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GHANA LIVESTOCK DEVELOPMENT HANDBOOK

A.I.D. HISTORICAL AND
TECHNICAL REVISION
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U.S. AID MISSION TO GHANA
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GHANA LIVESTOCK DEVELOPMENT HANDBOOK

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To the USAID-trained technicians, who are carrying out the work laid down by this publication and contributing to the development of the country, go many sincere thanks. These and other trained technicians are the ones who can successfully carry out an effective livestock program.

JACK WALKER
USAID National Livestock Advisor

INTRODUCTION

"A workman is no better than the tools he works with." A livestock enterprise can progress no faster than the efficiency and application of systems of animal and poultry management and the capacity of breeds to utilize these systems. To this end, the methods in this publication are designed to aid the Ghana farmers to improve, progressively, their livestock industries.

Progress in livestock and poultry improvement in Africa is a complex process. Each country has problems which are unique to its area which govern the adaptations of development systems used in other areas of the world. In this publication, an approach to livestock development, which was used by the USAID Mission to Ghana in cooperation with the Ministry of Agriculture, is presented.

The following guidelines were used:

1. There are technical answers to technical problems but they are usually modified by social and economic problems.
2. People react when they understand and accept. Education brings understanding.
3. Desire and the will to accomplish by self-indulgence is a pre-requisite of success.
4. Errors and experiences of the past help in planning the future.
5. A livestock industry must have market incentives and infrastructure.
6. Techniques cannot be transferred in their entirety from one environment to another. Ecological, sociological, and economic conditions are not uniform. Some activities must precede others while some cannot be utilized at all. No single group or agency can successfully cope with the total problem. The applicable responsibilities of implementation must be vested in many cooperating agencies of a government.
7. The supporting inputs responsible for livestock output have to be balanced.

In 1958, the Government of Ghana requested the technical cooperation of the United States Government in the development of a livestock program. A series of programs were designed to improve on the development of livestock. One of the major elements was a participant training program, which had achieved its purpose at the close of the project in 1967. The Government of Ghana now has a nucleus capable of formulating and carrying out a progressive livestock program. The participants serve as Ministry heads, college lectures, farm managers, and technicians specialized in artificial insemination.

BACKGROUND

Ghana is a country about the size of the State of Oregon in the United States and covers an area of slightly more than 92,000 square miles, with a population estimated at eight million people. Twenty-four tribal groups make up the population; the principal ones being Ga, Ewe, Fanti, Ashanti and Adangbe. Education has been patterned after the British system but shows signs of moderation. Literacy is estimated to be 25 percent. Roads are reasonably good and passable throughout the year. Improvement to agriculture or market access roads would greatly increase the potential output of the country and enable the development of cropping areas at present idle. There is an increased interest in small livestock development projects by civil servants and private businessmen.

About 60 percent of the population is engaged in agriculture. The country is divided into three main areas: (1) the northern savanna lying north of longitude 8°; (2) the rain forest area situated between longitude 6° and 8°; and (3) the Accra plains lying south of longitude 6° and located in the eastern half of the country. Livestock and poultry concentrates are produced and harvested in the northern savanna and Accra plains. The rain forest area is not suitable for large scale livestock farming and is, therefore, limited mainly to poultry production and close-house swine projects.

Climate

The climate is humid and the temperatures range from 70° to 108° Fahrenheit. The average mean daily temperature is 81° Fahrenheit. Rainfall distribution throughout the

