(s) closely tied to the public institution.

6. *As rapport with the target system becomes strengthened through the delivery of programs leading to gratification and reinforcement of needs perceived by the target system, change agents should consciously and tactfully work at providing inputs into the system that will enable its members to translate extrinsic needs into felt needs.*

Through informal and meaningful dialogue between the leaders of target systems and change agents, the immediate perceived needs of the publics represented by the leaders should come into focus. The immediate efforts of the change agents should be directed toward generating programs focused on felt needs that will result in almost instant payoff to the holders of such needs.

Results perceived by the target publics to be meaningful in satisfying their needs should enhance their state of readiness and receptiveness to considering external information that has a bearing upon nonperceived needs. That is, the stage should be set for the professional change agents to begin channeling program inputs into the dialogue with the leaders and followers that will cause them to translate extrinsic needs into felt needs.

7. *Through a gradual and purposively planned socialization process of leaders and members of specified target systems, change agents should, over time, work toward linkage of leadership systems of target publics that will facilitate concerted effort on the part of the several target systems in effecting changes that are outside the grasp or ability of a single target system.*

—The identification and fulfillment of needs of distinctive target groups is the first priority in effectively relating the resources of the adult education institution to its publics. However, the long-term objective should be to increase the socialization of these different groups through effective educational programs to the extent that they become knowledgeable about, concerned with, and committed to the seeking of solutions to problems or needs that transcend the boundaries of individual groups and affect the welfare of the general public.

This stage of socialization should ideally result in the linkage of leadership systems of target publics that will facilitate concerted effort on the part of the several groups in effecting needed changes that are outside the capability of a single group.

PROGRAM DESIGN AND IMPLEMENTATION

A major challenge confronting change agents is that of translating needs of target publics into a meaningful program design and developing effective strategies for its implementation. As leaders and change agents engage in dialogue over time, numerous needs will be identified. It is reasonable to assume that such needs will vary in their level of complexity.

The development of programs that will assure immediate fulfillment of perceived or felt needs by target publics should be given top priority by change agents. However, the change agent must be capable of perceiving and mapping the relationship between immediate, felt needs of target publics to higher level needs that will emerge as these lower level needs are satisfied. For example, the lower level need of a given group of homemakers to learn how to prepare a particular kind of dish must be seen by the change agent in relation to other higher level related needs that may emerge, such as the planning and preparation of balanced meals for their families, the selection and purchase of more economical foods that contain the necessary ingredients for

balanced meals, and ultimately concern for the health and happiness of their families.

This mental mapping by change agents is essential to the performance of their role as educators in designing programs to satisfy the immediate and felt needs of publics, but at the same time establishing the relationship of such needs to higher level ones that should eventually emerge as felt needs and be pursued by the learner in order to measure up to standards dictated by research findings and the expectations of society.

From an operational context, change agents—armed with an understanding of the perceived needs of learners and the relationship of these needs to higher level ones as inferred from research findings and the expectations of society, as well as how adults learn—must (1) design master (long-range) programs that identify the macro needs of their publics within which immediate and ascending levels of learner needs are encompassed, (2) design plans of work that outline instructional strategies for assisting learners to fulfill both felt and analyzed needs, and (3) develop plans for activating the plans of work and subsequentially master long-term programs.

Long-Range Program

The translation of learner needs into a long-range program that effectively defines and establishes their relationships and linkages to higher level related needs is a complex, but essential, component of total programming.

To achieve this rigorous, but highly desirable end, change agents must possess a broad and comprehensive perspective of "what is ultimately desired and is possible in learner behavior in the content area" within which learner needs have been expressed. That is, if the learner's immediate perceived (felt) need is to learn how to read the Bible, the change agent must have a mental perspective or cognitive map of what is desired or is possible with respect to adult reading skills, based upon societal expectations of its members and research findings.

In addition to a cognitive map of what is desired, and indeed what is expected of adults in terms of their ability to read, the change agent must also understand and be capable of delineating prerequisite reading skills that adults must successively master to perform at the highest desired level.

It is important to note that macro needs and hence the ultimate in terms of behavior change in learners are visionary in that such needs and expected levels of learner performance are subject to constant change because of the continuous flow of new and improved inputs of knowledge emanating from research findings.

