

AGRICULTURAL MECHANICS AT THE SECONDARY
SCHOOL LEVEL IN GHANA

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CHAPTER I

INTRODUCTION

The Republic of Ghana is situated in the west part of Africa between latitudes $4^{\circ}4'$ north and $6^{\circ}30'$ north of the Equator and also between longitudes $1^{\circ}12'$ east and $3^{\circ}15'$ west of the Greenwich Meridian. It is bounded on the east by Togoland and on the west by the Ivory Coast. On the north lies Upper Volta, and on the south lies the Gulf of Guinea, which is part of the Atlantic Ocean (Figure 1).

The total land area of the country is about 92,100 square miles. From the south up to the northern border is about 420 miles, and the widest part between the east and the west boundaries is about 334 miles. The land, which is divided up into nine political regions, is currently inhabited by a population of about 12 million people.

Due to warm temperatures all year round and an adequate amount of rainfall over a greater portion of the year, about 75,000 square miles, or 48 million acres of the land, are suitable for agriculture. Currently, over 50% of the total labor force of the nation is engaged in farming. However, due to ignorance, high level of illiteracy, and poor rigid traditional farming practices among the local farmers who happen to own most of the farm lands, the rate of food production in Ghana is very low compared to the rate of population growth.

Mechanized agriculture with the use of modern farming techniques which could ease the food production problem in the nation forms very

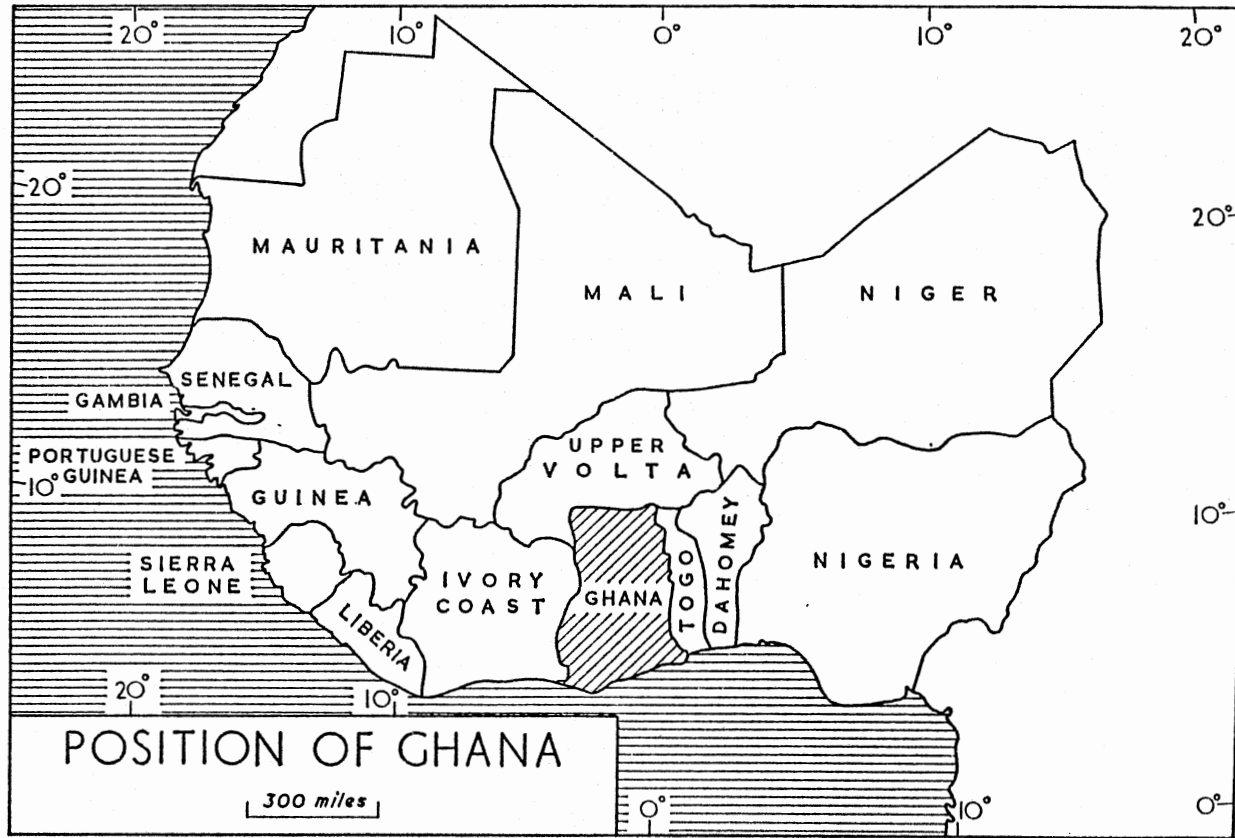


Figure 1. Position of Ghana in West Africa

little or no part of the farming styles practiced by the majority of the farmers. Instead, human labor, with its low efficiency as a source of farm power, continues to be the most widely used source of power for agricultural production in Ghana. As a result, there is always insufficiency of food, undernutrition, and malnutrition among the population.

The high level of illiteracy, coupled with ignorance, among most of the farmers almost absolutely limits their ability to understand and to adopt modern techniques of mechanized agriculture taught occasionally to them by the Extension Division of the Ministry of Agriculture. Surprisingly enough, a great number of the farmers have many teenage sons and daughters in secondary or high schools all over the country, and these parent farmers pay heavy sums of money every year for the schools to provide secondary school education for the students.

Ghanaian Secondary School Educational System

All secondary schools in Ghana run a minimum of five years' program and each one consists of at least five stages, commonly referred to as "forms." The first year is Form 1, the second is Form 2, the third is Form 3, the fourth is Form 4, and the fifth is Form 5. A number of the schools, upon the approval of the Ghana Education Service, operate an additional two years' program, commonly known as the 6th Form, and those two years are distinguished from each other as "lower 6 and upper 6." Students are mostly admitted into the secondary schools at the end of their 8th or 9th year of the regular elementary school education. Very few secondary schools accept candidates who have completed all 10 years of elementary school education, because

by then they would be about 16 or 17 years old and are considered too old to begin secondary school. In isolated cases candidates who have gone through accelerated primary or elementary school programs may enter secondary school after the 7th year. In all cases, candidates must pass a common entrance examination in order to be admitted into the secondary schools.

During the first three years of secondary school, students study all the secondary school subjects, which may number up to nearly 20. For the final two years of the five year program, or at the beginning of the fourth year, students choose a minimum of six and a maximum of nine subjects from any four specified groups of subjects. They study only those selected subjects throughout Forms 4 and 5 and, in the end, take the final examinations; namely, the School Certificate or General Certificate of Education (G.C.E.) "ordinary level" examination conducted by the West African Examinations Council. Those who want to do advanced secondary school studies and are able to achieve good grades at the ordinary level examination enter the 6th Form and, in the end, sit for the G.C.C. "advanced level" examinations before entering the university.

Agriculture is one of the major subjects taught in the secondary schools of Ghana. Yet, even after five years of secondary school study of the subject, the students have very little or nothing in terms of practical agricultural knowledge to contribute to their parent farmers on the farms during holidays. Those who even choose to be farmers later after school also tend to have no other choice but to join and continue the old non-efficient traditional methods of farming.

Statement of the Problem

The problem is that the five year secondary school agricultural program in Ghana is too much theory and too little practical. The program is very deficient in agricultural mechanics, the subject which could have a greater impact of application on the farm and in the home. Following this kind of program of instruction, students are trained in such a manner as to enable them to acquire as much theoretical knowledge as required. Evidence of this can be seen from a copy of the agricultural science syllabus used in Ghanaian Secondary Schools (see Appendix A), and a sample of the kind of examination questions which candidates answer in the School Certificate or G.C.E. "ordinary level" examinations (see Appendix B).

Purpose of the Study

This study is undertaken for three major purposes:

1. To determine the present status of agricultural mechanics in Ghanaian Secondary Schools.
2. To determine the need for the development of more practical and productive agricultural mechanics skills among students of Ghanaian Secondary Schools.
3. To use the opinions of the school heads and agricultural science teachers to determine the extent of teaching emphasis needed for the schools in selected agricultural mechanics areas with feasibility of teaching those areas implied.

Objectives of the Study

In order to fulfill the purpose of the study, the following objectives were set:

1. To review the G.C.E. "ordinary level" agricultural science syllabus published by the West African Examinations Council and used in the secondary schools of Ghana.
2. To find the average student population of the schools, the number of agricultural science teachers, and the most common occupation practiced by the majority of the students' parents.
3. To determine the land sizes of the schools, the percentage used for the school compound, the percentage for agricultural teaching purposes, and the percentage for food crop and/or livestock production for use in the schools' kitchen.
4. To determine the average number of students who complete Form 5 each year in the schools and what percentage of them attempt agricultural science in the final examinations.
5. To determine what sources of power, tools, and equipment are used for agriculture in the schools and the extent to which they are used.
6. To determine how skillfully prepared the students are for mechanized agricultural work during and after school.
7. To determine whether agricultural mechanics should receive more attention in the schools.
8. To develop a list of topic areas that could be included in agricultural mechanics programs in Ghanaian Secondary Schools, based on the extent of emphasis needed.

Scope and Limitations of the Study

1. This study was limited to the secondary schools of Ghana, West Africa.

2. This study was also limited to Forms 1 to 5 of the schools. Those forms constitute the completion of the five years of basic or ordinary level of secondary school work in Ghana, even though some of the schools have two years of Form 6 for advanced studies.

3. Only the school heads (administrators) and their agricultural science teachers responded to the questionnaires on the study.

Definitions of Terms

West African Examinations Council - This is a board of personnel from the five English speaking West African countries, namely Liberia, Ghana, Nigeria, Sierra Leone, and Gambia; and from the United Kingdom in charge of the handling of all major educational examinations among those nations in West Africa.

School Certificate - This is the diploma awarded to Secondary School graduates in Ghana. The comprehensive examination leading to the award of the diploma is the School Certificate Examination. Secondary School candidates taking the examination have to enter a minimum of six subjects and a maximum of nine for the ordinary level; a minimum of three and a maximum of five for the advanced level.

General Certificate of Education - This is often shortened as G.C.E. and it is similar to the school certificate except that it is opened to the public and candidates can enter any number of subjects but not exceeding nine.

Ordinary Level - The ordinary level of the School Certificate and the G.C.E. examinations evaluates candidates on the knowledge they are supposed to have obtained in a five year secondary school education or its equivalent.

Advanced Level - The advanced level of the School Certificate and the G.C.E. examinations evaluates candidates on the knowledge they are supposed to have obtained in a two year advanced secondary school education beyond the ordinary level.

Ministry of Agriculture - This is the branch of the Ghana government responsible for the nation's agricultural development.

Agricultural Mechanization - This is the replacement of primitive, traditional methods of farming with modern techniques involving the use of machines.

CHAPTER II

REVIEW OF LITERATURE

Introduction

For the purpose of the study, and especially this chapter, various important and related material was reviewed. These included literature on agricultural mechanics, secondary school agriculture, agriculture in Ghana, Ghanaian Secondary Schools' educational system, and their agricultural science program.

Meaning of Agricultural Mechanics

Agricultural mechanics, or "farm mechanics," as it is commonly known, has been defined in the Oklahoma Vocational Agriculture Notebook, Agricultural Mechanics I (6, p. AgM-5-A), as "all the unspecialized mechanical activities performed on the farm and in the home." The same meaning is shared by many other authors on the subject, including Phipps et al. (8) and Cook (3). However, in Methods of Teaching Farm Mechanics (5, p. 2), it is defined as "all of the unspecialized and many of the more specialized mechanical activities needed on the farm and in the home." Morford (5) goes further and names five major areas of instruction generally considered in agricultural mechanics as: 1) farm shop work, 2) farm power and machinery, 3) farm buildings and conveniences, 4) rural electrification, and 5) soil and water management. With these topic areas in view, perhaps a more

appropriate meaning of agricultural mechanics may be considered with what Phipps (7) gives as a subject containing all the necessary instructions that seek to develop the mechanical abilities of students in performing agricultural shop activities; in operating, maintaining, repairing, and adjusting farm machinery; in constructing and maintaining farm buildings; in installing and maintaining farm electrical systems; and in performing the mechanical activities in soil and water management programs.

Importance of Agricultural Mechanics

"With the increasing mechanization of farming, a farmer cannot be a success unless he possesses considerable mechanical knowledge and skill" (8, p. 14). Cook (3) lists a number of advantages of agricultural mechanics, including the following purposely to the benefit of the student:

1. It provides training in the skills that are necessary to do the needed farm mechanics jobs on the farm.
2. It gives students an opportunity to do purposeful thinking as well as to use their hands.
3. It provides work (job opportunities) for the individual needs of the boy (student) (pp. 273-274).

In view of the few advantages described above and considering many that can still be available to the farmer as well, agricultural mechanics is undoubtedly of great importance to every nation which depends on agriculture for its economic development and must therefore be to Ghana, and the secondary school therein.

Objectives of Agricultural Mechanics

Many authorities in the field of agricultural mechanics share

similar views on the objective of the subject. The following are a few of the most common ones shared by Phipps et al. (8) and Morford (5):

1. To help the student discover his farm mechanics aptitudes.
2. To develop basic skills in farm mechanics.
3. To provide opportunities for learning by doing.
4. To develop self-confidence in performing mechanical operations.
5. To understand the underlying principles of mechanical processes (Phipps et al., p. 15).

Teaching Agricultural Mechanics in Secondary Schools

Guiding Concept

In his bulletin, Teaching Agricultural Mechanics, Hill (4) discusses 12 guiding concepts in teaching agricultural mechanics to serve as guides in planning and developing the course of study and teaching the subject. He urges, among those 12 guidelines, that "Agricultural mechanics instruction must be an integral part of the vocational agricultural program" (p. 3). He stresses that "it is a part of instructional programs in agricultural education for pupils and young farmers served by the secondary school" (p. 3), and that the subject "is included in or has content that parallels the instruction in agricultural subjects" (p. 3).

Course of Study

Hill (4) makes a very important statement regarding the course of

study for agricultural mechanics. Beginning the discussion on that, he reminds his readers about the aim of agricultural education in the secondary school, that is, to provide pupils or students with training in agriculture. Having hit the word "training," Hill proceeds to state the points to consider in determining the course of study for agricultural mechanics in the secondary school. He reminds his readers that "a training program must be built on the knowledge, attitudes, and skills needed to perform the work of an occupation" (p. 6), and he continues his discussion by stating that,

The starting point for planning a course in agricultural mechanics is an analysis of the mechanical aspects of farming into the abilities needed by an operator. An educational or training program must be organized in terms of what the pupils already know, readiness of the pupils, opportunity to learn, and logical sequence. This applies to agricultural mechanics instruction as well as to other phases of agriculture (p. 6).