year is concentrated into one major and one minor season for the majority of the regions and into only one season in other locations. Four weather zones within Ghana may be defined as near as possible as follows: (See Map 3). (1) A single rainy season where the monthly totals rise slowly from March with a check in June or July until a maximum is reached in August or September. Monthly totals then decreases sharply. This type occurs north and east of a line running through Wa ($10^{\circ} 04'N$, $02^{\circ} 30'W$) and Salaga $08^{\circ} 33'N$, $00^{\circ} 31'W$); (2) A single rainy season between March and October with not much variation between the monthly totals. This area is bounded on the north by the first type and on the south by a line running through Kintampo ($08^{\circ} 03'N$, $01^{\circ} 44'W$) and the Hohoe ($07^{\circ} 09'N$, $00^{\circ} 29'E$); (3) Two rainy seasons with the monthly totals reaching their maximum in May to June and October. The totals in each of these months are similar and the periods December to February and July, August, early September are much drier than the rest of the year. This area is bounded on the north by the second type and on the south by a line through Wiawso ($06^{\circ} 12'N$, $02^{\circ} 29'W$) and Keta ($05^{\circ} 55'N$, $00^{\circ} 59'E$); (4) Two rainy seasons, the principal reaching its maximum in May and June and the subsidiary in October. This affects the whole coastal plain. There are two sub-divisions of this type, almost sufficiently different to be classed as separate types. In the West, the principal maximum (associated with the greatest rainfall in the country) is particularly well marked. In the East, (associated with the lowest rainfall in the country), there is no noticeable minor season evident.

January is a dry month throughout the country, although the driest month in the eastern coastal regions is in August. Considerable variations exist between successive rainy seasons in the time of onset, duration and amounts received. In some

seasons, individual rainfalls are numerous and well distributed and in others, scattered and infrequent. An example is the (tear shaped) area running from the Accra suburbs east to a point between Nungua and Ashiamang.

It is estimated that Ghana has 58,000 square miles of natural grassland which consists of interior and coastal savanna, separated from each other by a forest zone. The interior savanna consists of guinea savanna in the northern and upper regions and derived savanna in the north Ashanti and Brong-Ahafo regions. The most prominent grasses of the interior savanna are *Andropogon* and *Hyparrhenia* species. The coastal savanna comprises the Accra and Ho-Keta plains where most important grass genera are: Brachiara, Veteveria, Andropogon and Monocybum. The protein content of these grasses is extremely low due to the slow build up of soil nutrients under the effect of tropical climate and present soil management practices. Legumes usually planted for livestock consumption under semi-tropical conditions, such as alfalfa, lucerne and clovers, do not grow well enough in Ghana to be economical to plant. Taking this into consideration, several different legumes were introduced into the country to test their adaptability under the local conditions. These legumes are Centrosema, Stylosanthes gracilis and alyce clover, all of which grow reasonably well. Alyce clover matures under local conditions and will reseed itself. Seed harvest from Centrosema and Stylosanthes is difficult and the relatively high cost of imported seed, which is about \$3.00 per pound in Accra, makes it too expensive for the Ghanaian farmer to purchase. Alyce clover may prove to be the most useful since both the planting and seed harvesting of this legume is relatively easy.

KEY TO GHANA'S GENERAL PATTERN OF LAND USE

1. Compound farming area.

Interior Savanna Zone

- 1 and 3 compound farming mixed with land rotation as in three.
2. Grazed grassland with rare land rotation as in 3.
3. Land rotation with grazed tree savanna regrowth fallow.
4. Less intensive land rotation with sparsely grazed tree savanna regrowth fallow and scattered patches of 5.
5. Little cultivated ungrazed tree savanna, including forest reserves.

Derived Savanna Zone

6. Land rotation with cocoa in forest cutliers mixed with less intensive land rotation in more extensive patches of savanna.
7. Less intensive land rotation with tree savanna regrowth fallow and some small cultivated forest outlines.
8. Little cultivated, ungrazed tree savanna mixed with occasional patches of incompletely developed closed forest or secondary forest.