Nevertheless, the forward-looking educational change agent must maintain, as his hidden agenda, the pursuit of the ideal by learners in terms of their behavior. This ideal, expressed in macro needs and high level learner performance (objectives), provides the change agent with a map or design for diagnosing learner deficiencies, identifying and sequencing learner objectives designed to help learners fulfill needs depicted by these deficiencies, and the selection and organization of learner activities designed to help learners acquire the behavior specified in the learner objectives.

This master (long-term) plan provides a blueprint for change agents in purposefully guiding learner efforts toward the fulfillment of both perceived and nonperceived needs of a higher ascending order that over time could result in the fulfillment of macro needs.

Thus, the long-range program has, as its primary function, that of providing change agents with a master strategy for thinking about and indeed designing learner activities that will enable learners to experience fulfillment of immediate felt needs, and also map the next related learner behavioral tasks that must be mastered by such learners to fulfill higher level related needs. The immediate fulfillment of perceived learner needs and their related higher level counterparts are viewed as integral components of a master strategy designed to facilitate maximal development of the learner in terms of his abilities and expected performance levels imposed upon him by societal expectations.

The long-range program is viewed first and foremost as an internal prospectus developed by and for use by change agents. It is possible that such a prospectus could be popularized and disseminated to publics.

Three processual tasks are proposed for change agents in designing the long-range program. They are suggestive, and no claim is made regarding their inclusiveness or completeness.

1. *Change agents must specify the macro level needs of their target publics in the content areas within which learner needs have been expressed in agent-leader dialogue. Further, for each macro need delineated, change agents must identify—beginning with the lowest level learner need—prerequisite micro needs in their ascending order that must be successively mastered by learners to exhibit eventually the level of behavior implied in the statement of macro need.*

All needs of man are a part of a related network or hierarchy that may not be perceived by him. His tendency at a given time is to feel or perceive the immediate, based upon his state of socialization, with little or no knowledge about and/or interest in those needs that are outside

his social environment and realm of perception. For example, the immediate perceived need of the disadvantaged homemaker may be to learn how to prepare a cake. The need is immediate, and every effort should be expended in helping her fulfill this need. However, associated with this need may be, and often are, higher level needs.

The learner may have deficiencies with respect to other nutritional needs, such as how to assess nutritive values of various foods in relation to the food needs of her family, how to plan and prepare balanced meals, how to purchase economical foods that will provide a balanced diet, etc. Armed with an understanding of the nutritive needs of people, the change agent sets about to define the ideal "model" in terms of desired learner behavior and skills in nutrition.

Once the ideal behavioral prototype, with respect to nutritional behavior, is established, the change agent defines in sequential order the lower level prerequisite behaviors and skills that must be mastered by the homemaker-learner to attain the ideal behavior. This mapping of behaviors and skills in sequential order—proceeding from the most elementary level to the highest level of complexity and abstraction—in its complete context constitutes the basis for developing a hierarchy of objectives.

This hierarchy makes it possible to start where the homemaker is, in terms of level of knowledge, understanding, and skills, and to plan for her orderly, continuous intellectual growth.

The lack of appropriate attention by change agents to a detailed, thorough, and comprehensive analysis of existing learner behavior and needs in relation to higher level needs that have the potential of becoming intrinsically felt by learners has hampered change agent effectiveness in capitalizing on and sustaining learner motivation. Indeed, many change agents who lack this mental perspective have settled for one-shot learner activities, with little attention to how such activities could be used as a springboard in helping learners attain higher level needs.

Thus it is envisioned that the first component of the long-range program would be a comprehensive treatment of macro needs of learners or target publics, with particular attention being given to the numerous micro needs encompassed within each of the macro needs.

2. *Change agents must formulate for each macro need, macro level objectives, which specify the ideal "desired end in learner behavior" sought in fulfilling macro needs of publics. Desirably, agents would specify for each macro objective, teaching-level objectives that define specific behaviors to be mastered by learners to satisfy micro needs inferred or stated for macro need.*

Macro needs establish the distance or spread that exists between learners' present or existing state of behavior and the ideal state of behavior that has been deduced from research findings and the expectations of society. The spread between these two extreme points may be viewed as a learner need continuum. The most elemental or learner perceived need is inferred on one end of the continuum, with the most ideal nonperceived learner need existing on the opposite end. Interspersed between both points are a number of prerequisite needs that must be fulfilled by the learner to attain the highest level need. The change agent has the responsibility of converting these needs into objectives that clearly specify the behavior that must be attained by learners to fulfill each need. Such objectives should clearly identify the learner, the behavior change desired, and the content area in which the behavior change is to take place.