Content of Course

Phipps (7) outlines a number of factors that must be considered in determining what the course content for agricultural mechanics should be. He points out for the teacher to consider: 1) how long the class period will be, 2) the number of periods to be devoted to the subject each week, and 3) how many years will be devoted to the subject. He goes on to point out that 4) the needs of the student and the community should be taken into account, and 5) the instructor's qualifications should be considered.

Evaluation

Evaluation is an essential aspect in every teaching and learning

situation. According to Phipps (7), it helps students to see their mistakes and stimulates efforts towards objectives. It is also valuable to the teacher because it helps him to discover the strength and weakness of his instruction. Evaluation of agricultural mechanics programs can be done through examinations, checking student notebooks, and assessing completed projects. In the process, Phipps (7) suggests a number of items to evaluate and these include accuracy and completeness of planning, choice of suitable materials, type of project, quality of workmanship, skills developed, amount of work done by student, selection and use of tools and equipment, the usefulness of the project, and the students' ability to solve problems.

Agriculture in Ghana

Agriculture, which forms the backbone of Ghana's developing economy, also provides the most common and widespread occupation for the people of the country. According to Boateng (1), a professor of geography in one of the Ghanaian Universities, it occupies over 70% of the entire working population. From this evaluation, it is obvious that the farming methods are still primarily of the peasant type when compared to the farming practices of nations like the United States. The majority of the farmers still apply human labor to cutlasses or machetes, hoes, and axes to clear the heavy forests during the farming season. The land, in most cases, is not loosened up by any effective plowing means before planting is done. In isolated cases hoes are used to break the soil surface to heap up the top soil into small mounds for planting food crops such as yams, cassava, and sweet potatoes. In farming areas, especially where the land is being

cleared for the first time, very little or no efforts are made to get rid of the heavy stumps that may remain on the land after the trees are cut down, and according to Boateng, the farm usually has an untidy appearance.

In 1949, mechanized farming was started on an experimental basis at Damongo by the government. Boateng (1, p. 75) mentions that "the experiment met with only qualified success" and blames this limited success largely on social problems. It is very uncommon to find agricultural mechanization activities on the local farms. Even since Ghana became independent in 1957, most of all the mechanized farming that had been tried is by the government and the University of Ghana on its experimental farms. The masses of youthful teenagers in the numerous secondary schools are not involved in any active agricultural mechanization activities in school, and yet only a small fraction of them make it into the universities. Besides, not all those who make it there go to study agriculture.

Agriculture in Ghanaian Secondary Schools

In the regulations and syllabi published by the West African Examinations Council (10) for the 1980 joint examinations of the School Certificate and the General Certificate of Education, the secondary school agriculture is under the title of agricultural science. Forms 1 to 5 of the secondary schools are supposed to study what is described as the "ordinary level" of the subject for their examination (see Appendix A).

For the purpose and convenience of the examination, the students are supposed to study agricultural science under four broad sections.

Section A of the subject as shown in the syllabus deals with introduction to agriculture, and under this section students are supposed to know, before the final examination, the meaning and importance of agriculture, general principles of land use, agricultural systems, agricultural development, uses of simple farm tools and agricultural machinery, climate and its effect on agriculture, and the use of agricultural and forest products and their by-products. Under Section B, which is soil science, students study soil formation and properties, soil and water conservation, and soil fertility. Section C contains what should be studied under crop science, namely a review of plant study, annual and perennial crop plants, pastures and forage crops, crop improvement, weeds, crop diseases, and pests. Finally, Section D is on animal science. It outlines such topics as: a review of animal physiology in relation to agriculture, farm animals, animal nutrition, reproduction, improvement, diseases, pests, and parasites.

It is evident from the above review of the agriculture taught in the secondary schools of Ghana that, of all the areas of agricultural mechanics instructions shown under the contents of Farm Mechanics by Phipps et al. (8), only simple farm tools and agricultural machinery, plus soil and water conservation, are superficially covered during all the five years of Ghanaian secondary school agriculture.

In the area of practical agricultural science, the syllabus (see Appendix A) contains the following for the students to know before going for the practical part of the entire final examination:

1. Recognition of soil samples, types of rocks, types of fertilizers, and manures. It includes soil acidity tests and a description of soil profile.

2. Recognition of parts and whole of crop plants and farm animals studied.
3. Recognition of main pests of crops and their damaging effects.
4. Recognition of seeds and fruit structure.
5. Recognition of common hand tools, their uses, and maintenance.
6. Recognition of animal feed-stuffs.
7. Recognition of main ecto- and endo-parasites of farm animals.

Again, it can be seen that even the practical side of the subject in the school has to do mostly with theoretical knowledge reinforcement rather than skills development.

Some Weaknesses in the Agricultural Science Program in Ghanaian Secondary Schools

Ghana is a developing nation and, like many other such nations, the agricultural program in its educational institutions such as the secondary schools face a lot of weaknesses which limit their ability to play any role in the nation's agricultural development. In their book, Education to Feed the World's Hungry, Casey and Price (2) outline some of these weaknesses found in educational institutions of most developing nations. Those that apply to the situation in Ghana include:

Little or no involvement of the college or school in the nation's efforts to substantially improve agricultural production or rural development. The potential role of the institutions in agriculture is either not recognized or assigned a low priority (p. 64).

As mentioned above, the secondary schools in Ghana follow a kind of agricultural program which mostly prepares the students to pass the School Certificate or General Certificate of Education examination. It is only during military takeover of the government that the army usually forces the schools to make large farms to produce some of the food required to feed the students. Under such pressures the students may then be made to clear some of the fallow lands of the schools to produce food crops. Otherwise, it is the Ministry of Agriculture that shoulders the burden of almost all the efforts required to produce food to feed the nation.

Casey and Price (2) further state that

Quite often the college or school tends to perpetuate, rather than dissipate, the philosophy that 'working with the hand' or manual labor is beneath the dignity of the truly educated person. To engage in activities which might involve field contact with the soil or with animals is, in many cultures, considered inappropriate for the educator (p. 64).

This is a common notion developed among students of most Ghanaian institutions, including the secondary schools. In many cases students, especially those in their fourth and fifth years of secondary school, are reluctant to get involved in any farm work that requires the use of manual labor and hand tools. This has been so because traditionally the hard labor work in most Ghanaian educational institutions has always been done by the students in their first or early years. Quite often too, work such as land clearing is given as punishment to students for a committed offense and the students do it with great ill feeling. No skills are developed in the process and students reach their final years not willing to indulge in any agricultural activity except what will help them pass their final examination.

Conclusion

Considering what agricultural mechanics has to offer as shown under the meaning, importance, and objectives at the beginning of this chapter, Hill (4) can only be supported in his statement that the subject must be an integral part of the vocational agricultural program. In view of the need for improving Ghanaian agriculture and the resources available in Ghanaian Secondary Schools, the researcher wishes to emphasize that it is time that agricultural mechanics received more attention in the agricultural science program in the secondary schools of Ghana.

CHAPTER III

DESIGN AND PROCEDURE

Introduction

The design of the study was dictated by the purpose and objectives specified in Chapter I, and the procedure followed was determined by considering the best and most effective means to reach the population chosen for the study.

Population of the Study

Three representative secondary schools were chosen from each of the nine regions of Ghana, making a total of 27 schools. The headmasters/headmistresses and agricultural science teachers of the schools were requested to respond to instruments of questionnaire which were mailed to the schools. Out of the 27 schools, 25 of them (about 92.59%) responded. This consisted of all three representative schools from each of seven regions and two schools from each of the remaining two regions (Table I).

A map showing the nine regional divisions of Ghana and the locations of the towns where the representative schools were chosen may be seen in Figure 2.

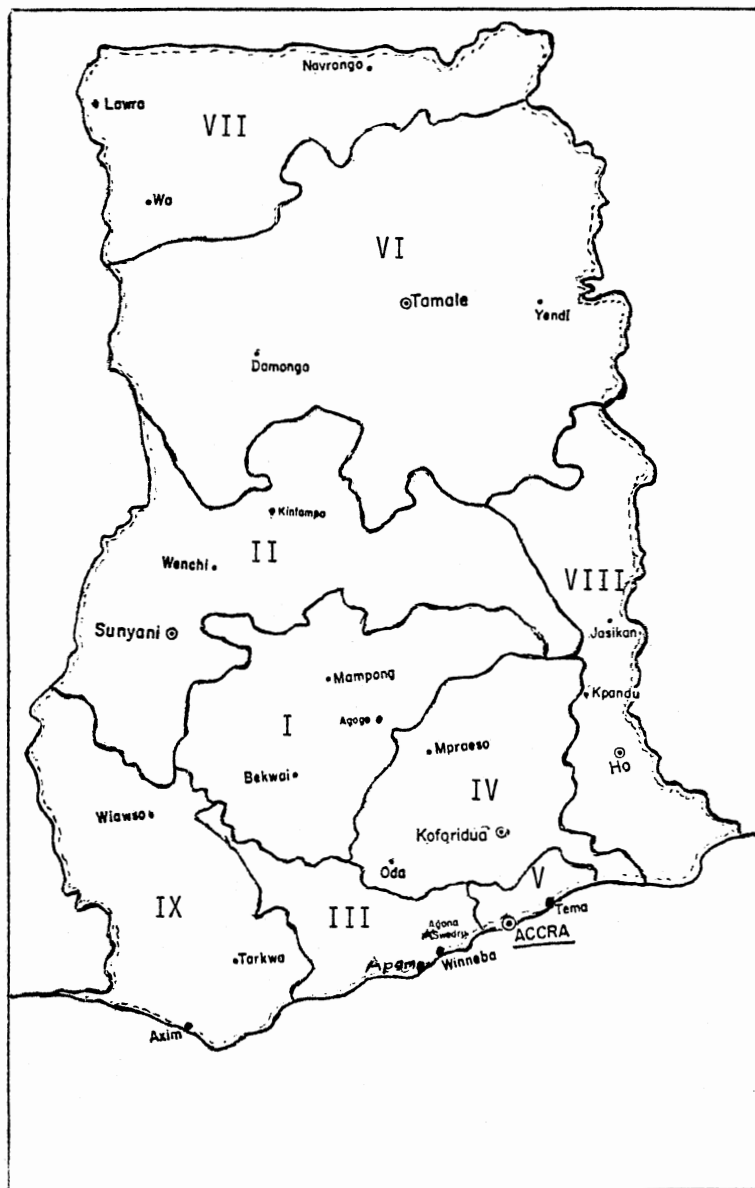
Instrument

The instrument used to obtain the information needed for this

TABLE I
LIST OF REPRESENTATIVE SCHOOLS

Region	Name of School	Town of Location
I - Ashanti	1. Agogo State Secondary	Agogo
	2. Amaniampong Secondary	Mampong
	3. Seventh Day Adventist Secondary	Bekwai
II - Brong Ahafo	1. Kintampo Secondary	Kintampo
	2. Sunyani Secondary	Sunyani
	3. Wenchi Secondary	Wenchi
III - Central	1. Apam Secondary	Apam
	2. Swedru Secondary	Agona Swedru
	3. Winneba Secondary*	Winneba
IV - Eastern	1. Ghana Secondary	Koforidua
	2. Mpraeso Secondary*	Mpraeso
	3. Oda Secondary	Oda
V - Greater Accra	1. Accra High School	Accra
	2. Achimota Secondary	Accra
	3. Tema Secondary	Tema
VI - Northern	1. Damongo Secondary	Damongo
	2. Ghana Secondary	Tamale
	3. Yendi Secondary	Yendi
VII - Upper	1. Lawra Secondary	Lawra
	2. Navrongo Secondary	Navrongo
	3. Wa Secondary	Wa
VIII - Volta	1. Bueman Secondary	Jasikan
	2. Kpandu Secondary	Kpandu
	3. Mawuli Secondary	Ho
IX - Western	1. Asankragwa Secondary	Asankragwa
	2. Axim Secondary	Axim
	3. Tarkwa Secondary	Tarkwa

*Schools that failed to respond.



Key:

- | | |
|--------------------------|----------------------|
| I - Ashanti Region | VI - Northern Region |
| II - Brong-Ahafo Region | VII - Upper Region |
| III - Central Region | VIII - Volta Region |
| IV - Eastern Region | IX - Western Region |
| V - Greater Accra Region | |

Figure 2. Map of Ghana Showing Regional Divisions and Town Locations of Representative Schools

study was in the form of a comprehensive questionnaire. It consisted of two parts. Part I (see Appendix C) was for the school heads to respond to. It contained questions that sought to collect agricultural information about the schools and the school heads' opinions on teaching, in the broad sense, some major topics of agricultural mechanics. Part II (see Appendix D) was for the agricultural science teachers to respond to and it contained questions seeking information about the sources of power, tools, and equipment used for agricultural activities in the schools. It also sought the teachers' opinions on the feasibility of teaching some detailed topics of agricultural mechanics, and the extent of emphasis needed for those areas.

Procedure for Data Collection

In September of 1980, after the author had decided on the title of the study, he sent requests to relatives in Ghana requesting that they go to the Ghana Ministry of Education to collect and send a list of names and addresses of the secondary schools in Ghana which teach agricultural science. When these efforts had failed because the ministry would not release such a list for unknown reasons, the author's friend and fellow former teacher of secondary school agricultural science in Ghana, who was then studying at the University of Ghana, Legon, compiled the list and sent it, together with a copy of the 1980 agricultural science syllabus published by the West African Examination Council and used in the secondary schools of Ghana.

Early in February of 1981, the questionnaires (see Appendixes C and D) were mailed, together with a covering letter (see Appendix E) to three representative schools selected from each of the nine regions

of Ghana, making a total of 27. They were all expected back within two and one-half months, but by the end of May, only a very small fraction had been returned. Since most of the secondary schools go on holidays (summer vacation) at the end of the academic year in June or the early part of July, it became necessary for the author to travel to Ghana in the early part of June to personally collect most of the remaining questionnaires.

In Ghana, the author visited the Ministry of Education and talked personally with Mr. G. K. Brese, Assistant Director of Education in Charge of Secondary School Agriculture. After the researcher had given a thorough description and explanation about his study, the Assistant Director gave his permission and a written note (see Appendix F) for him to take to the schools he was to visit. The researcher then went personally to the remaining representative schools which had not yet responded to their questionnaires. The school heads (administrators) and agricultural science teachers were then asked personally by the researcher to complete the questionnaires and to submit them to the researcher, which they complied with.