Forest Zone

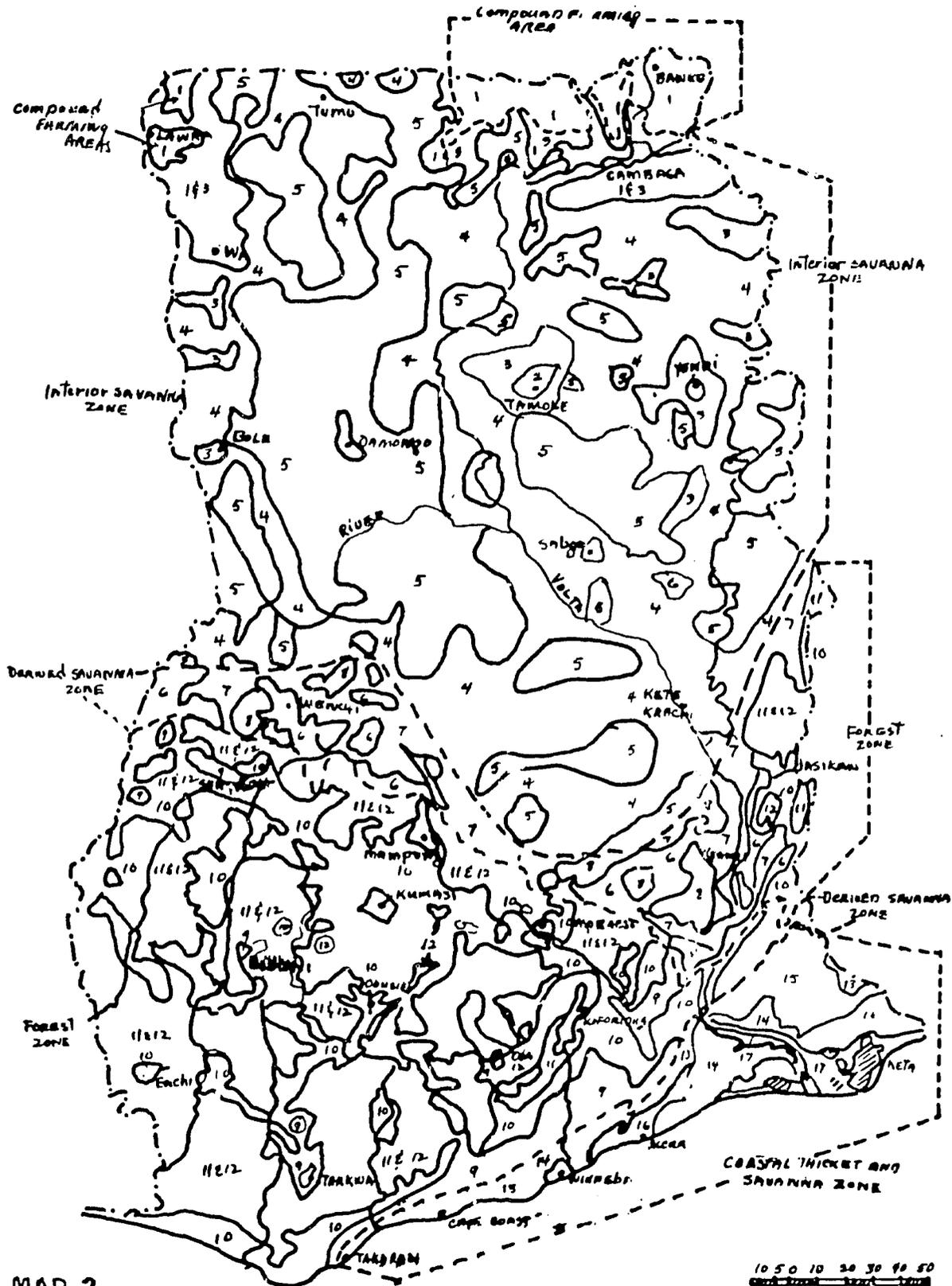
9. Intensive land rotation with little forest remaining area of most commercialized food cropping.
10. Land rotation with small percentage of forest remaining; area of most extensive established cocoa, including area of newest cocoa planting, especially in the northwest.
11. Less intensive land rotation with much forest remaining.
12. Little farmed closed forest, including forest reserves area (outside of reserves) of most active timber harvest; owing to limitations, scales 11 and 12 have been mapped together over much of the zone.