The change agent should specify for each macro need in the form of an objective the ideal behavior to be sought in given publics. For each macro objective, specific teaching or learner objectives should be formulated in consonance with micro needs. These teaching-learner level objectives should begin with the felt needs of learners and continue with each successful higher level need leading to the macro need. This hierarchy of objectives constitutes a map for the change agent in selecting and organizing learner activities that are purposively oriented and which, if properly implemented, should ensure the continuing intellectual growth and development of the learner(s).

3. *Change agents must outline general educational and instructional strategies for assisting target publics and hence learners in acquiring or attaining behaviors specified in macro and micro objectives set forth in the preceding two processual tasks.*

This processual task provides change agents the opportunity to think about and preferably outline in preliminary form what will need to be done to accomplish each of the macro objectives. First and foremost, attention is focused on the public's state of being in terms of existent behavior and life style(s). Emphasis is given to inhibitors and facilitators of change that may or may not be present. Learning strategies, along with the effects of reference groups and aspects of culture, are taken into consideration in thinking about the change process. The absence or presence of resources that will be needed in structuring and sustaining learner activities for each macro objective is evaluated. Armed with this knowledge, change agents should

project and indeed outline strategies that, if successfully implemented, will result in learner fulfillment of needs defined in the long-range program.

Plans of Work

Implementation of the long-range program requires that carefully designed instructional strategies and plans be developed and effected by change agents. The complexity and interrelatedness of needs outlined in the long-range program do not lend themselves to immediate treatment. Many high level needs require several years of continuous and concentrated effort by change agents before their maximal attainment by learners can be reasonably assured. As indicated in the discussion of needs in the long-term program, the fulfillment of a given macro need may entail the attainment of a number of prerequisite behavioral changes by the learners. Planning for the orderly and effective acquisition of these prerequisite behaviors by learners is a major undertaking that besets the change agent.

For each macro need and, more specifically, the micro needs contained therein, teaching plans must be developed to guide the efforts of the change agent in facilitating learner fulfillment. These teaching plans constitute instructional units tailored to learner needs and objectives. Programmed over a given interval of time, these individual but related teaching plans should aid learners in acquiring the prerequisite behaviors and skills that collectively will enable them to exhibit the macro level of behavior specified in a given macro level need.

The composite of teaching plans tailored to help learners fulfill needs within an interval of a year is commonly referred to as a plan of work in the Cooperative Extension Service. The findings gleaned from change agents' diagnosis of learner needs in the long-range program constitute the basis for designing individual teaching plans and hence the plan of work. For each macro level need, change agents must address themselves to the following questions:

1. What are the specific learner needs encompassed within each macro need outlined in the long-term program?
2. What behavioral change(s) must learners attain to fulfill each of the micro needs contained within the macro needs?
3. What learner activities should be selected and how should they be organized to facilitate learner achievement of the desired behavior?
4. How should learner programs be assessed and what measures should be employed to evaluate learner activities?

The guided efforts of change agents in seeking answers to these questions constitute four processual tasks in developing teaching plans and plans of work.

1. *Change agents must delineate, order and sequence micro needs of learners inferred for each macro need.*

For each macro need there is a multitude of learner micro needs. Change agents must be capable of diagnosing macro needs of target publics and clearly defining micro needs of learner groups that must be satisfied before such subjects can be expected to exhibit the level of behavior inferred as a requirement for fulfilling defined macro needs. Concurrent with this diagnosis and delineation of micro learner needs, change agents must arrange them in a sequential order, starting with the most elemental and proceeding to the highest level and most complex micro level need. The sequencing of related micro needs inferred for high level macro needs will assist change agents in determining the starting point for various learner groups within a given target public, as well as aiding them in planning for their learners' orderly progression to fulfilling successive ascending level related needs. The detailed attention given to this important component of teaching plans will greatly facilitate change agent efforts in formulating for each need appropriate teaching-learner level objective.