In nearly all such cases, the schools had either not received the previously mailed questionnaires or had received them but misplaced them. In very few cases had the questionnaires been completed and returned but the author had not received them before making the trip. Nevertheless, all the representative schools under these categories were issued new copies of the questionnaires to complete during the research trip, which lasted 40 days.

CHAPTER IV

PRESENTATION AND ANALYSIS OF DATA

Introduction

The purposes of this study have been: 1) to determine the present status of agricultural mechanics in Ghanaian Secondary Schools, 2) to determine the need for the development of more practical and productive agricultural mechanics skills among students of Ghanaian Secondary Schools, and 3) to determine the extent of teaching emphasis needed for the schools in selected agricultural mechanics areas, with feasibility of teaching those areas implied.

The objectives specified were: 1) to review the G.C.E. "ordinary level" agricultural science syllabus published by the West African Examinations Council and used in Ghanaian Secondary Schools; 2) to find out the average student population of the schools, the number of agricultural science teachers, and the most common occupation practiced by the majority of the students' parents; 3) to determine the land sizes of the schools, the percentage used for the compound, the percentage for agricultural teaching purposes, and the percentage for food crop and/or livestock production for use in the schools' kitchens; 4) to determine the average number of students who complete Form 5 each year in the schools and what percentage of them attempt agricultural science in the final examinations; 5) to determine what sources of power, tools, and equipment are used for agriculture in the schools and the extent to

which they are used; 6) to determine how skillfully prepared the students are for mechanized agricultural work during and after school; 7) to determine whether agricultural mechanics should receive more attention in the schools; and 8) to develop a list of topic areas that could be included in agricultural mechanics programs in Ghanaian Secondary Schools based on the extent of emphasis needed.

Treatment and Analysis of Data

After all the data needed for the study had been collected, they were treated and analyzed to accomplish the individual objectives outlined in Chapter I in an effort to fulfill the ultimate purposes of the study also outlined in Chapter I. A review of the G.C.E. "ordinary level" agricultural science syllabus published by the West African Examination Council and used in Ghanaian Secondary Schools is presented in Chapter II, and accomplishes the first objective of the study. It must be noted that the review showed how deficient the syllabus is in the area of agricultural mechanics.

The various responses provided by the school heads to Part I of the questionnaire (see Appendix C) were treated and have been presented in tabular form as follows:

Table II shows responses about average student population of the schools requested in question 2 to fulfill part of objective number two of the study. It can be seen from this table that most of the secondary schools (Forms 1-5) have had over 500 student population every academic year since September, 1976.

Table III shows responses to question 3, which asked for the number of agricultural science teachers in the school to fulfill further

TABLE II
 RESPONSE OF SCHOOL HEADS (ADMINISTRATORS)
 REGARDING AVERAGE STUDENT POPULATION
 (FORMS 1-5) BETWEEN SEPTEMBER,
 1976, AND JUNE, 1981

Population Range	No. Responding	% Responding
399 and below	0	0
400 to 499	2	8.00
500 to 599	6	24.00
600 to 699	9	36.00
700 to 799	5	20.00
800 to 899	3	12.00
900 and above	<u>0</u>	<u>0</u>
Total	25	100.00

TABLE III
 RESPONSE OF SCHOOL HEADS (ADMINISTRATORS)
 REGARDING THE NUMBER OF AGRICULTURAL
 SCIENCE TEACHERS IN THE
 SCHOOLS

No. of Teachers	No. Responding	% Responding
One	4	16.00
Two	14	56.00
Three	5	20.00
Four	2	8.00
Five	<u>0</u>	<u>0</u>
Total	25	100.00

part of objective number two. According to that table, most of the schools have two agricultural science teachers each. A few have one, three or four, but none has more than four.

Table IV contains responses provided to question 4 regarding the most common occupation practiced by the majority of the students' parents. From that table, it is clearly evident that farming is the most common occupation practiced by the parents. It is the occupation for nearly 75% of the students' parents. This evidence completes the accomplishment of objective number two. It must be pointed out that in question 4, from which Table IV was derived, a column was provided for respondents to write in what they might consider as "other occupation," if not any of the three choices provided, but nothing else was specified.

Table V represents the response provided to question 5, about the total land sizes of the schools. The question sought to fulfill part of objective number three. From the table it is evident that the majority of the secondary schools have land sizes ranging from 300 to 700 acres.

Table VI contains information that is a further fulfillment of objective number three. It is a presentation of the response obtained by question 6 which asked about the percentage of school land used for the school compound and teachers' residence. The response provided shows that in most schools, the school compound and all buildings, including teachers' residential areas, occupy about 60% of the school land. It must be pointed out that this evidence leaves about 40% of the lands which can be put to very useful agricultural purpose.

TABLE IV
 RESPONSE OF SCHOOL HEADS (ADMINISTRATORS)
 REGARDING THE MOST COMMON OCCUPATION
 PRACTICED BY THE MAJORITY OF THE
 STUDENTS' PARENTS

Occupation	No. Responding	% Responding
Farming	18	72.00
Trading	3	12.00
Office	<u>4</u>	<u>16.00</u>
Total	25	100.00

TABLE V
 RESPONSE OF SCHOOL HEADS (ADMINISTRATORS)
 REGARDING THE TOTAL LAND SIZE
 OF THE SCHOOLS

Land Size in Acres	No. Responding	% Responding
100 and below	1	4.00
101 to 200	3	12.00
201 to 300	3	12.00
301 to 400	6	24.00
401 to 500	7	28.00
501 to 600	4	16.00
601 to 700	1	4.00
701 and above	<u>0</u>	<u>0</u>
Total	25	100.00

TABLE VI
 RESPONSE OF SCHOOL HEADS (ADMINISTRATORS)
 REGARDING THE PERCENTAGE OF SCHOOL
 LAND USED FOR SCHOOL COMPOUND
 WITH ALL BUILDINGS INCLUDING
 TEACHERS' RESIDENTIAL
 AREAS

% of Land	No. Responding	% Responding
20% or less	0	0
20.1% to 40%	3	12.00
40.1% to 60%	17	68.00
60.1% to 80%	5	20.00
80.1% to 100%	<u>0</u>	<u>0</u>
Total	25	100.00

Table VII shows the response provided to question 7 which, in an effort to help fulfill objective number three, asked about the percentage of school land used for agricultural teaching purposes. The evidence provided in the table indicates that the majority of the schools use 10% or less of their lands for agricultural teaching purposes.

Table VIII presents information obtained through question 8 which asked about the percentage of school land used for food crops and/or livestock production for use in the school kitchens. This was to help fulfill completely objective number three. The information presented in the table shows that over 75% of the schools do not produce anything on the remaining school land to help subsidize the amount of food purchased by the school kitchen to feed the students.

TABLE VII

RESPONSE OF SCHOOL HEADS (ADMINISTRATORS)
REGARDING THE PERCENTAGE OF SCHOOL
LAND USED FOR AGRICULTURAL
TEACHING PURPOSES

% of Land	No. Responding	% Responding
5% or less	8	32.00
5.1% to 10%	11	44.00
10.1% to 15%	6	24.00
15.1% to 20%	0	0
20.1% to 25%	0	0
25.1% and above	<u>0</u>	<u>0</u>
Total	25	100.00

TABLE VIII

RESPONSE OF SCHOOL HEADS (ADMINISTRATORS)
REGARDING THE PERCENTAGE OF SCHOOL
LAND USED FOR FOOD CROPS AND/OR
LIVESTOCK FOR THE
SCHOOL KITCHEN

% of Land	No. Responding	% Responding
None	19	76.00
5% or less	3	12.00
5.1% to 10%	1	4.00
10.1% to 15%	2	8.00
15.1% to 20%	0	0
20.1% to 25%	0	0
25.1% and above	<u>0</u>	<u>0</u>
Total	25	100.00

Table IX represents the response provided to question 9 about the average number of students who complete Form 5 each academic year since 1976. The information provided fulfills part of objective number four. It shows that in most schools the number of students who complete Form 5 each year ranges from 50 to 150.

TABLE IX
RESPONSE OF SCHOOL HEADS (ADMINISTRATORS)
REGARDING THE AVERAGE NUMBER OF
STUDENTS WHO COMPLETE FORM 5
EVERY YEAR

Average Number	No. Responding	% Responding
25 to 50	1	4.00
51 to 75	5	20.00
76 to 100	8	32.00
101 to 125	6	24.00
126 to 150	3	12.00
151 to 175	2	8.00
176 to 200	<u>0</u>	<u>0</u>
Total	25	100.00

Table X contains the information provided as response to question 10. It helps to accomplish completely objective number four by showing the percentage of Form 5 students who attempt agricultural science each year at the final examination which is the G.C.E. "ordinary level"

examination. The table indicates that in most secondary schools, 20 to 60% or more of the Form 5 students attempt the subject at the examination. This means that such percentage of students study the subject throughout all five years of the secondary school education in Ghana.

TABLE X
 RESPONSE OF SCHOOL HEADS (ADMINISTRATORS) REGARDING THE PERCENTAGE OF FORM 5 STUDENTS WHO ATTEMPT AGRICULTURAL SCIENCE EACH YEAR AT G.C.E. "ORDINARY LEVEL"

% of Form 5 Students	No. Responding	% Responding
None	0	0
1% to 20%	4	16.00
21% to 40%	10	40.00
41% to 60%	6	24.00
61% to 80%	3	12.00
81% to 100%	2	8.00
Total	25	100.00

Table XI contains information provided by agricultural science teachers to question numbers 2 and 3 (see Appendix D). It shows the information needed to accomplish objective number five regarding the sources of power, tools, and equipment used for agriculture in the schools, and the extent to which they are used. The evidence provided

TABLE XI

JUDGMENTS OF AGRICULTURAL SCIENCE TEACHERS REGARDING
THE EXTENT TO WHICH SELECTED SOURCES OF POWER,
TOOLS, AND EQUIPMENT ARE USED FOR
AGRICULTURE IN GHANAIAN
SECONDARY SCHOOLS

Sources of Power, Tools, and Equipment	Total Responding	Response per Category										Cumulative Value	Mean	Rating
		Always (5)		Great Extent (4)		Moderate (3)		Little Extent (2)		None (1)				
		No.	%	No.	%	No.	%	No.	%	No.	%			
Manpower or hand tools	25	23	92.00	2	8.00	0	0	0	0	0	0	123	4.92	Always
Working animals such as horses and/or bulls	25	0	0	0	0	0	0	2	8.00	23	92.00	27	1.08	None
Small gas engines such as lawn mowers	25	0	0	0	0	0	0	2	8.00	23	92.00	27	1.08	None
Heavy machines such as tractors and combines	25	0	0	0	0	0	0	2	8.00	23	92.00	27	1.08	None
Small hand tools such as cut- lasses, axes, and hoes	25	23	92.00	2	8.00	0	0	0	0	0	0	123	4.92	Always
Machine-operated tools or equipment such as plows	25	0	0	0	0	0	0	2	8.00	23	92.00	27	1.08	None

Note: Table of absolute limits--always, 4.5-5; great extent, 3.5-4.49; moderate, 2.5-3.49; little extent, 1.5-2.49; none, 1-1.49.

indicates that over 90% of the schools depend on manpower or hand labor, small hand tools like cutlasses (machettes), and hoes for agricultural work, and that these are the only major sources of power, tools, and equipment used all the time. It must be mentioned that in the questionnaire (Appendix D), a column was provided, asking for what might be other power, tools, and equipment, but nothing else was specified.

Table XII represents school heads' responses to question 11. Together with Table XIII, which represents agricultural science teachers' responses to a similar question (see Appendix D, question 4), these two tables provide the necessary information to accomplish objective number six about how equipped the secondary school graduates are in mechanized agricultural skills.

For a better analysis and interpretation of the responses provided to the questions from which these tables were derived, a rating value was established for each item under the judgment category. This ranged from: very highly equipped, 5; highly equipped, 4; equipped, 3; fairly equipped, 2; and poorly equipped, 1. Absolute limits are shown in Tables XII and XIII.

After computing the information provided in these tables, a mean of 1.20 was derived for the school heads' response in Table XII, indicating an overall rating of "poorly equipped." A mean of 1.52 was derived in Table XIII for the agricultural science teachers' response, indicating an overall rating of "fairly equipped." However, it can be noticed from the table that the teachers seemed to be almost equally divided on that judgment in that 52% of them felt the students were "fairly equipped," and 48% of them felt they were "poorly equipped." Nevertheless, it is very important to note that these judgments are not

TABLE XII
 JUDGMENTS OF SCHOOL HEADS (ADMINISTRATORS) REGARDING
 HOW EQUIPPED SECONDARY SCHOOL GRADUATES ARE
 IN AGRICULTURAL MECHANICS

Judgment Category	Category Rating Value	No. Responding	% Responding	Cumulative Value	Mean	Rating
Very highly equipped	5	0	0	0		
Highly equipped	4	0	0	0		
Equipped	3	0	0	0		
Fairly equipped	2	5	20.00	10		
Poorly equipped	1	<u>20</u>	<u>80.00</u>	<u>20</u>		
Total		25	100.00	30	1.20	Poorly Equipped

Note: Table of absolute limits--very highly equipped, 4-5.5; highly equipped, 3.5-4.49; equipped, 2.5-3.49; fairly equipped, 1.5-2.49; poorly equipped, 1-1.49.

TABLE XIII

JUDGMENTS OF AGRICULTURAL SCIENCE TEACHERS REGARDING
HOW EQUIPPED SECONDARY SCHOOL GRADUATES ARE IN
AGRICULTURAL MECHANICS SKILLS

Judgment Category	Category Rating Value	No. Responding	% Responding	Cumulative Value	Mean	Rating
Very highly equipped	5	0	0	0		
Highly equipped	4	0	0	0		
Equipped	3	0	0	0		
Fairly equipped	2	13	52.00	26		
Poorly equipped	1	<u>12</u>	<u>48.00</u>	<u>12</u>		
Total		25	100.00	38	1.52	Fairly equipped

Note: Table of absolute limits--very highly equipped, 4.5-5; highly equipped, 3.5-4.49; equipped, 2.5-3.49; fairly equipped, 1.5-2.49; poorly equipped, 1-1.49.

positively strong enough and that the students pass out of the five year Ghanaian Secondary School agricultural program with heads full of agricultural knowledge highly deficient in the more practical and productive agricultural mechanics skills needed for the nation's agricultural development.