Coastal thicket and savanna zone

13. Coastal thicket
14. Grass savanna
15. Tree savanna
16. Savanna thicket transition area.
17. Lagoons and marshes.

Reference - Figure 47 - Agriculture and Land Use in Ghana:
Published by Ministry of Agriculture 1962.

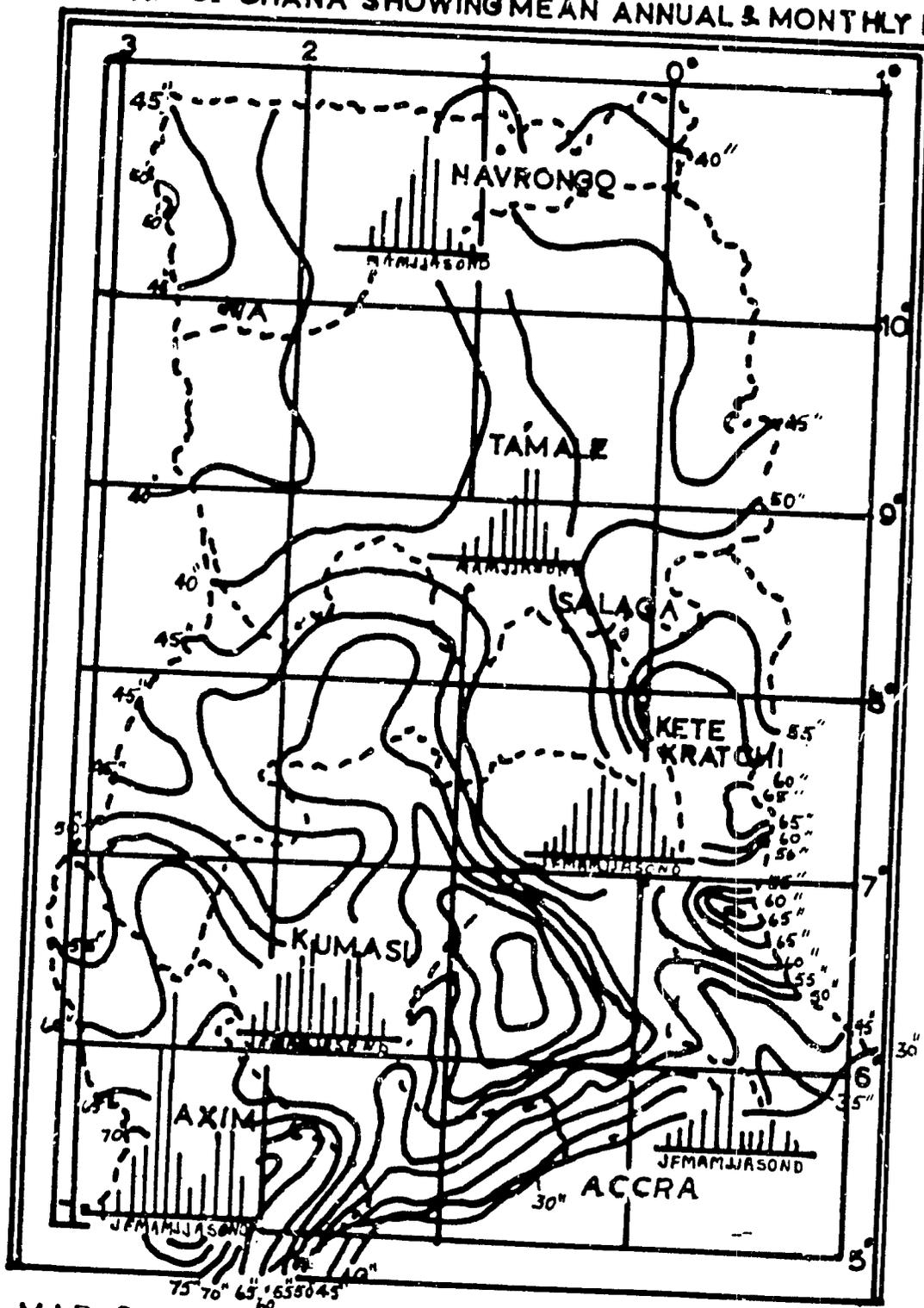
GHANA'S GENERAL PATTERN OF LAND USE



MAP 2

0 10 20 30 40 50
MILES

MAP OF GHANA SHOWING MEAN ANNUAL & MONTHLY RAIN



MAP 3

The University of Ghana and the Animal Research staff of the Ghana Academy of Sciences have been experimenting with grasses and legumes collected from various regions of the world. Seeds of these have been planted in small test plots but very few have been tried on farmers' fields. To date, very little of this work has been of practical value to the cattle farmer. Future results may be beneficial if seed stocks are available; however, with the exception of the legumes, it would appear to be more fruitful to test and improve those local grasses which are considered of economic value. Strains of these local grasses should also be developed.

Cattle

The breeds of livestock in Ghana are made up of the indigenous animals and crosses resulting from the infusion of cattle breeds from neighboring countries. European, American, Russian and Indian cattle have been used in experiments aimed at upgrading the local breeds. This was done by importing both live animals and semen.

Cattle Population

TABLE 1 - GHANA CATTLE CENSUS FIGURES

Animals	1963	1964	1965	1966
Cattle	476,000	472,000	497,000	528,000
Sheep	485,000	468,000	478,000	486,000
Goats	523,000	489,000	490,000	412,000
Pigs	50,000	35,000	42,000	80,000
Poultry	1,000,000	1,000,000	950,000	941,000

Animal Diseases

The major animal diseases of economic importance within the country are: Rinderpest, Contagious Bovine Pleuro Pneumonia, Anthrax, Trypanosomiasis of cattle; New Castle and Fowl Pox of poultry. Rabies is also very prevalent within the country and many animals are infected. Brucellosis is recognized now as a major deterrent to an expanding animal industry.

Many of these diseases can be controlled by vaccinations and the Animal Health Division has carried out an active program during the past four years, as shown in Table 2:

TABLE 2 - NUMBER OF VACCINATIONS IN THE YEARS 1963-1966 PERFORMED BY THE ANIMAL HEALTH DIVISION

Disease	1963	1964	1965	1966
<u>Cattle</u>				
Rinderpest ⁺⁺	185,738	159,992	270,843	346,349
C.B.P.P. ⁺	335,335	331,963	273,045	-
Anthrax	45,901	23,012	46,342	-
Trypanosomiasis	55,011	4,998	9,721	9,856
<u>Poultry</u>				
New Castle	1,069,285	1,221,918	1,534,625	-
Fowl Pox	-	263,424	480,000	-
<u>Government Organization</u>				

The direction for animal husbandry work lies with the Ministry of Agriculture. In June 1967, the Animal Husbandry Division which set the program of animal breeding and improvement, was dissolved and its duties spread to three other divisions, Extension, State Farms, Services and Supplies. The efforts to maintain the proper technical support needed in the country's development program has been hindered by the lack of qualified personnel to fill the established positions; as an example, 40 percent of the established positions in the Animal Health and Husbandry are vacant.

⁺⁺ Regionally-sponsored Campaigns operated with equipment furnished by USAID.

⁺ Contagious Bovine Pleuro Pneumonia.



Figure 1 - A chronic case of a skin disease found in Ghana. To date, no cure has been found; although research work is being carried on to determine the cause and method of control. It may become a disease of economic importance if it continues to spread. All livestock owners should report all cases to the nearest veterinarian.

TABLE 3 - STAFFING PATTEEN, DIVISION OF ANIMAL HEALTH

Position Title	Positions		
	Established	Filled	Vacant
Chief Veterinary Officer	1	1	-
Deputy Chief Animal Husbandry Officer	1	1	-
Deputy Chief Veterinary Officer	1	-	1
Principal Veterinary Officers	3	3	-
Veterinary Investigation Officers	2	-	2
Veterinary Officers	15	5	11
Assistant Veterinary Officers	3	3	-
Principal Livestock Officer	1	1	-
Principal Stock Superintendent	1	1	-
Senior Stock Superintendent	2	2	-
Stock Superintendents	16	11	5
Senior Veterinary Assistants	19	18	1
Veterinary Assistants	73	50	23
Total	138	95	43

There are only 18 veterinarians in all of Ghana. Animal Husbandry Division has 40 positions vacant.