2. *Change agents must formulate teaching-level objectives for each micro need inferred or stated for each macro need specified in the long-range program.*

Micro needs define the spread that exists between the learners' present state of behavior and/or skills and the level of behavior thought to be within the possibiliby of learner attainment. This perceived level of attainment in a content area is equated with the change in behavior to be sought by the learner. Hence, the change agent utilizes his understanding of learner needs which have been discerned from actual study of the learner, the cultural heritage of the learner, the expectations of the learner held by his society, and findings advanced by research to specify clearly the change in behavior toward which the learner's efforts are to be directed. This formulation results in the statement of a teaching-learner level objective that, if attained by the learner, should satisfy the need. In stating teaching-learner objectives, emphasis is placed on what the learner is to do. Ideally, well-stated teaching-learner objectives should clearly define the learner, the behavioral change to be sought, and the content area in which the change in behavior is to become operative. Contingent upon the complexity and scope of the micro need, change agents could inceivably formulate more than one teaching-

learner level objective. These objectives, which evolve from learner needs, become the target toward which the change agents' and learners' efforts are directed. They constitute the bases for decisions by change agents concerning the selection and organization of appropriate learner activities in which learners will engage to achieve the change in behavior. Teaching-level objectives are quite specific and within the realm of learner achievement.

3. *Change agents must select and organize learner activities for each teaching-learner level objective that will assure learners' attainment of the behavior specified in the objective.*

Having accomplished the crucial task of identifying the specific behavioral changes to be sought in the learner in teaching-learner objectives, the change agent should turn his attention to planning for their attainment. Emphasis on intended alterations in the behavioral patterns of a given target public with defined needs (micro) focuses on the learner as the chief component of the change (educational) effort. In analyzing the present competencies of the learner in relation to intended changes in behavior, the change agent considers those experiences that will result in maximum attainment of the behavior. Taken in this light, the change agent is less a purveyor of information than a strategist who designs environments (situations, events, activities) in which learners are afforded opportunities to experience certain effects. It is the active interaction between the learner and the structured situation—on a mental and/or physical level—which results in content being assimilated by the learners. Thus, learning experiences are not what the change agent does; they are not what appears in a teaching plan; they are not the facilities, devices, or techniques used. Learning experiences are what the learner actively interacts with, physically and/or mentally, as a result of his participation in the learning process. The change agent's role is thus to structure an environment in which the desired reactions can and will be forthcoming from the learner.

The design of learning experiences takes its cue from the teaching-learner objectives to be attained. Learners must be afforded opportunity to practice the behavior specified in the objective. They must be afforded opportunity to experience feedback in terms of the success of their efforts in achieving the behavior described in the objective. Equally important is to provide learners the opportunity to associate that which they are attempting to learn with ideas, events, or notions with which they have had some prior experience. In designing learner experiences, change agents should keep in focus the fact that most learners will have to be afforded opportunity to relearn or rearrange much of which they already have as part of their life styles.

In designing learning experiences, three important criteria will need to be utilized in organizing the experience to ensure continuous maximal growth on the part of the learners. Specifically, the experience will need to be organized to provide the learner several opportunities to practice and try out the new behavior. Second, consideration will have to be given to organizing the experiences in a manner that will permit the orderly progression of the learner from the acquisition of simple to more complex behaviors in a given content area. This concept of sequence in organizing learning experiences is consistent with the need to make provisions for learners to achieve continually higher level related needs, as pointed up in previous discussion of macro and micro needs. A third element or criterion to be considered in organizing experiences for the learner is to make provision for learners to perceive relationships between that which is being learned and other situational contexts.

4. *Change agents must plan for the assessment of learner progress in achieving the behavioral outcomes specified in each teaching-learner level objective and rigorous evaluations of learner activities provided them in helping them acquire the intended changes in behavior.*

A teaching plan is not complete until plans are formulated for assessing learner progress in relation to behavioral changes specified in objectives and the teaching-learner efforts expended in achieving such changes. Actually, evaluation begins in the formative stages of a teaching plan and extends throughout its development and implementation. For example, decisions about teaching-learner objectives require evaluative judgments. So do the selection and organization of learner activities that will help attain the desired objectives. These evaluations are the preliminary and intermediate stages of evaluation.

Here a problem arises. The criteria used to check learning activities are general principles, not highly precise statements of the exact conditions likely to encourage the learning desired. Furthermore, any set of learning activities (experiences) must be measured against a number of criteria. Since each of these can only be approximated, one cannot predict with perfect accuracy that certain learner activities will actually produce desired results. In addition, the actual teaching-learner process involves many variables, including differences in individual students, the environmental conditions in which the learning takes place, the change agent's skill in setting the conditions as they are planned, and the personality of the change

agent. These variables make it impossible to guarantee that the actual learning experiences (activities) provided for are precisely those that are outlined. It is important to check carefully whether or not the plans for learning experiences and activities actually function to guide the change agent in producing the outcomes desired. For these reasons, continual evaluation is imperative throughout the development of the teaching plan, with the primary focus on the degree to which the teaching-learner level objectives of the plan are being attained.