Table XIV represents school heads' responses to question 12. Together with Table XV, which represents agricultural science teachers' responses to the same question (see Appendix D, question 5), they fulfill objective number seven on whether agricultural mechanics should receive more attention in the secondary schools of Ghana. A rating value was established as follows: strongly agree, 5; agree, 4; no opinion, 3; disagree, 2; strongly disagree, 1. (See absolute limits in Tables XIV and XV.) After computing the findings shown in the tables, the school heads' responses showed a mean of 4.56 and the agricultural science teachers' responses showed a mean of 4.68. Each of the two sides indicated that both school heads and agricultural science teachers "strongly agree" that agricultural mechanics should receive more attention in the secondary schools of Ghana.

Table XVI shows how school heads responded to questions 13 to 27 of their questionnaire (see Appendix C) and Table XVII shows how agricultural science teachers responded to questions 6a to 20c of their questionnaire (see Appendix D). These tables, together with their matching Tables XVIII and XIX, which show ranking of items, indicate the extent of teaching emphasis which, according to respondents' opinions, should be given those selected areas of agricultural mechanics. For proper interpretation and analysis of the data provided in those tables, a rating value was established for the extent of emphasis

TABLE XIV

OPINIONS OF SCHOOL HEADS (ADMINISTRATORS) AS TO WHETHER
THE TEACHING OF AGRICULTURAL MECHANICS SHOULD
RECEIVE MORE ATTENTION IN THE GHANAIAN
SECONDARY SCHOOLS AGRICULTURAL
SCIENCE PROGRAM

Opinion Category	Category Rating Value	No. Responding	% Responding	Cumulative Value	Mean	Rating
Strongly agree	5	16	64.00	80		
Agree	4	7	28.00	28		
No opinion	3	2	8.00	6		
Disagree	2	0	0	0		
Strongly disagree	1	<u>0</u>	<u>0</u>	<u>0</u>		
Total		25	100.00	114	4.56	Strongly Agree

Note: Table of absolute limits--strongly agree, 4.5-5; agree, 3.5-4.49; no opinion, 2.5-3.49; disagree, 1.5-2.49; strongly disagree, 1-1.49.

TABLE XV

OPINIONS OF AGRICULTURAL SCIENCE TEACHERS AS TO
WHETHER THE TEACHING OF AGRICULTURAL MECHAN-
ICS SHOULD RECEIVE MORE ATTENTION IN THE
GHANAIAN SECONDARY SCHOOLS AGRICUL-
TURAL SCIENCE PROGRAM

Opinion Category	Category Rating Value	No. Responding	% Responding	Cumulative Value	Mean	Rating
Strongly agree	5	19	76.00	95		
Agree	4	4	16.00	16		
No opinion	3	2	8.00	6		
Disagree	2	0	0	0		
Strongly disagree	1	0	0	0		
Total		25	100.00	117	4.68	Strongly Agree

Note: Table of absolute limits--strongly agree, 4.5-5; agree, 3.5-4.49; no opinion, 2.5-3.49; disagree, 1.5-2.49; strongly disagree, 1-1.49.

TABLE XVI

OPINIONS OF SCHOOL HEADS (ADMINISTRATORS) REGARDING
THE EXTENT OF TEACHING EMPHASIS WHICH SHOULD BE
GIVEN SELECTED GENERAL AREAS OF
AGRICULTURAL MECHANICS

Area	Total Responding	Response per Category										Cumulative Value	Mean	Rating
		Always (5)		Great Extent (4)		Moderate (3)		Little Extent (2)		None (1)				
		No.	%	No.	%	No.	%	No.	%	No.	%			
<u>Farm Shop Work</u>														
Shop Tools and Equipment	25	8	32.00	8	32.00	5	20.00	4	16.00	0	0	95	3.80	Great Extent
Woodwork and Farm Carpentry	25	8	32.00	8	32.00	5	20.00	4	16.00	0	0	95	3.80	Great Extent
Paint Work	25	0	0	3	0	7	28.00	9	36.00	6	24.00	57	2.28	Little Extent
Metal Work	25	2	8.00	4	16.00	7	28.00	5	20.00	7	28.00	64	2.56	Moderate
Rope and Leather Work	25	0	0	0	0	4	16.00	11	44.00	10	40.00	44	1.76	Little Extent
<u>Farm Power and Machinery</u>														
Farm Motors	25	15	60.00	8	32.00	2	8.00	0	0	0	0	113	4.52	Always
Trucks and Tractors	25	0	0	0	0	2	8.00	9	36.00	14	56.00	38	1.52	Little Extent
Transmission of Power	25	0	0	0	0	3	12.00	8	32.00	14	56.00	39	1.56	Little Extent
Farm Machinery	25	2	8.00	4	16.00	8	32.00	6	24.00	5	20.00	67	2.68	Moderate
<u>Farm Structures and Conveniences</u>														
Farm Buildings	25	2	8.00	5	20.00	7	28.00	6	24.00	5	20.00	68	2.72	Moderate
Concrete Work	25	4	16.00	5	20.00	8	32.00	5	20.00	3	12.00	77	3.08	Moderate
Farm Home Conveniences and Sanitation	25	8	32.00	9	36.00	5	20.00	3	12.00	0	0	97	3.88	Great Extent
Fencing	25	6	24.00	9	36.00	5	20.00	3	12.00	2	8.00	89	3.56	Great Extent
<u>Rural Development</u>														
Rural Electrification	25	16	64.00	7	28.00	2	8.00	0	0	0	0	114	4.56	Always
<u>Resource Conservation</u>														
Soil and Water Management	25	15	60.00	8	32.00	2	8.00	0	0	0	0	113	4.52	Always

Note: Table of absolute limits--always, 4.5-5; great extent, 3.5-4.49; moderate, 2.5-3.49; little extent, 1.5-2.49; none, 1.0-1.49.

TABLE XVII

OPINIONS OF AGRICULTURAL SCIENCE TEACHERS REGARDING
THE EXTENT OF TEACHING EMPHASIS WHICH SHOULD BE
GIVEN SELECTED SPECIFIC AREAS OF
AGRICULTURAL MECHANICS

Area	Total Re- sponding	Response per Category										Cumulative Value	Mean	Rating
		Always (5)		Great Extent (4)		Moderate (3)		Little Extent (2)		None (1)				
		No.	%	No.	%	No.	%	No.	%	No.	%			
Farm Shop Work														
1. <u>Shop Tools and Equipment</u>														
a. Developing a home-farm shop	25	6	24.00	4	16.00	8	32.00	4	16.00	3	12.00	81	3.24	Moderate
b. Selecting and using hand tools	25	18	72.00	6	24.00	1	4.00	0	0	0	0	117	4.68	Always
c. Selecting and using power tools	25	2	8.00	4	16.00	7	28.00	5	20.00	7	28.00	64	2.56	Moderate
d. Maintaining and repairing tools	25	18	72.00	5	20.00	2	8.00	0	0	0	0	116	4.64	Always
2. <u>Woodwork and Farm Carpentry</u>														
a. Making simple sketches and reading blueprints	25	10	40.00	8	32.00	5	20.00	2	8.00	0	0	101	4.04	Great Extent
b. Selecting and caring for lumber	25	6	24.00	4	16.00	7	28.00	5	20.00	3	12.00	80	3.20	Moderate
c. Selecting and using nails, screws, bolts, and glue	25	6	24.00	4	16.00	7	28.00	5	20.00	3	12.00	80	3.20	Moderate
d. Woodworking and farm carpentry projects	25	18	72.00	4	16.00	2	8.00	1	4.00	0	0	114	4.56	Always
3. <u>Paint Work</u>														
a. Painting	25	0	0	4	16.00	6	24.00	9	36.00	6	24.00	58	2.32	Little Extent
b. Refinishing	25	0	0	4	16.00	6	24.00	9	36.00	6	24.00	58	2.32	Little Extent
c. Glazing	25	0	0	4	16.00	6	24.00	7	28.00	8	32.00	56	2.24	Little Extent
4. <u>Metal Work</u>														
a. Metal work equipment and their uses	25	6	24.00	8	32.00	6	24.00	3	12.00	2	8.00	88	3.52	Great Extent
b. Electric arc welding	25	18	72.00	4	16.00	2	8.00	1	4.00	0	0	114	4.56	Always
c. Oxyacetylene welding	25	0	0	0	0	0	0	12	48.00	13	52.00	37	1.48	None
d. Hot metal work	25	0	0	2	8.00	6	24.00	8	32.00	9	36.00	51	2.04	Little Extent
e. Cold metal work	25	0	0	4	16.00	6	24.00	6	24.00	9	36.00	55	2.20	Little Extent
f. Cutting, bending, and fasten- ing sheet metal	25	0	0	2	8.00	8	32.00	6	24.00	9	36.00	53	2.12	Little Extent
g. Soldering	25	0	0	2	8.00	6	24.00	8	32.00	9	36.00	51	2.04	Little Extent

TABLE XVII (Continued)

Area	Total Re- sponding	Response per Category										Cumulative Value	Mean	Rating	
		Always (5)		Great Extent (4)		Moderate (3)		Little Extent (2)		None (1)					
		No.	%	No.	%	No.	%	No.	%	No.	%				
5. Rope and Leather Work															
a. Selecting and using rope	25	0	0	0	0	7	28.00	9	36.00	9	36.00	48	1.92	Little Extent	
b. Selecting and using leather	25	0	0	0	0	2	8.00	13	52.00	10	40.00	42	1.68	Little Extent	
c. Repairing and preserving leather	25	0	0	0	0	2	8.00	12	48.00	11	44.00	41	1.64	Little Extent	
Farm Power and Machinery															
6. Farm Motors (Engines)															
a. Understanding the fundamental principles of engines	25	20	80.00	3	12.00	2	8.00	0	0	0	0	118	4.72	Always	
b. Operating small gas farm engines	25	18	72.00	5	20.00	2	8.00	0	0	0	0	116	4.64	Always	
c. Engine trouble shooting	25	18	72.00	3	12.00	3	12.00	1	4.00	0	0	113	4.52	Always	
d. Small gas engine repair and maintenance	25	18	72.00	3	12.00	3	12.00	1	4.00	0	0	113	4.52	Always	
7. Trucks and Tractors															
a. Operating farm tractors	25	0	0	0	0	2	8.00	9	36.00	14	56.00	38	1.52	Little Extent	
b. Repairing and maintaining farm tractors	25	0	0	0	0	2	8.00	9	36.00	14	56.00	38	1.52	Little Extent	
c. Operating farm trucks	25	0	0	0	0	0	0	10	40.00	15	60.00	35	1.40	None	
d. Repairing and maintaining farm trucks	25	0	0	0	0	0	0	11	44.00	14	56.00	36	1.44	None	
8. Transmission of Power															
a. Selecting and using farm belts	25	0	0	2	8.00	5	20.00	9	36.00	9	36.00	50	2.00	Little Extent	
b. Repairing farm belts	25	0	0	2	8.00	5	20.00	9	36.00	9	36.00	50	2.00	Little Extent	
9. Farm Machinery															
a. Selecting and using farm machinery	25	0	0	0	0	0	0	14	56.00	11	44.00	39	1.56	Little Extent	
b. Maintaining and repairing farm machinery	25	0	0	0	0	0	0	14	56.00	11	44.00	39	1.56	Little Extent	
c. Constructing labor-saving farm equipment	25	18	72.00	4	16.00	2	8.00	1	4.00	0	0	114	4.56	Always	

TABLE XVII (Continued)

Area	Total Re- sponding	Response per Category										Cumulative Value	Mean	Rating
		Always (5)		Great Extent (4)		Moderate (3)		Little Extent (2)		None (1)				
		No.	%	No.	%	No.	%	No.	%	No.	%			
Farm Structures and Conveniences														
10. <u>Farm Buildings</u>														
a. Constructing farm buildings	25	2	8.00	4	16.00	8	32.00	6	24.00	5	20.00	67	2.68	Moderate
b. Maintaining and repairing farm buildings	25	2	8.00	4	16.00	8	32.00	6	24.00	5	20.00	67	2.68	Moderate
11. <u>Concrete Work</u>														
a. Understanding uses and composition of concrete	25	18	72.00	3	12.00	2	8.00	2	8.00	0	0	112	4.48	Great Extent
b. Determining quantities and proportions for concrete mixtures	25	18	72.00	3	12.00	2	8.00	2	8.00	0	0	112	4.48	Great Extent
c. Mixing, pouring, curing, and reinforcing concrete	25	18	72.00	3	12.00	2	8.00	1	4.00	1	4.00	111	4.44	Great Extent
d. Making concrete blocks	25	16	64.00	3	12.00	2	8.00	2	8.00	2	8.00	104	4.16	Great Extent
e. Using concrete blocks and concrete	25	16	64.00	3	12.00	2	8.00	2	8.00	2	8.00	104	4.16	Great Extent
12. <u>Farm-Home Conveniences and Sanitation</u>														
a. Establishing farm water supply systems	25	18	72.00	5	20.00	1	4.00	1	4.00	0	0	115	4.60	Always
b. Selecting and using plumbing equipment	25	4	16.00	4	16.00	10	40.00	6	24.00	1	4.00	79	3.06	Moderate
c. Establishing farm sewage disposal systems	25	18	72.00	4	16.00	2	8.00	1	4.00	0	0	114	4.56	Always
d. Cooling the farm home	25	16	64.00	3	12.00	2	8.00	2	8.00	2	8.00	104	4.06	Great Extent
13. <u>Fencing</u>														
a. Constructing fences	25	9	36.00	9	36.00	3	12.00	2	8.00	2	8.00	96	3.84	Great Extent
b. Maintaining and repairing fences	25	9	36.00	9	36.00	3	12.00	2	8.00	2	8.00	96	3.84	Great Extent

TABLE XVII (Continued)

Area	Total Re- sponding	Response per Category										Cumulative Value	Mean	Rating
		Always (5)		Great Extent (4)		Moderate (3)		Little Extent (2)		None (1)				
		No.	%	No.	%	No.	%	No.	%	No.	%			
Rural Development														
14. Rural Electrification														
a. Understanding the funda- mentals of electricity	25	20	80.00	4	16.00	1	4.00	0	0	0	0	119	4.76	Always
b. Wiring the farmstead	25	7	28.00	7	28.00	6	24.00	3	12.00	2	8.00	89	3.56	Great Extent
c. Selecting and using electric motors	25	4	16.00	4	16.00	8	32.00	6	24.00	3	12.00	75	3.00	Moderate
d. Maintaining and repairing electric motors	25	4	16.00	4	16.00	8	32.00	6	24.00	3	12.00	75	3.00	Moderate
Resource Conservation														
15. Soil and Water Management														
a. Using contour farming, strip cropping, and grassed waterways	25	15	60.00	4	16.00	2	8.00	2	8.00	2	8.00	103	4.12	Great Extent
b. Terracing to control soil erosion	25	15	60.00	4	16.00	2	8.00	2	8.00	2	8.00	103	4.12	Great Extent
c. Providing farm drainage and irrigation systems	25	18	72.00	5	20.00	1	4.00	1	4.00	0	0	115	4.60	Always

Note: Table of absolute limits--always 4.5-5; great extent, 3.5-4.49; moderate 2.5-3.49; little extent, 1.5-2.49; none, 1-1.49.

needed as follows: always, 5; great extent, 4; moderate, 3; little extent, 2; none, 1. A table of absolute limits is provided in each of Tables XVI to XIX.