Trained Technicians

To carry out specific tasks required for successful operations, trained people must be behind every effective organization or business. This is true in the field of animal industry in Ghana. USAID/Ghana realizing this, programmed to provide the Ghana Government with technically qualified personnel in the field of animal husbandry and health. Degree courses were the first consideration followed by short term specialized training in areas which would increase the productivity of the production program.

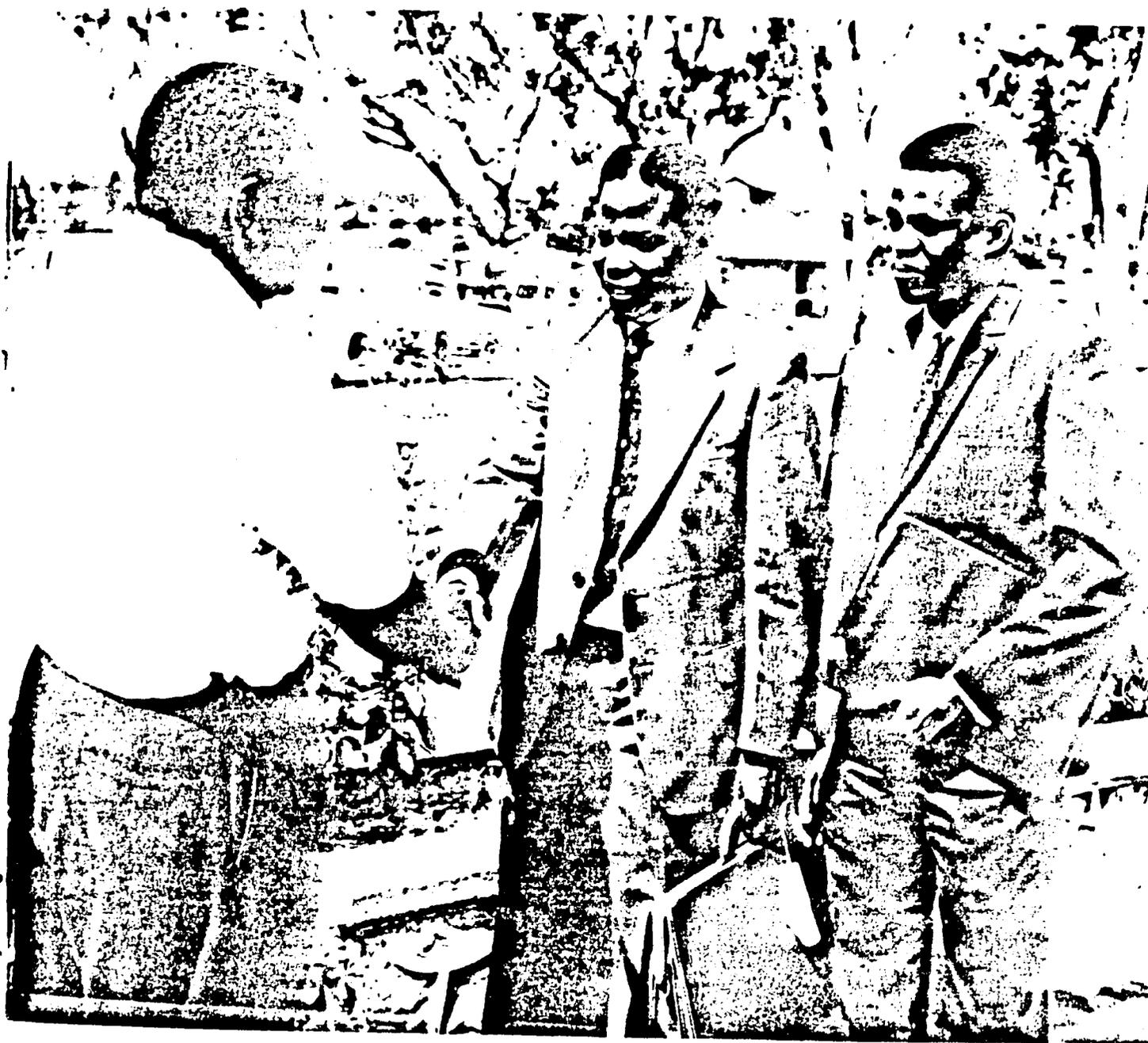


Figure 2 - Mr. H.E. Thompson, (former Head of the Animal Husbandry Division) bidding goodbye to Mr. K.A. Coleman and W.S. Kpiniong who received special training in farm management and artificial insemination.

U.S. colleges which could satisfy the training needs of the selected participants were chosen.

Starting in 1959, an average of two participants in the fields of livestock or poultry have been trained yearly. The total number of participants who have completed training in the U.S. is 27, five of which are in supporting fields.

The following is a list of these officers, their field of training and last location:

U.S.-TRAINED TECHNICIANS - POSITION AND LOCATION

Name	Technical field	Position location
Sackey, F.M.A.	Poultry	Poultry Extension Education Specialist, Ministry of Agriculture, Accra.
Olympio, M.K.	Animal Husbandry	Deputy Chief Animal Health Division, Accra.
Quartey-Papafio	Animal Husbandry	Assistant Farm Manager, University of Ghana, Legon.
Gyamfi, K.	Poultry	Poultry Specialist, Agriculture Training Institute, Kwadaso.
Antwi, L.W.	Poultry	Poultry Officer, Volta River Authority.
Ashun, E.A.	Animal Husbandry	Senior Technical Officer, Volta River Authority.
Thompson, H.E.	Agriculture Extension, Animal Husbandry	Chief Services Officer, Ministry of Agriculture, Extension Division, Accra.
Ababio, L.N.	Animal Husbandry	Lecturer, Animal Husbandry, University of Ghana, Legon.
Agudu, E.W.	Poultry	Poultry Specialist, Ghana Academy of Sciences, Accra.