There are essentially three aspects of evaluation with respect to teaching plan objectives:

1. Evaluation must appraise the behavior of the student, since the objective(s) of a given teaching plan is to change his behavior.

2. Evaluation must be made at initial and succeeding stages to identify changes. A teaching plan cannot be evaluated by assessing the student only at the end of the plan. Without knowing where he was at the beginning, it is impossible to determine the scope or degree of change in his behavior.

3. Appraisals made during or at the end of the plan are not a sufficient basis for an educational evaluation because some of the desired objectives may be attained only temporarily. Responses can be learned, then rapidly forgotten. To have some estimate of the permanence of the learning requires another point of evaluation some time after the instruction has been completed. Hence, there is need to plan for follow-up studies of learners in order to obtain evidence of the permanence (or impermanence) of the learning acquired in the program.

Plans should be made to utilize the findings of such evaluative studies to adapt and/or redirect teaching plans as warranted. Slight changes in teaching plans may improve considerably the output, namely, changes in learner behavior.

In retrospect, plans should be developed to assess learner activities and other inputs to determine whether or not they are contributing to learners' achievement of the teaching-learner objectives. From the very beginning, plans should be made and effected to ascertain the degree to which learners modify or change their behavior as specified in the objectives. These plans should make provision for evaluation of learners before, during, and following their actual participation in a teaching-learning situation. Last, but not least, these findings should be utilized to redirect and/or adapt teaching plans to improve the quality of the product, namely, change in the behavior of learners.

Activating Plans of Work

The actual implementation of teaching plans is a crucial task that confronts change agents. Teaching plans are useless unless they are implemented. The techniques of activating a teaching plan(s) require excellence of change agents in mobilizing, developing, and utilizing resources required to implement and carry through on learner activities; effective and constructive monitoring of the teaching-learning process; the meaningful utilization of opportunities to reinforce learners; and being sensitive to the need for and a willingness to redirect learners' activities if observations and feedback infer the need for such action. Operationally, four elemental, but important, processual tasks may be inferred for change agents in activating plans of work.

1. *Change agents must identify, mobilize, develop, and utilize resources needed to implement and carry through effectively on planned learner activities enumerated in teaching plans and plans of work.*

The effective implementation of specified learner activities may require the utilization of several kinds of resource people. The nature of the learner activity will dictate the kinds of resource competencies needed to plan and implement the activity. Particular attention must be given to identification and recruitment of appropriate resource persons (*i.e.*, volunteer leaders, teacher aides, other professional personnel). A special attempt needs to be made to help these resource persons acquire a thorough understanding of what will be expected of them in following through on the planning and implementation of a designated learner activity. Technical training in content and teaching-learning strategies and methodologies must be provided those who are responsible for specific learner activities. Too, opportunities must be provided for continual reinforcement of such resource personnel.

Plans also will have to be made to acquire the kind of literature and other resources needed to implement learner activities. Such teaching-instructional aids must be tailored to the specific situation.

2. *Change agents must make provision for the continuous monitoring of planned learner activities.*

The activation and continual renewal of learner activities especially selected and organized to produce desired learner outcomes is a crucial element of the change process. Change agents should adopt as part of their role the responsibility for and commitment to periodically monitoring and examining on-going

learner activities. Such monitoring must be constructive and purposive. Particular emphasis should be given to an examination of opportunities being provided for learner involvement and interaction with the content as well as the extent to which learners are being afforded the opportunity to practice the new behavior delineated in the objective(s). Another relevant point of observation is that of trying to obtain a perspective of teacher behavior in providing for continuous learner reinforcement.

The ability of resource persons to deliver should be kept under constant surveillance. Too, the relationship between teachers and learners should be continually examined.

Findings obtained in the monitoring of learner activities should be tactfully shared with responsible persons. These findings should be used to improve the quality of learner activities.