TABLE XVIII
RANKING OF ITEMS AS SHOWN BY SCHOOL
HEADS' RESPONSE

Ranking	Item	Mean	Rating
1	Rural Electrification	4.56	Always
2	Farm Motors	4.52	Always
3	Soil and Water Management	4.52	Always
4	Farm Home Conveniences and Sanitation	3.88	Great Extent
5	Shop Tools and Equipment	3.80	Great Extent
6	Woodwork and Farm Carpentry	3.80	Great Extent
7	Fencing	3.56	Great Extent
8	Concrete Work	3.08	Moderate
9	Farm Building	2.72	Moderate
10	Farm Machinery	2.68	Moderate
11	Metal Work	2.56	Moderate
12	Paint Work	2.28	Little Extent
13	Rope and Leather Work	1.76	Little Extent
14	Transmission of Power	1.56	Little Extent
15	Trucks and Tractors	1.52	Little Extent

TABLE XIX
 RANKING OF ITEMS AS SHOWN BY
 TEACHERS' RESPONSE

Ranking	Item	Mean	Rating
1	Understanding the fundamentals of electricity	4.76	Always
2	Understanding the fundamental principles of engines	4.72	Always
3	Selecting and using hand tools	4.68	Always
4	Maintaining and repairing tools	4.64	Always
5	Operating small gas farm engines	4.64	Always
6	Establishing farm water supply systems	4.60	Always
7	Providing farm drainage and irrigation systems	4.60	Always
8	Woodworking and farm carpentry projects	4.56	Always
9	Electric arc welding	4.56	Always
10	Constructing labor-saving equipment	4.56	Always
11	Establishing farm sewage disposal system	4.56	Always
12	Engine trouble shooting	4.52	Always
13	Small gas engine repair and maintenance	4.52	Always
14	Understanding the uses and composition of concrete	4.48	Great Extent
15	Determining quantities and proportions of concrete mixtures	4.48	Great Extent
16	Mixing, pouring, curing, and reinforcing concrete	4.44	Great Extent
17	Making concrete blocks	4.16	Great Extent
18	Using concrete blocks and concrete	4.16	Great Extent
19	Cooling the farm home	4.16	Great Extent
20	Using contour farming, strip cropping, and grassed waterways	4.12	Great Extent
21	Terracing to control soil erosion	4.12	Great Extent
22	Making simple sketches and reading blueprints	4.04	Great Extent

TABLE XIX (Continued)

Ranking	Item	Mean	Rating
23	Constructing fences	3.84	Great Extent
24	Maintaining and repairing fences	3.84	Great Extent
25	Wiring the farmstead	3.56	Great Extent
26	Metal work equipment and their uses	3.52	Great Extent
27	Developing a home-farm shop	3.24	Moderate
28	Selecting and caring for lumber	3.20	Moderate
29	Selecting and using nails, screws, bolts, and glue	3.20	Moderate
30	Selecting and using plumbing equipment	3.16	Moderate
31	Selecting and using electric motors	3.00	Moderate
32	Maintaining and repairing electric motors	3.00	Moderate
33	Constructing farm buildings	2.68	Moderate
34	Maintaining and repairing farm buildings	2.68	Moderate
35	Selecting and using power tools	2.56	Moderate
36	Painting	2.32	Little Extent
37	Refinishing	2.32	Little Extent
38	Glazing	2.24	Little Extent
39	Cold metal work	2.20	Little Extent
40	Cutting, bending, and fastening sheet metal	2.12	Little Extent
41	Hot metal work	2.04	Little Extent
42	Soldering	2.04	Little Extent
43	Selecting and using farm belts	2.00	Little Extent
44	Repairing farm belts	2.00	Little Extent
45	Selecting and using rope	1.92	Little Extent
46	Selecting and using leather	1.68	Little Extent
47	Repairing and preserving leather	1.64	Little Extent
48	Selecting and using farm machinery	1.56	Little Extent
49	Maintaining and repairing farm machinery	1.46	Little Extent

TABLE XIX (Continued)

Ranking	Item	Mean	Rating
50	Operating farm tractors	1.52	Little Extent
51	Repairing and maintaining farm tractors	1.52	Little Extent
52	Oxyacetylene welding	1.48	None
53	Maintaining and repairing farm trucks	1.44	None
54	Operating farm trucks	1.40	None

The indications imply that topic areas not checked "none" are feasible to teach in Ghanaian Secondary Schools, at least to the extent indicated, and that they can be included in agricultural mechanics programs for the schools. This information accomplishes objective number eight of the study.

Table XX provides a side by side comparison of respondents' responses already presented in Tables XVI to XIX. It must be pointed out that since the school heads responded to broader topics, whereas the agricultural science teachers responded to detailed topics, the means and ratings indicated by asterisks were not directly derived from the responses. Rather, to provide some approximate figures to facilitate comparisons between the two opinions, the asterisk means and ratings in Table XX were derived by averaging the teachers' means and ratings of the detailed topics found under each broad topic in Table XVII, and this represents what could have been the teachers' responses if they had to rate those broad topics.

TABLE XX
 COMPARISON BETWEEN OPINIONS OFFERED BY SCHOOL
 HEADS (ADMINISTRATORS) AND AGRICULTURAL
 SCIENCE TEACHERS REGARDING THE EXTENT
 OF TEACHING EMPHASIS WHICH SHOULD
 BE GIVEN SELECTED AREAS
 OF AGRICULTURAL
 MECHANICS

Area	Teachers' Response		School Heads' Response	
	Mean	Rating	Mean	Rating
<u>Shop Tools and Equipment</u>	(3.78)*	Great Extent*	3.80	Great Extent
a. Developing a home-farm shop	3.24	Moderate		
b. Selecting fusing hand tools	4.68	Always		
c. Selecting and using power tools	2.56	Moderate		
d. Maintaining and repairing tools	4.64	Always		
<u>Woodwork and Farm Carpentry</u>	(3.75)*	Great Extent*	3.80	Great Extent
a. Making simple sketches and reading blueprints	4.04	Great Extent		
b. Selecting and caring for lumber	3.20	Moderate		
c. Selecting and using nails, screws, bolts, and glue	3.20	Moderate		
d. Woodworking and farm carpentry projects	4.56	Always		
<u>Paint Work</u>	(2.29)*	Little Extent*	2.28	Little Extent
a. Painting	2.32	Little Extent		
b. Refinishing	2.32	Little Extent		
c. Glazing	2.24	Little Extent		
<u>Metal Work</u>	(2.57)*	Moderate*	2.56	Moderate
a. Metal work equipment and their uses	3.52	Great Extent		
b. Electric arc welding	4.56	Always		
c. Oxyacetylene welding	1.48	None		
d. Hot metal work	2.04	Little Extent		
e. Cold metal work	2.20	Little Extent		
f. Cutting, bending, and fastening sheet metal	2.12	Little Extent		
g. Soldering	2.04	Little Extent		
<u>Rope and Leather Work</u>	(1.75)*	Little Extent*	1.76	Little Extent
a. Selecting and using rope	1.92	Little Extent		
b. Selecting and using leather	1.68	Little Extent		
c. Repairing and preserving leather	1.64	Little Extent		
<u>Farm Motors (Engines)</u>	(4.60)*	Always*	4.52	Always
a. Understanding the fundamentals of engines	4.72	Always		
b. Operating small gas farm engines	4.64	Always		
c. Engine trouble shooting	4.52	Always		
d. Small gas engine repair and maintenance	4.52	Always		
<u>Trucks and Tractors</u>	(1.47)*	Little Extent*	1.52	Little Extent
a. Operating farm tractors	1.52	Little Extent		
b. Repairing and maintaining farm tractors	1.52	Little Extent		
c. Operating farm trucks	1.40	None		
d. Repairing and maintaining farm trucks	1.44	None		

TABLE XX (Continued)

Area	Teachers' Response		School Heads' Response	
	Mean	Rating	Mean	Rating
<u>Transmission of Power</u>	(2.00)*	Little Extent*	1.56	Little Extent
a. Selecting fusing farm belts	2.00	Little Extent		
b. Repairing farm belts	2.00	Little Extent		
<u>Farm Machinery</u>	(2.56)*	Moderate*	2.68	Moderate
a. Selecting and using farm machinery	1.56	Little Extent		
b. Maintaining and repairing farm machinery	1.56	Little Extent		
c. Constructing labor-saving equipment	4.56	Always		
<u>Farm Buildings</u>	(2.68)*	Moderate*	2.72	Moderate
a. Constructing farm buildings	2.68	Moderate		
b. Maintaining and repairing farm buildings	2.68	Moderate		
<u>Concrete Work</u>	(4.34)*	Great Extent*	3.08	Moderate
a. Understanding the uses and composition of concrete	4.48	Great Extent		
b. Determining quantities and proportions for concrete mixtures	4.48	Great Extent		
c. Mixing, pouring, curing, and reinforcing concrete	4.44	Great Extent		
d. Making concrete (cement) blocks	4.16	Great Extent		
e. Using concrete blocks	4.16	Great Extent		
<u>Farm Home Conveniences and Sanitation</u>	(4.12)*	Great Extent*	3.88	Great Extent
a. Establishing farm water supply systems	4.60	Always		
b. Selecting and using plumbing equipment	3.16	Moderate		
c. Establishing farm sewage disposal systems	4.56	Always		
d. Cooling the farm home	4.16	Great Extent		
<u>Fencing</u>	(3.84)*	Great Extent*	3.56	Great Extent
a. Constructing fences	3.84	Great Extent		
b. Maintaining and repairing fences	3.84	Great Extent		
<u>Rural Electrification</u>	(3.58)*	Great Extent*	4.56	Always
a. Understanding the fundamentals of electricity	4.76	Always		
b. Wiring the farmstead (home)	3.56	Great Extent		
c. Selecting and using electric motors	3.00	Moderate		
d. Maintaining and repairing electric motors	3.00	Moderate		
<u>Soil and Water Management</u>	(4.28)*	Great Extent*	4.52	Always
a. Using contour farming, strip cropping, and grassed waterways	4.12	Great Extent		
b. Terracing to control soil erosion	4.12	Great Extent		
c. Providing farm drainage and irrigation system	4.60	Always		

*Since the school heads responded to broader topics whereas the agricultural science teachers responded to detailed topics, these means and ratings have been derived by averaging out the teachers' means and ratings of the detailed topics to represent what could have been the teachers' response if they had those broad topics.

Note: Table of absolute limits--always, 4.5-5; great extent, 3.5-4.49; moderate, 2.5-3.49; little extent, 1.5-2.49; none, 1-1.49.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The purposes of the study were: 1) to determine the present status of agricultural mechanics in Ghanaian Secondary Schools, 2) to determine the need for the development of more practical and productive agricultural mechanics skills among students of the schools, and 3) to use the opinions of the school heads and agricultural science teachers to determine the extent of teaching emphasis needed for the schools in selected agricultural mechanics areas, with the feasibility of teaching those areas implied.

In order to accomplish these purposes, a number of objectives were set (see Chapter I), and a survey questionnaire was developed in line with the objectives. All of the nine regions of Ghana were considered for the study. Three representative secondary schools were chosen from each region and the school heads, together with their agricultural science teachers, were requested to respond to a survey of questionnaire. At first, the questionnaires were mailed to the schools, but later on, when the number returned was not encouraging, it became necessary for the author to travel to Ghana to visit personally with those school heads and agricultural science teachers of the schools who had not returned their questionnaires. By this procedure, about 92% of the questionnaires were returned. All the data derived from the research have been presented in tables and discussed in Chapter IV.

Findings and Conclusions

The research study made many interesting discoveries about agricultural mechanics at the secondary school level in Ghana. These findings led to important conclusions in line with the objectives and the overall purposes of the study.

It was discovered that most of the secondary schools in Ghana have yearly average student populations (Forms 1-5) of between 500 and 800. It was also discovered that the majority of the students' parents (over 70%) are farmers. This leads the author to conclude that many of the students have some farm background.

The study revealed that most of the secondary schools have two agricultural science teachers each, and land sizes of between 300 and 700 acres, about 40% of which could be used for productive agricultural purposes. The study showed that, presently most schools use less than 10% of their land for agricultural teaching purposes. Asked about the percentage of the land used to produce food crops and/or livestock for use in the school kitchen, over 75% of the schools indicated that they do not use any portion of their school land for that purpose, and about 12% of the schools said they use less than 5% of their land. This leads to the conclusion that, besides the portion of land used for the school compounds with all buildings including teachers' residence, and the portion used for teaching purposes, there are still large portions of the school lands that could be used for productive agricultural work but are presently not being used.

Some of the other findings of the study were that between 50 and 150 students complete Form 5 each year from most of the secondary

schools in Ghana. Out of this number about 40 to 60% attempt agricultural science at the final examination. This indicates the percentage who actually graduate from secondary schools with five years of agricultural science studies. Yet, both school heads and agricultural science teachers of the secondary schools could not judge these graduates any better than being mostly "poorly equipped" in skills for mechanized agricultural work. Eighty percent of the school heads judged them "poorly equipped." Almost half of the teachers judged them "poorly equipped," and the other half said the students were "fairly equipped."

A copy of the syllabus for agricultural science published by the West African Examinations Council and used in Ghanaian Secondary Schools may be found in Appendix A. A review of the syllabus may also be found under "Agriculture in Ghanaian Secondary Schools" in Chapter II. Looking at the syllabus and considering what agricultural mechanics is as defined by such authors as Morford (5) and Phipps (7), it was clearly evident that the syllabus was very highly deficient in agricultural mechanics, and that as far as the present status of the subject in Ghanaian Secondary Schools is concerned, it can be said to be very little or none. This fulfills the first purpose of the study.

One important finding of the study was that when asked whether agricultural mechanics should receive more attention in Ghanaian Secondary Schools, almost all school heads and agricultural science teachers responded positively that they "strongly agree." This led the author to conclude, in fulfillment of the second purpose of the study, that there is great need for the development of agricultural mechanics skills among students of Ghanaian Secondary Schools.