Gandaa, S.T.	Animal Husbandry	Senior Technical Officer, Nyankpala Farm Institute, Northern Ghana.

Figure 3 - Two USAID-trained technicians discussing the operation of a new incubator used in the Volta River Re-settlement project. The technicians are, Mr. F.M.A. Sackey and Mr. E.A. Ashun.



Figure 4 - USAID Livestock Advisor with Mr. T.O. Mills, National Livestock Breeder, (center) and Mr. E.K.B. Nyarko, Farm Manager, Pong-Tamale Animal Husbandry Station (standing second from right) examining an injured calf while on making the rounds on the station.

<u>Name</u>	<u>Technical field</u>	<u>Position location</u>
Buamah, T.F.	Animal Husbandry	Senior Technical Officer, Nyankpala Farm Institute, Northern Ghana.
Mills, T.O.	Animal Husbandry	National Breeder, Acting Chief, Animal Husbandry Officer, Accra.
Ablakwa, E.T.	Animal Husbandry	Officer-in-Charge, Nungua Artificial Insemination Station, Animal Husbandry Division, Accra.
Aboagye, G.M.	Animal Husbandry	District Animal Husbandry Officer, Koforidua.
Laryea, J.O.	Animal Husbandry	Livestock Breeding Foreman, University of Ghana Farm, Nungua.
Kessey, A.G.	Poultry	Head, Poultry Department, University of Science and Technology, Kumasi.
Coleman, K.A.	Range Management and Artificial Insemination	Officer-in-Charge, Amelorkope Animal Husbandry Station, Volta Region.
Kpiniong, W.S.	Ranch Management and Artificial Insemination	Artificial Insemination Specialist, Livestock Station, Pong-Tamale.
Quartey, S.B.K.	Veterinary	Chief Veterinary Officer, Animal Health Division, Accra.
Fumi-Fiamawle, J.K.C.	Dairy	Head, Dairy Section, Animal Husbandry, Accra.
Larson, R.	Animal Nutrition	Lecturer, University of Ghana, Legon.
Wutch, J.	Tropical Pasture and Forage Crops	Ghana Academy of Sciences, Accra
Andoh, Thomas	Seed Multiplication	Chief Seed Multiplication Officer, Extension Service Division, Ministry of Agriculture, Accra.
Asare, E.O.	Land Planning and Soils	Range Management, University of Science and Technology, Kumasi.
Djokoto, R.K.	Soil Testing and Fertility	Soil Research Institute, Kwadaso, Kumasi.