3. *Change agents should provide for the continuous reinforcement of learners.*

Motivation is the key to an individual's continued persistence in expending effort to acquire new behavior. A major factor in motivating learners is that of systematically and deliberately providing them with feedback on the progress they are attaining in accomplishing their objectives. This important requirement for learning should not be left to chance. Rather, change agents with their resource personnel should plan for a reward system that will provide instant, continuous feedback to learners. Such a reward system may need to be tailored to the individual learners, since learners' abilities and needs vary. The use of covert and overt rewards should be planned for, depending upon the learner and his situation.

4. *Change agents must maintain a continuing sensitivity to the need for and a continuing willingness to adapt and/or redirect learner activities as observations and feedback infer the need for such changes.*

The need for adjustments or adaptations in learner activities is of crucial importance in facilitating the learning process. Rarely, if ever, do change agents and their resource personnel implement learner activities as actually planned. Because of the complexity of human behavior and the multitude of variables involved, change agents need to provide for flexibility in learner activities so that needed adjustments can be effected.

Change agents and their leader resource personnel must make observations of learner activities continuously, so that needed revisions can be made. Hence, it is imperative that change agents and leaders possess a thorough understanding of their learners, the situation with which such learners are confronted, and the teaching-learning process in order to make objective observations about what is happening to the learner.

PROGRAM EVALUATION AND ACCOUNTABILITY

A major challenge confronting the educational institution is that of determining the impact of its planned programming efforts in effecting desired behavioral changes in its publics. The total system and its individual subsystems must be continually sensitive to and committed to the concept of accountability. To achieve this end every subsystem within the organization must perfect and utilize tested and valid methods for pinpointing evidences in relation to their program objectives and for collecting such evidences. Although all subsystems (job groups) in the organization or institution have strategic roles to perform in overall institutional program evaluation, the major responsibility for basic program evaluation rests with the county and/or area operational units. That is, the results obtained through county-based programs, plans of work, and teaching plans must be determined before judgments can be rendered about the effectiveness of the institution's overall program effectiveness. Supporting specialized and program subsystem staffs can and should reinforce county and/or area staff members' program evaluation efforts by helping them identify and specify types of evidences to be sought in their respective content areas and in developing valid and reliable tools of measurement to be utilized in collecting and interpreting evidence(s) in relation to teaching-learner objectives and long-term program objectives. Theoretically, judgments rendered about the effectiveness of the total institution in accomplishing its macro program objectives should represent the summed evaluative findings gleaned from long-term programs and plans of work developed and effected at its county and area operational unit levels. The specificity of evidences in relation to levels of objectives and the preciseness of measures developed for collecting such evidence will determine to a great extent the institution's capability in assessing its overall program impact.

Since the major responsibility for program evaluation rests with change agents at the operational level, they must be thoroughly equipped with and skilled in the use of evaluative tools that will facilitate continuous evaluation of program outputs and inputs in relation to teaching-learner level objectives and to relate these findings to the macro objectives of their long-term

programs. Their program counterparts at higher levels of the institution must be capable of relating and interpreting these results to the institutional program objectives. Further, these higher level program counterparts must be knowledgeable about and highly proficient in teaching their operational level program counterparts at county and area levels how to detect, discern, and evaluate program results and how to construct and utilize various measurement instruments.

From an operational context, three major processual tasks are inferred for change agents and their specialized supervisory program counterparts in program evaluation and accountability. These tasks are suggestive and are advanced as a framework for guiding the thoughts of professionals in thinking about program evaluation and accountability.

1. *Change agents must specify program outputs (evidence) in relation to teaching-learner level objectives. Desirably, change agents should be assisted by their supervisory and specialized program counterparts in specifying evidence(s) to be obtained to verify successful attainment of ascending higher level related teaching-learner level objectives. Change agents, supervisory, and specialist program personnel must acquire skill in relating evidence obtained about the attainment of teaching-learner objectives at the teaching plan and plan of work levels to long-term program objectives and subsequently macro institutional objectives.*

Outputs (evidence) for teaching-learner level objectives must be identified in order to make informed judgments about their successful attainment. This task is the primary responsibility of change agents at the level at which the actual teaching takes place. However, supervisors and specialists can be valuable resource persons to the change agents in specifying and pinpointing such evidences. These outputs may be increased knowledge, changed attitudes, and/or the acquisition of new skills by learners. Another level of program output may be the extent to which certain practices have been adopted. These behavioral outputs may be both overt and covert. That is, some outputs may be observable and measurable while others may only be inferred.