Finally, the study also discovered, perhaps most importantly, the topic areas of agricultural mechanics which, in the school heads' and their agricultural science teachers' opinions, would presently be feasible to teach in the schools. This was determined from their responses regarding the extent of teaching emphasis needed for selected areas of agricultural mechanics presented in Table XX. Table XXI is a brief summary of the contents of Table XX. Among the topics school heads considered Rural Electrification, Farm Motors, Soil and Water Conservation, in their broad sense, as subjects that should be taught "always." Agricultural science teachers considered Farm Motors (engines) for such emphasis. Both sides considered Trucks and Tractors as the areas which, at the secondary school level, should have the least emphasis, according to the mean value in the table. This fulfills the third and final purpose of the study.

Recommendations

Based on the findings and conclusions of this study, the author wishes to make the following recommendations:

1. That the findings of this study be given serious consideration by the authorities of the Ghana Ministry of Education in charge of secondary school educational programs in agriculture. This recommendation is made because: a) the study was funded by the government of Ghana through the Scholarships Secretariat and the Embassy of Ghana in Washington, D.C., U.S.A., b) the findings came out of the responses provided by school heads (administrators) and agriculture science teachers of secondary schools over all the nine regions of Ghana, and c) the author undertook the study with a sincere determination to

TABLE XXI

OPINIONS OF SCHOOL HEADS (ADMINISTRATORS) AND AGRICULTURAL SCIENCE TEACHERS REGARDING THE EXTENT OF TEACHING EMPHASIS WHICH SHOULD BE GIVEN SELECTED BROAD AREAS OF AGRICULTURAL MECHANICS

Area	Teachers' Response		School Heads' Response	
	Mean	Rating	Mean	Rating
Shop Tools and Equipment	(3.78)*	Great Extent*	3.80	Great Extent
Woodwork and Farm Carpentry	(3.75)*	Great Extent*	3.80	Great Extent
Paint Work	(2.29)*	Little Extent*	2.28	Little Extent
Metal Work	(2.57)*	Moderate*	2.56	Moderate
Rope and Leather Work	(1.75)*	Little Extent*	1.76	Little Extent
Farm Motors (Engines)	(4.60)*	Always*	4.52	Always
Trucks and Tractors	(1.47)*	Little Extent*	1.52	Little Extent
Transmission of Power	(2.00)*	Little Extent*	1.56	Little Extent
Farm Machinery	(2.56)*	Moderate*	2.68	Moderate
Farm Buildings	(2.68)*	Moderate*	2.72	Moderate
Concrete Work	(4.34)*	Great Extent*	3.08	Moderate
Farm Home Conveniences and Sanitation	(4.12)*	Great Extent*	3.88	Great Extent
Fencing	(3.84)*	Great Extent*	3.56	Great Extent
Rural Electrification	(3.58)*	Great Extent*	4.56	Always
Soil and Water Management	(4.28)*	Great Extent*	4.52	Always

Note: Table of absolute limits--always, 4.5-5; great extent, 3.5-4.49; moderate, 2.5-3.49; little extent, 1.5-2.49; none, 1-1.49.

*See Table XX.

produce a useful product as a contribution to the agricultural development of Ghana and that the study must therefore not be considered as merely a partial fulfillment of a master's degree program.

2. That the topic areas of agricultural mechanics shown in Table XX which, according to the school heads and agricultural science teachers, should receive strong emphasis (e.g., "always, "great extent," and "moderate"), be given immediate attention with all priority.

3. That even if agricultural mechanics does not become a major part of the secondary Forms 1-5 agricultural science syllabus, it should at least be stressed in the instructions for Forms 1-3.

4. That the gap between the teacher-student ratio be reduced through the training of more teachers of agriculture for the schools to improve efficiency and quality of work. Tosu (9, p. 5), when talking about problems of the maize farmer in Ghana, said: Where student labour is available supervision is poor and so is quality of work." This statement is true and can be supported by comparing the evidence in Tables II, III, IX, and X. With an average population (Forms 1-5) of nearly 600 students and about two agricultural science teachers per school, there is a teacher-student ratio of about 1:300. Considering fact that not all students in their final two years of secondary school study agriculture, the ratio may narrow down to about 1:200, which is still too wide for better efficiency and quality of work.

5. That the distribution of agricultural science teachers in the schools should be handled more fairly. According to Table III, some schools have one agricultural science teacher while others have up to four. Even though this may, perhaps, be justifiable, the author believes that a more efficient work could result in a broader sense if

those schools with one agricultural science teacher would have two before those with three get four.

6. That the schools should put more of their idle lands to continuous and productive agricultural use for food and/or meat through livestock production to subsidize what has to be purchased by the school kitchen to feed the masses of student population. This could lead to low boarding and lodging cost for the resident students.

7. Finally, the author wishes to recommend that where the knowledge of the schools' agricultural science teachers is deficient in the needed agricultural mechanics skills; resource people should be invited to help in the teaching program. There may be more mechanics specialists employed by the industries than education (11, p. 39).

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APPENDIXES

APPENDIX A

AGRICULTURAL SCIENCE SYLLABUS FOR THE 1980
WEST AFRICAN SCHOOL CERTIFICATE AND
GENERAL CERTIFICATE OF EDUCATION
EXAMINATION

AGRICULTURAL SCIENCE (ORDINARY LEVEL)

Candidates can be accepted for this subject only in accordance with regulations G.4(2), 4(3) and 5(3)

Candidates offering Agricultural Science will be required to offer, in addition, General Science or Biology and Chemistry.

When Agricultural Science is taken together with General Science or Biology or Chemistry at the same examination, a pass may be awarded in Agricultural Science irrespective of the candidate's performance in General Science or Biology or Chemistry.

There will be three papers all of which must be taken:

PAPER 1 will be a 1½-hour practical paper.

PAPER 2 will be a 1 hour theory (objective) paper.

PAPER 3 will be a 2-hour written paper consisting of four sections. There will be three questions in section A and two in each of the remaining three sections B, C & D. Candidates will be required to answer one question from each section.

Practical work should form the basis of preparing for this subject. Candidates will be required to submit their PRACTICAL FIELD NOTEBOOKS for which marks will be awarded.

DETAILED SYLLABUS

Candidates will be expected to answer questions on the topics set out in the column headed 'Syllabus'. The notes are intended to indicate the scope of the questions which will be set but they are not to be considered as an exhaustive list of limitations and illustrations.

It is desirable that schools presenting candidates for Agricultural Science should keep a School Farm, but where this is not possible, a well planned garden with small plots of farm crops for regular observation during growth is essential. At least two species of livestock, preferably one monogastic e.g. pigs, poultry, and one ruminant e.g., sheep, goat, cattle or a herbivore e.g. rabbit, guinea-pigs must be kept. The Practical Field Note Books of the candidates should contain records of individual projects, farm activities and observations carried out on the school farm or garden.

It is also recommended that the study of Agricultural Science in the School Campus be supplemented by visits to well organized farms and/or Agricultural Research Stations.

SECTION A: Introduction to Agriculture

SYLLABUS

NOTES

- | | |
|---|---|
| 1. The meaning and importance of Agriculture. | This should involve a discussion of the importance of Agriculture to man generally and its role in the economy of the relevant West African country, emphasizing that agriculture is a business. |
| 2. General principles of land use. | This should be discussed in relation to the use of land for Agriculture, Forestry and wild life conservation purposes, bearing in mind the physical, economic and social factors, commercialisation, communication and marketing. |

AGRICULTURAL SCIENCE (ORDINARY LEVEL)

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3. Agricultural Systems: land tenure problems; shifting cultivation; crop rotation; continuous cropping; mono-cropping; mixed-cropping; pastoral and mixed farming.

4. Development of Agriculture: role of science and technology in development of Agriculture, including tools and source of farm power. Problems of development of local Agriculture. Role of Government—Agricultural policies, regulations and programmes. Agricultural education, research and extension, credit facilities, subsidies, quarantine, vaccines and farm settlement schemes.

5. Simple farm tools and Agricultural machinery: their uses and maintenance.

6. An elementary study of climate with particular reference to its effects on Agriculture. The main types and ecological distribution of crops (cereals, legumes, roots, vegetables, edible fruits, beverages, spices, drugs, oils, gums, latex, fibre); and animals (cattle, sheep, pigs, goats, horses, donkeys, poultry, rabbits) found in West African countries.

7. Use of Agricultural and Forest products and their by-products.

Engineering details should be avoided.

The discussion should include the use of agricultural and forest products for the provision of

- (1) *Food*: fresh and processed;
- (2) *Clothing*: hides and skins, fibre, rubber, etc.,
- (3) *Shelter*: Timber, gums, resins, etc.
- (4) *Health*: Drugs;
- (5) *Fuel and Power*: oil, minerals; and
- (6) *Others*.

SECTION B: Soil Science

1. Soil formation and properties: rocks—main types, rock weathering and factors of soil formation. Composition and properties of the soil; sand, silt, clay, organic matter; soil acidity. Soil texture and structure, and their importance. Soil water, its source, movement and importance. Water—retaining properties of humus and clay.

Different soil types should be handled and the separation of a soil into sand, silt and clay fractions demonstrated. Water-holding capacity and drainage of a sandy soil, clay soil, and soil with a high percentage of organic matter should be simply demonstrated by pouring water over samples of these soils in funnels.

AGRICULTURAL SCIENCE (ORDINARY LEVEL)

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2. Soil and water conservation: depletion of soil resources by leaching, cropping, burning and oxidation of organic matter; erosion—its importance, causes, prevention and control—irrigation and drainage.

3. Soil fertility: plant nutrients; major sources of nitrogen, phosphorus and potassium. Maintenance of soil fertility; crop rotations, including cover crops and green manures. Composting. The part played by livestock; farmyard manure; the living population of the soil and its role in the carbon cycle (especially Earth-worm and Termite) and nitrogen cycle (especially nitrogen fixing bacteria); the use of commercial fertilizers and lime; the principles and practice of cultivation and their effects on soils.

SECTION C: Crop Science

1. A review (with emphasis on their Agricultural implications) of plant parts, their functions, growth, development and reproduction.

2. Annual and perennial crop plants: external morphology, life-history, propagation, growth, cultivation, harvesting, storage, marketing and uses of local crop plants. Minimum of two crops from each of groups 1 to 6 should be selected from the list in the Appendix table below.

3. Pastures and forage crops: recognition and study of main grasses and legume species commonly used in pastures. Natural pastures and their distribution. Important forage grasses and legumes and their uses.

4. Crop improvement: aims, methods, introduction, selection and cross-breeding.

5. Weeds: their importance in Agriculture. Recognition of common annual and perennial weeds of local importance. Methods of dispersal and control of weeds.

Where there are two or more types in each group not more than one member of each type should be studied.

Detailed botanical studies are not required. Students will be expected to recognize on the basis of gross morphological appearance, at most four species of grasses and at least one species of legume used in pastures.

Chromosomes and Mendel's 'Laws' need not be treated in detail. A brief study of sexual and asexual methods of crop improvement. A comparison of a local variety and an improved variety of a crop plant can be made for demonstration.

Herbicides can be mentioned but not details of chemical structure and mode of physiological action.

AGRICULTURAL SCIENCE (ORDINARY LEVEL)

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6. Diseases: a simple general account of diseases caused by fungi, bacteria, nematodes and viruses and nutrient deficiencies affecting crops. The nature of the damage, methods of transmission and common methods of control.

Microscopic recognition of the causal organisms may be demonstrated where feasible.

7. Pests: a general account of pests of crop plants and stored products, their types and importance; principles and methods of pest control.

Study should include a general account of pests including rodents, birds and insects. An account should also be given of the life-cycle of a biting insect, e.g. grasshopper, a boring insect, e.g. a weevil, a sucking insect, e.g. an aphid.

SECTION D: Animal Science

1. A review (with emphasis on the Agricultural implications) of the organs and tissue of animals and their functions.

A discussion of various species of domestic animals, their uses, and the common breeds (exotic and local) of each of the species.

2. Farm Animals: purposes of their production. Types and economic value of domestic animals locally produced.

3. Elementary study of Animal Nutrition: Functions of carbohydrates, fats, proteins, minerals and vitamins. Feeding stuffs—sources of main nutrients; balanced rations; maintenance and production rations; malnutrition in farm animals.

Details of formulation of diets and biochemical details of these major nutrients are not required.

4. Reproduction in farm animals: heat period (oestrus); a general outline of the development, nourishment, respiration and birth of the young. Mammary glands; milk; lactation; egg formation; weaning of young.

Details of cell division and of the anatomy of the early embryo and the formation of the foetal membranes are not required.

5. Study of one animal from each of the following groups: study including the main aspects of general management, feeding and breeding.

- (a) cattle, sheep and goats;
- (b) pigs, rats and dogs;
- (c) rabbits, guinea-pigs, horses and donkeys;
- (d) chicken, ducks, turkey, guinea-fowl.

6. Animal improvement: aims, methods: introduction, selection and cross-breeding (including the use of artificial insemination).

Chromosomes and Mendel's 'Laws' need not be treated in detail. Comparison of a local breed and an improved breed of animal can be made for demonstration purposes.

7. Diseases: a general account of important diseases in farm animals. Control: preventive and remedial measures.

Local examples should be emphasized.

AGRICULTURAL SCIENCE (ORDINARY LEVEL)

SYLLABUS	NOTES
<p>8. Pests and parasites: insects and ticks as carriers of disease in farm animals. Life-history of one endoparasite of farm animals, e.g. liver-fluke, round-worm of pig, tape-worm of cow, trypanosomes; and one ectoparasite of farm animals, e.g. ticks or lice. The principles and methods of control of pests and parasites of farm animals.</p>	<p>Details of structure are not required.</p>

APPENDIX TABLE

List of annual and perennial crops (See SECTION C. 1.2 of Syllabus).

Group 1: *Cereals*: maize, millet, rice, guinea corn, wheat, tamba, acha.

Group 2: *Legumes*: beans, cow peas, groundnuts, soya beans, bambara-groundnuts, yam beans, pigeon pea.

Group 3: *Roots, tubers and vegetables*: cassava, yams, cocoyams, potatoes, sweet-potatoes, onion, charlots, pumpkins, tomatoes, carrots, okro, spinach, vegetable jute, lettuce, cabbage, cauliflower.

Group 4: *Edible fruits and nuts*: avocado pear, bananas, citrus fruits, guavas, mango, jackfruit, pawpaw, pineapple, cashew, water-melon.

Group 5: *Beverages, spices and drugs*: cocoa, coffee, colanut, peppers, benni-seed, ginger, sugar-cane.

Group 6: *Oils, latex and fibres*: coconut, cotton, oil palm, shea butter, sun-flower, sesame, rubber, sisal, kapok, jute, hemp.

PRACTICAL AGRICULTURAL SCIENCE

One hour and a half will be allowed for the practical test which can be taken in an ordinary classroom. The principal aim will be to test skill in observation and recognition. The practical note book covering the work of the entire syllabus, field work, farm diary and project work will be examined and assessed.

NOTE: It is assumed that candidates will have gained adequate experience of every practical aspect of the entire syllabus.

SYLLABUS	NOTES
<p>1. Soil samples, rocks, and fertilizers.</p>	<p>Soil samples are to be examined for texture by feel only, acidity by simple tests. Common rock types of igneous, metamorphic and sedimentary origin. Soil profile description. Recognition of common types of fertilizers and manures.</p>
<p>2. Growth, habitat and form of plants and animals studied as listed in Appendix Table (Groups 1 to 6) and sub-section 5 of Section D of the syllabus.</p>	<p>Recognition of parts and whole of the crop plants and farm animals studied.</p>

AGRICULTURAL SCIENCE (ORDINARY LEVEL)

SYLLABUS	NOTES
3. Main pests and diseases of crops.	Recognition of main pests, their damage to crops. e.g. cotton stainer, stem borers of cereals, weevils of grains and yam beetle. Recognition of main diseases of crops and their causal agents where feasible with characteristic symptoms, e.g. smut of cereals, maize-rust, swollen shoot of cocoa, mosaic of cassava, rosette and leaf-spot of groundnut, blast of rice and brown-rot of pineapple, nematodes of crops, parasitic seed bearing plants such as dodder and mistletoe, and nutrient deficiency symptoms.
4. Seeds, fruits, food storage organs and other parts of the main crop plants and local weeds.	Recognition of the structure of seeds and fruits of the main crop plants and of weeds in relation to the mode of their dispersal.
5. Tools.	Recognition of common hand tools, e.g. cutlasses, hoes, forks, mattock, trowels, rakes, budding knives, shears, secateurs, chain measurer, sprayer etc. and their uses and maintenance.
6. Animal feed-stuffs.	Recognition and comments on the use of main animal feed-stuffs, e.g. palm kernel meal, blood meal, bone meal, maize, guinea corn, groundnut cake, fish meal and common forage crops e.g. guinea grass, elephant grass, giant star grass, andropogon, calopogonium, pueraria, centrosema and stylosanthes.
7. Main pests and parasites of farm animals.	Recognition of main ectoparasites and endoparasites of animals, e.g. ticks, lice, tape-worms and round-worms, recognition of ill-health symptoms.

APPENDIX B

AGRICULTURAL SCIENCE QUESTIONS OF THE 1980
WEST AFRICAN SCHOOL CERTIFICATE AND
GENERAL CERTIFICATE OF EDUCATION
EXAMINATION

462 June
S.C./G.C.E. 1980
AGRICULTURAL
SCIENCE 2
Objective Test
1 hour

Candidate's Name Index Number

WEST AFRICAN EXAMINATIONS COUNCIL

School Certificate and G.C.E.

AGRICULTURAL SCIENCE 2

OBJECTIVE TEST

June 1980

1 hour

Do not open this book until you are told to do so. While you are waiting, read the following instructions carefully.

1. Use pencil throughout.
2. Write clearly in the spaces provided :
 - (a) your name and index number above on this question paper ; and
 - (b) your name on the answer sheet.

3. Index number. On the answer sheet, write down your index number vertically in the squares below the arrow. There are numbered spaces in line with each of the digits you have written down vertically. For each digit shade carefully the space with the same number as the digit. An example is given below for Index No. 41230068.



IDENTIFICATION NUMBER

4	0	1	2	3	4	5	6	7	8	9
1	0	1	2	3	4	5	6	7	8	9
2	0	1	2	3	4	5	6	7	8	9
3	0	1	2	3	4	5	6	7	8	9
0	0	1	2	3	4	5	6	7	8	9
0	0	1	2	3	4	5	6	7	8	9
6	0	1	2	3	4	5	6	7	8	9
8	0	1	2	3	4	5	6	7	8	9

INSTRUCTIONS*Attempt all the questions.*

Each question is followed by five options lettered A-E. Find out the correct option for each question and shade in pencil on your answer sheet the answer space which bears the same letter as the option you have chosen. Give only **one** answer to each question. An example is given below.

Example:

White Leghorn is the name of

- A. a disease of turkeys.
- B. a fungus living in the soil.
- C. a breed of chickens.
- D. an agricultural system.
- E. a harvesting machine.

Answer to the example:

The correct answer is the statement lettered C and therefore answer space C has been shaded.

A	B	C	D	E
<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>

Think carefully before you shade the answer spaces; erase completely any answer you wish to change. Do all rough work on the question paper.

Now answer the following questions.

1. The most dependable farm power or energy which could lead to increased agricultural productivity is
 - A. human power.
 - B. animal power.
 - C. sun's energy.
 - D. mechanical power.
 - E. hydro-electric power.

2. Why should the teaching of Agricultural Science be emphasized in schools?
 - A. To help students to understand the meaning of agriculture
 - B. To help students to teach their parents about plants
 - C. To increase students' knowledge of science
 - D. To enable students to understand the application of science
 - E. To provide the scientific basis of agriculture for students

3. Agriculture is important to the economy of many West African countries because it
 - A. encourages mechanization.
 - B. solves manpower problems.
 - C. provides foreign exchange.
 - D. encourages the development of technology.
 - E. leads to the establishment of agricultural banks.

3

4. Which of these will be the ultimate effect of increased government subsidy on agricultural equipment for local farmers ?
- A. Farmers will use machines and become lazy.
 - B. Farmers will manage their farms better.
 - C. Governments will control the prices of what the farmers produce.
 - D. Every local farmer will get a loan.
 - E. Agricultural productivity will increase.
5. Which of the following is **not** a function performed by extension workers ?
- A. Making the results of research known to local farmers
 - B. Distribution of fertilizers to farmers
 - C. Giving loans to farmers
 - D. Helping farmers to plan their planting
 - E. Instructing farmers on the use of fungicides and insecticides
6. The rearing of cattle is more common in the northern than in the southern parts of West Africa because
- A. the land in the south is more suitable for growing crops.
 - B. the pasture grass in the south is not very nutritious.
 - C. the north is cooler for animals.
 - D. insecticides are easier to apply in the north.
 - E. there are extensive areas of grassland in the north.
7. Mixed cropping can be explained as the system
- A. practised by literate farmers.
 - B. that guards against total crop failure.
 - C. in which a farmer plants different crops on different plots at a time.
 - D. in which crops are planted in staggered form.
 - E. in which taller crops are used to protect the shorter ones from heat.
8. Which of these is the most complete reason for encouraging afforestation in West African countries ?
- A. To provide timber and fuel
 - B. To shade the land and supply fuel
 - C. To meet the needs for food and shelter, and to prevent soil erosion
 - D. To supply timber and fuel and check soil erosion
 - E. To provide wind break
9. The most probable way to overcome the land tenure problem in your area is
- A. to allow the traditional rulers to control all land.
 - B. to allow religious leaders to control all agricultural land.
 - C. to encourage farmers to form co-operative societies based on land holdings.
 - D. to encourage family ownership of land.
 - E. to fragment the land for individuals for careful planning.

4

10. What are disc-harrows used for ?
- A. To uproot stumps
 - B. To uproot weeds and apply fertilizers
 - C. To sow different types of seeds
 - D. To make holes for transplanting of tree crops
 - E. To break up soil lumps and level surfaces after ploughing
11. The degree of soil erosion is **not** affected by
- A. the amount of vegetation cover on the soil.
 - B. leaching of soil nutrients.
 - C. rainfall.
 - D. the slope of land.
 - E. the physical nature of the soil.
12. The amount of soil water in any soil does **not** depend on
- A. the soluble materials in the soil.
 - B. the air spaces between the particles.
 - C. the humus content of the soil.
 - D. the texture of the soil.
 - E. the structure of the soil.
13. Nitrogen is available to plants in the form of
- A. nitrogen solution.
 - B. ammonia solution.
 - C. nitrite.
 - D. nitrate.
 - E. nitrogen gas.
14. Iron is an essential element for most plants, but it is particularly necessary for the development of
- A. hormones.
 - B. succulent stems.
 - C. chlorophyll.
 - D. succulent fruits.
 - E. fibrous roots.
15. If a farmer discovers that his farm soil is acidic, which of these should he use to reduce the acidity ?
- A. Ammonium sulphate
 - B. Calcium hydroxide
 - C. Sodium hydroxide
 - D. Potassium phosphate
 - E. Ammonium phosphate

5

16. Why are silt and clay fractions considered to be very important in any agricultural soil ?
- A. They supply chemical fertilizer to the soil.
 - B. They have greater exposed surface areas containing readily available plant nutrients.
 - C. They contain plenty of manganese required by plants in large quantities.
 - D. They are sticky and thus do not allow insect pests to burrow easily into the soil.
 - E. They are more suitable fractions for agricultural mechanization.
17. Soil organisms which feed on dead remains of plants and animals are called
- A. saprophytes.
 - B. fungi.
 - C. protozoa.
 - D. parasites.
 - E. algae.
18. Which of the following is **not** a reason why the soil is cultivated before planting ?
- A. To improve soil aeration
 - B. To kill weeds and weed seeds
 - C. To loosen the soil for root penetration
 - D. To provide a proper medium for germination of seeds
 - E. To destroy harmful crop pests and disease agents in the soil
19. A soil is considered good for plant growth if it is
- A. bulky and loamy.
 - B. loose, porous and of crumb structure.
 - C. of crumb structure and heavily leached.
 - D. of crumb structure and loamy.
 - E. loose, porous and of prismatic structure.
20. The type of rock formed when a molten mass from the interior of the earth extrudes to the earth's surface is
- A. magma.
 - B. sedimentary.
 - C. metamorphic.
 - D. igneous.
 - E. conglomerate.
21. Cassava tuber is not usually planted because it
- A. is used in producing garri.
 - B. contains too much carbohydrates.
 - C. is not resistant to most diseases.
 - D. has a very thick scale covering.
 - E. does not contain buds.

6

22. Sweet orange does not thrive well
- A. on undulating land.
 - B. on slightly sloping land.
 - C. in deep soils.
 - D. in sandy soils.
 - E. in clay loam soils.
23. Oil palm estates should be near the extraction factories because
- A. planters want to supervise the extraction process.
 - B. oil palm fruits rot within a relatively short time.
 - C. oil palm fruits are not easily harvested.
 - D. the fruits will absorb moisture if exposed for too long.
 - E. pests will eat up the fruits.
24. Most varieties of rice grow best on
- A. gentle slopes.
 - B. hilly land.
 - C. steep slopes.
 - D. flat land.
 - E. ravines.
25. Maize belongs to the family of plants called
- A. vegetables.
 - B. grasses.
 - C. trees.
 - D. legumes.
 - E. weeds.
26. The following are given as reasons why farmers must pay attention to the planting distances of their crops:
- I. To provide room for roots to grow
 - II. To provide room for weeding
 - III. To provide space for the farmer to walk between rows
 - IV. To make it difficult for insects to attack crops
 - V. To provide space in between plants at maturity
- Which of the options A to E is correct ?
- A. I, II, III, IV and V
 - B. I, II, III and IV only
 - C. I, II, III and V only
 - D. II, III, IV and V only
 - E. II, III and IV only
27. The collective name for chemicals used in controlling insect pests is
- A. herbicides.
 - B. shelltox.
 - C. gammalin.
 - D. insecticides.
 - E. D.D.T.

7

28. Which of the following is an annual weed?
- A. *Aspilia africana*
 - B. *Tridax procumbens*
 - C. Carpet grass
 - D. Finger grass
 - E. *Imperata cylindrica*
29. Cassava mosaic is transmitted through
- A. a deposit of fungus hyphae.
 - B. piercing and sucking insects.
 - C. absorption from the soil.
 - D. chewing insects.
 - E. inheritance.
30. Which of these plant diseases is not caused by fungus?
- A. Yam mosaic
 - B. Rice blast
 - C. Stalk or root rot of rice
 - D. Leaf spot of cassava
 - E. Leaf blight of maize
31. If you were a poultry farmer, which of these types of chickens would you stock for egg production only?
- A. Rhode Island Red
 - B. White Leghorn
 - C. Plymouth Rock
 - D. Sussex
 - E. New Hampshire
32. The main reason why farmers give maintenance rations to their farm animals is to
- A. provide energy for growth.
 - B. improve milk production.
 - C. provide energy for work.
 - D. carry out body processes and repairs.
 - E. increase disease resistance.
33. The gestation period in pigs is about
- A. 112-115 days.
 - B. 365-366 days.
 - C. 9 months.
 - D. 160-170 days.
 - E. 11 months.
34. When a sow has a swollen vulva with mucous discharge, emits a loud grunting noise, and is restless, the indications are that it is likely to
- A. be suffering from mastitis.
 - B. be suffering from a venereal disease.
 - C. be on heat.
 - D. have been bitten by a tsetse fly.
 - E. have just been mated by a male.

8

35. Which of these farm animals is reared for wool production in wool-producing countries ?
- A. Cattle
 - B. Goat
 - C. Sheep
 - D. Horse
 - E. Swine
36. Which of the following statements about goats is **not** correct ?
- A. Goat milk is not good for human consumption.
 - B. Goats are very good foragers.
 - C. Goat meat is acceptable among Muslim communities.
 - D. Goats browse on a variety of vegetation.
 - E. Goats have an appetite for many edible materials.
37. In a country where there is *urgent* need for *acceptable* animal protein supply, which of these animals should be reared to meet the immediate demand ?
- A. Cattle
 - B. Poultry
 - C. Rabbits
 - D. Goats
 - E. Sheep
38. What is the term used to describe the method of breeding which relies on the introduction of semen into the mature female by the animal breeder ?
- A. Cross-breeding
 - B. Castration
 - C. Artificial insemination
 - D. Hybridization
 - E. Inbreeding
39. Why are prevention and control of plant and animal diseases necessary ?
- A. The affected plants and animals usually die.
 - B. Diseases disturb plants and animals.
 - C. All plant and animal diseases also affect man.
 - D. Diseases cause a decrease in production.
 - E. Diseases are difficult to detect.
40. A cattle or sheep grazing near water containing snails is likely to be infected by
- A. liver fluke.
 - B. trypanosomiasis.
 - C. hookworm.
 - D. tapeworm.
 - E. water fever.

463 June
S.C./G.C.E. 1980
AGRICULTURAL
SCIENCE 3
2 hours

WEST AFRICAN EXAMINATIONS COUNCIL
School Certificate and G.C.E.
AGRICULTURAL SCIENCE 3

June 1980

2 hours

*Answer four questions: one from each Section.
All questions carry equal marks.*

SECTION A

Answer one question from this Section.