In determining program outputs, change agents and their supervisory-specialist program counterparts must consider the validity and reliability of evidence(s) used to verify successful attainment of specified objectives. Likewise, change agents need to examine initial and subsequent measures in determining program outputs. Follow-up studies on learner participants may be helpful to change agents in ascertaining the degree of the permanency of changes in learners.

Ideally, sequenced teaching-learner level objectives in a content or macro need area and their outputs should be additive in nature. That is, the outputs of sequenced teaching-learner objectives within a need area should contribute to the major program outputs specified in the long-range program objectives. Likewise, these major program outputs should contribute to the overall institutional outputs specified in the institutional objectives. This concept of hierarchy of objectives is important for the large decentralized educational system, such as the Cooperative Extension Service. It is possible for subsystems in an educational institution to produce outputs which do not contribute to the macro objectives of the total organization. Thus, it is essential that means be devised for examining outputs in relationship to the organization's hierarchy of objectives.

In addition to determining the major program outputs and their hierarchial nature, change agents, assisted by their supervisory and specialist program counterparts, need to make judgments, relative to the appropriateness of outputs in meeting needs. After careful examination, they may conclude that the outputs produced do not contribute to fulfilling the needs that have been identified in teaching plans and planned long-term programs.

2. *Change agents, assisted by their supervisory and specialist program colleagues, must study, analyze, and evaluate program inputs at the instructional, program, decision-making, and institutional levels in relation to their appropriateness and effectiveness in generating desired program outputs specified in teaching-learner level objectives, long-term program objectives, and institutional, macro level objectives.*

The actual program outputs are rarely if ever the same as those intended or desired. There are numerous variables that cannot be completely controlled; hence the actual outputs may vary from those intended. Some of these variables may be referred to as program inputs. One major program input focuses on the macro institution, including its structure, management processes, and programming processes. Other program inputs include such variables as the adequacy of the linkages effected between the institution and its target publics to identify needs; the adequacy and accuracy of the long-range program in reflecting the felt and analyzed needs of target publics; the specificity and clarity of objectives in relation to learner needs at all levels; time; leaders; materials and supplies; learner participants; the reliability and validity of factual information; and numerous others. Change agents need to examine the outputs in relation to the actual program inputs so

as to understand these variables better and hence be in a better position to revise the input-output system.

The interaction between program inputs at all levels of the system have an important bearing on program outputs. The dynamics of such program inputs as leader identification, training, and utilization; decision-making; social action; planning and the design and implementation of teaching-learning activities may be major determinants in the teaching-learning process. A thorough understanding of the dynamics of these inputs (activities) may help change agents to understand why certain program outputs were realized. If the crucial points in those program inputs and their packaging and delivery can be identified for both successes and failures in regard to program outputs, change agents will have a better understanding of the outputs achieved and how to modify those types of inputs to produce more desirable outputs.

3. *Change agents, supervisors, specialists, and administrators must exhibit skills in interpreting results or program outputs in relation to objectives and inputs and in the actual utilization of these findings as a basis for modifying and/or redirecting program efforts, renewal of institutional structures and management processes, and in accounting to their publics, funding sources, and to their profession.*

The continuous evaluation of its programs in relation to results attained or being attained is of first priority to the Extension system. There are several reasons for engaging in program evaluation; however, a major reason is to use these evaluative findings to modify, revise, and/or redirect program inputs for present or future program cycling. These findings may reveal that the objectives need clarifying, or that the needs of target publics require further amplification, or that more time is needed, or that the teaching-learner strategies need to be changed and/or modified.

A second major use of program evaluative findings is to examine the viability and effectiveness of the total institution. The renewal of the system (institution) in terms of structure and key management processes may be necessary in order for effective fulfillment of its mission. Change agents, supervisors, specialists, and administrators have complementary roles to perform in accomplishing this on-going task.

The accurate reporting of program results is of a continuing nature. Extension's public must be continually apprised of the successes and failures of the system. This is particularly true of the learners, leaders, systems, and other key publics. In addition, means must be devised and implemented for reporting program results to the system's funding agencies. Extension must be continually cognizant of its mission and its responsibility to the public domain. That is, the Extension system must ever be prepared to account to its legislative bodies for its programs and to justify the confidence and support accorded it by these law-making and policy-formulation groups. In maintaining and improving the standards of the profession, it is imperative that professional educators throughout the system continually examine the results of their efforts in relation to the expected roles of professional adult education change agents.

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