1. (a) Discuss the importance of **either** crop production **or** animal production in your national economy.

(b) What are the limiting factors to the development of the area of production you have chosen?

2. Considering the present traditional methods of farming in most West African countries, what would be the impact of Science and Technology, if applied on a larger scale, on the development of agriculture in this area?

3. (a) Discuss the essential climatic factors that determine the distribution of **two named** cereal crops and **two named** tree crops in most West African countries.

(b) What are the functions of the forestry department in your country?

SECTION B

Answer one question from this Section.

4. 'Without the interaction of rocks, physical forces, and the activities of living organisms, there would be no soil.' Discuss.

5. (a) Name **three** chemical fertilizers and **one** major nutrient that each fertilizer supplies.

(b) Which of the fertilizers would you recommend for growing leafy vegetables and why?

(c) How is the fertilizer mentioned in (b) applied?

(d) What are the advantages of chemical fertilizers?

SECTION C

Answer one question from this Section.

6. With reference to a *named* vegetable, describe the sequence of operations, from cultivation to storage, which would enhance yield, good storage and good market quality.

7. (a) Define the term 'pest' in relation to crop production.

(b) Discuss the significance of each of the following groups of pests in crop production in West Africa:

(i) stem borers of cereals,

(ii) grain weevils,

(iii) rodent pests.

(c) How are the pests mentioned in (b) normally controlled?

SECTION D

Answer one question from this Section.

8. Discuss cattle under the following headings:

(a) General management;

(b) Feeding;

(c) Breeding.

9. Write *short* notes on **five** animal diseases of economic importance in West Africa. At least **one** nutritional deficiency disease should be discussed.

APPENDIX C

QUESTIONNAIRE - PART I, SCHOOL HEADS

QUESTIONNAIRE PART I

Responses requested from School Heads (Administrators)

1.

Name of School	Town	Region
----------------	------	--------
2. What has been the average student population (Forms 1-5) for the past five academic years, September 1976 to June 1981? Please check (✓) one.

a) 399 & below ()	d) 600 to 699 ()	g) 900 & above ()
b) 400 to 499 ()	e) 700 to 799 ()	
c) 500 to 599 ()	f) 800 to 899 ()	
3. How many Agricultural Science teachers do you have in your school? (Please check (✓) one.

a) One ()	c) Three ()	e) Five ()
b) Two ()	d) Four ()	
4. What would you say is the most common occupation practiced by the majority of your students' parents? Please check (✓) one.

a) Farming ()	c) Office ()
b) Trading ()	d) Other (Please specify) _____
5. What is the total land size of your school? Please answer in acres. Please check (✓) one.

a) 100 and below ()	d) 301 to 400 ()	g) 601 to 700 ()
b) 101 to 200 ()	e) 401 to 500 ()	h) 701 and above ()
c) 201 to 300 ()	f) 501 to 600 ()	
6. What percentage of your entire school land would you say is used for the school compound with all buildings including the area for teachers' residences. Please check (✓) one.

a) 20% or less ()	d) 60.1% to 80% ()
b) 20.1% to 40% ()	e) 80.1% to 100% ()
c) 40.1% to 60% ()	
7. What percentage of your entire school land would you say is currently being used for agricultural teaching purposes (student gardens, experimental plots & demonstration farms)? Please check (✓) one.

a) 5% or less ()	d) 15.1% to 20% ()
b) 5.1% to 10% ()	e) 20.1% to 25% ()
c) 10.1% to 15% ()	f) 25.1% and above ()
8. What percentage of your entire school land is used to produce food crops and/or livestock for use by the school's kitchen? Please check (✓) one.

a) None ()	d) 10.1% to 15% ()	g) 25.1% and above ()
b) 5% or less ()	e) 15.1% to 20% ()	
c) 5.1% to 10% ()	f) 20.1% to 25% ()	
9. What is the average number of students who complete Form 5 in your school each year during the past five academic years? Please check (✓) one.

a) 25 to 50 ()	d) 101 to 125 ()	g) 176 to 200 ()
b) 51 to 75 ()	e) 126 to 150 ()	
c) 76 to 100 ()	f) 151 to 175 ()	
10. Approximately what percentage of your Form 5 students attempt Agricultural Science at G.C.E. 'O' level each year during the past five academic years? Please check (✓) one.

a) None ()	c) 21% to 40% ()	e) 61% to 80% ()
b) 1% to 20% ()	d) 41% to 60% ()	f) 81% to 100% ()

11. In your judgment as headmaster/headmistress, after a student has studied through the five years of secondary school G.C.E. 'O' level Agricultural Science program, how equipped is he/she in terms of mechanized agricultural skills to enter into productive farming as a career after school if no higher formal education is pursued? Please check (✓) one.

- | | |
|-----------------------------|------------------------|
| a) Very highly equipped () | d) Fairly equipped () |
| b) Highly equipped () | e) Poorly equipped () |
| c) Equipped () | |

Please give your opinion on the following by checking (✓) the box that best expresses your feeling.

Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree

12. The teaching of agricultural mechanics should receive more attention in the Ghanaian secondary schools' agricultural program to provide students with knowledge and skills toward mechanizing Ghanaian agriculture.

Consider the need and how feasible it would be, using the current available or possible resources of the school and the country to teach the following areas of Agricultural Mechanics in the Ghanaian secondary schools, and check the appropriate box which best indicates your opinion as to the extent of teaching emphasis needed.

SECTION A (FARM SHOP WORK)

13. Shop tools and equipment
14. Woodwork and farm carpentry
15. Paint work
16. Metal work
17. Rope and leather work

Always	Greater Extent	Moderate	Little Extent	None

SECTION B (FARM POWER AND MACHINERY)

18. Farm motors
19. Trucks and tractors
20. Transmission of power
21. Farm machinery

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SECTION C (FARM STRUCTURES AND CONVENIENCES)

22. Farm buildings
23. Concrete work
24. Farm home conveniences and sanitation
25. Fencing

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SECTION D (RURAL DEVELOPMENT)

26. Rural electrification

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SECTION E (RESOURCE CONSERVATION)

27. Soil and water management

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APPENDIX D

QUESTIONNAIRE - PART I, AGRICULTURAL
SCIENCE TEACHERS

QUESTIONNAIRE PART II

Response Requested from Agricultural Science Teachers

1. _____
 Name of School Town Region

2. To what extent are the following sources of power used for agriculture in the school?

- a) Manpower or hand labor
- b) Working animals such as horses and/or bulls
- c) Small gas (petrol) engines such as lawn mowers, chain saws and rototillers
- d) Heavy machines such as tractors and combine harvesters
- e) Other. (Please Specify) _____

	Always	Great Extent	Moderate	Little Extent	None
a)					
b)					
c)					
d)					
e)					

3. To what extent are the following tools and equipment used for agriculture in the school?

- a) Small hand tools such as cutlasses (machettes), axes, hoes, hand forks, etc.
- b) Machine operated tools or equipment such as plows, discs, etc.
- c) Other. (Please Specify) _____

	Always	Great Extent	Moderate	Little Extent	None
a)					
b)					
c)					

4. In your judgment as an agricultural science teacher, after a student has studied through the five years of secondary school G.C.E. 'O' level agricultural science program, how equipped is he/she in terms of mechanized agricultural skills to enter into production farming as a career after school if no higher formal education is pursued? Please check (✓) one.

- a) Very highly equipped ()
- b) Highly equipped ()
- c) Equipped ()
- d) Fairly equipped ()
- e) Poorly equipped ()

Please give your opinion of the following by checking (✓) the box that best expresses your feeling.

5. The teaching of agricultural mechanics should receive more attention in the Ghanaian secondary schools agricultural program to provide students with knowledge and skills towards mechanizing Ghanaian agriculture.

	Strongly Agree	Agree	No opinion	Disagree	Strongly Disagree

Consider the need and how feasible it would be, using the current available or possible resources of the school and the country to teach the following areas of agricultural mechanics in the Ghanaian secondary schools, and check the appropriate box which best indicates your opinion as to the extent of teaching emphasis needed.

SECTION A (FARM SHOP WORK)

6. Shop tools and equipment

- a) Developing a home-farm shop
- b) Selecting and using hand tools
- c) Selecting and using power tools
- d) Maintaining and repairing tools

	Always	Great Extent	Moderate	Little Extent	None
a)					
b)					
c)					
d)					

7. Woodwork and farm carpentry

- a) Making simple sketches and reading blueprints
- b) Selecting and caring for lumber
- c) Selecting and using nails, screws, bolts, and glue
- d) Woodworking and farm carpentry projects

	Always	Great Extent	Moderate	Little Extent	None
a)					
b)					
c)					
d)					

8. Paint work

- a) Painting
- b) Refinishing
- c) Glazing

	Always	Great Extent	Moderate	Little Extent	None
a)					
b)					
c)					

9. Metal work

- a) Metal work equipment and their uses
- b) Electric arc welding
- c) Oxyacetylene welding
- d) Hot metal work
- e) Cold metal work
- f) Cutting, bending and fastening sheet metal
- g) Soldering

	Always	Great Extent	Moderate	Little Extent	None
a)					
b)					
c)					
d)					
e)					
f)					
g)					

	Always	Great Extent	Moderate	Little Extent	None		Always	Great Extent	Moderate	Little Extent	None
10. Rope and leather work						16. Concrete work					
a) Selecting and using rope						a) Understanding the uses and composition of concrete					
b) Selecting and using leather						b) Determining quantities and proportions for concrete mixtures					
c) Repairing and preserving leather						c) Mixing, pouring, curing and reinforcing concrete					
SECTION B (FARM POWER AND MACHINERY)						d) Making concrete (cement) blocks					
11. Farm motors (engines)						e) Using concrete blocks and concrete					
a) Understanding the fundamental principles of engines						17. Farm/home conveniences and sanitation					
b) Operating small gas farm engines						a) Establishing farm water supply systems					
c) Engine trouble shooting						b) Selecting and using plumbing equipment					
d) Small gas engine repair and maintenance						c) Establishing farm sewage disposal systems					
12. Trucks and tractors						d) Cooling the farm home					
a) Operating farm tractors						18. Fencing					
b) Repairing and maintaining farm tractors						a) Constructing fences					
c) Operating farm trucks						b) Maintaining and repairing fences					
d) Repairing and maintaining farm trucks						SECTION D (RURAL DEVELOPMENT)					
13. Transmission of power						19. Rural electrification					
a) Selecting and using farm belts						a) Understanding the fundamentals of electricity					
b) Repairing farm belts						b) Wiring the farmstead (home)					
14. Farm machinery						c) Selecting and using electric motors					
a) Selecting and using farm machinery						d) Maintaining and repairing electric motors					
b) Maintaining and repairing farm machinery						SECTION E (RESOURCE CONSERVATION)					
c) Constructing labor-saving farm equipment						20. Soil and water management					
SECTION C (FARM STRUCTURES AND CONVENIENCES)						a) Using contour farming, strip cropping and grassed waterways					
15. Farm buildings						b) Terracing to control soil erosion					
a) Constructing farm buildings						c) Providing farm drainage and irrigation system					
b) Maintaining and repairing farm buildings											

APPENDIX E

LETTER ACCOMPANYING QUESTIONNAIRE TO THE
SECONDARY SCHOOLS IN GHANA

235 Agricultural Hall
Oklahoma State University
Stillwater, OK 74074
U.S.A.
February 4, 1981

Dear Sir/Madam:

I am a Ghanaian graduate student in the above named university, pursuing a Master of Science degree in Agriculture.

I am currently conducting a research study for my thesis, the title of which is:

"PROMOTING THE TEACHING OF AGRICULTURAL MECHANICS IN THE
SECONDARY SCHOOLS OF GHANA."

I need answers to a few questions from the Headmasters or Headmistresses and the Agricultural Science Teachers of selected secondary schools in Ghana.

It is my greatest pleasure to consider your institutions as one of the few representative schools. I will therefore be very grateful if you could respond to Part I of the enclosed questionnaires, and let your agricultural science teacher also respond to Part II, so that you might return them to me in the enclosed, self-addressed envelope by the 30th of April, 1981. Thank you.

Yours sincerely,

N. K. Appiah

HEADMASTER/HEADMISTRESS
REPRESENTATIVE SECONDARY SCHOOLS
GHANA, WEST AFRICA

APPENDIX F.

LETTER FROM MR. G. K. BRESE, ASSISTANT
DIRECTOR (AGRICULTURAL EDUCATION),
GHANA EDUCATION SERVICE

GHANA EDUCATION SERVICE

In case of reply the number and date of this letter should be quoted

My Ref. No. TT.485/191.....

Your Ref. No.....



REPUBLIC OF GHANA

HEADQUARTERS

Ministry Branch Post Office

P. O. Box M 45

Accra, Ghana

17th June,19.81.

TO WHOM IT MAY CONCERN

Mr. N.K. Appiah, a Ghanaian graduate student in Oklahoma State University is pursuing his Master's degree studies with his thesis on the topic;

" PROMOTING THE TEACHING OF AGRICULTURAL MECHANICS IN THE SECONDARY SCHOOLS OF GHANA."

Mr. Appiah wants the opinion and judgements of agricultural science teachers and administrators of representative Secondary Schools in Ghana on the feasibility of implementing such a programme.

I should be grateful for your assistance to Mr. Appiah in his research.

Sincerely yours,

(G.K. BRESE)
ASSISTANT DIRECTOR (AGRIC. EDUC.)
for: DIRECTOR-GENERAL.

Note: The author wishes to explain that the title of the study at the time this letter was issued was as stated in the letter; however, it was later found more appropriate to change the title to "Agricultural Mechanics at the Secondary School Level in Ghana."

VITA I

Nyantakyi Kwasi Appiah

Candidate for the Degree of

Master of Science

Thesis: AGRICULTURAL MECHANICS AT THE SECONDARY SCHOOL LEVEL
IN GHANA

Major Field: Agricultural Education

Biographical:

Personal Data: Born in Kukurantumi-Akim, Ghana, August 20, 1951, the son of Opanin Kwaku Nyantakyi and Madam Margaret Ohenewa Doky. Married Doris H. Adjei, two children; Phillip and Margaret.

Education: Attended Agona Swedru Secondary School, Government Post Secondary Teachers Training College at Peki, and Agricultural Specialist Teachers College at Mampong Ashanti; received the Bachelor of Science in Agriculture degree from Oklahoma State University in 1979; completed the requirements for the Master of Science degree in May, 1982.

Professional Experience: Middle School Teacher, Seventh Day Adventist Middle School, Kukurantumi-Akim, Ghana, 1970; Agricultural Science Teacher, Ghana Secondary School, Koforidua, 1975.