<u>Name</u>	<u>Technical Field</u>	<u>Position Location</u>
Labi, W.	Marketing	Regional Marketing Officer, Accra.
Obeng, H.	Soil Research and Analysis	Principal Research Officer, Soil Research Institute, Kwadaso, Kumasi.
Nyarko, E.K.B.	Animal Husbandry	Manager, Pong-Tamale Livestock Station.

These participants can give information regarding development work in livestock production. In developing a ranch or livestock operation, a farmer should be in constant contact with the District Extension Service Officer. These officers are trained to help the farmer find answers and ways and means best suited for livestock production. If they do not have the answers, they know whom to contact to obtain the necessary information. As a help, some of these people have been listed above.

PRE-REQUISITE FOR FARM OR RANCH DEVELOPMENT

A. Management:

Many people in Ghana have recently developed interest in agriculture production and livestock or poultry farming. To this end, some have actually tried to establish themselves without any guidelines or technical help. This type of operation is extremely risky as well as being costly in the long run. In planning a project, different types of information are necessary to give a good foundation and basis for its development. As a guideline, the following questions and statements are designed to help outline the pre-requisites required to develop a project:

First, when a person plans a project, he must think of management. This is a process which involves all aspects of the endeavor. After a decision has been taken as to the type of farm a person wants to establish and he is satisfied that it will be the utmost of his ambition, then the following things should be taken care of:

How much land will I need for the project?
Is the land I have adequate for the life time
of the project?

Do I have clear title to the land to do with
it as I want?

What type of soil makes up the land and is it
suitable for the type of farm I want?

What about the location of the land? Is it in
an area where the physical and climatic conditions
are suitable for the project?

If I am not sure about the soil and the above
conditions, who can I check with to be certain it
is satisfactory?

Is there a market for my products?

Is feed available to see my project through?

Do I have the technical knowledge and experience
to successfully carry the project through?

If I do not have the technical knowledge, do I
know where I can find a person to manage my farm?

Do I have enough capital to see the project
through?

Questions of this nature should be carefully examined for
each one is very important in the overall management process.

There are agriculture bodies in the Ministry of Agriculture
which can supply the answer to these questions, but it requires per-
sonal contact.

Observations of many new enterprises which have been started in
the country reveal a lack of management. Without strict management,
a project will fail. This management must be an interested manage-
ment. By this is meant professional and personnel in the type of
operation which is being carried on. If a person can answer yes to
these questions and find the proper management, then the next step
can be made--seek finance.

If you are a person fortunate enough to have enough money to finance your project, then you will not be particularly interested in this section; however, you may get some ideas as to how you can use credit to work for you.

B. Farm Credit:

Farm credit is an input tool which can be used by a progressive farmer. It is a specialized tool and requires a person to have special qualifications and requirements before he can use it. To meet these qualifications, a person must have a recognized credit rating based on business achievements and technical ability.

Credit can do as much for agriculture and the farmer as it has done for commerce and industry if it is used for productive purposes in a sound and constructive manner. USAID has backed the programs of the National Investment Bank and the Agricultural Development Bank. From these institutions it is possible for a livestock farmer to secure loans for the promotion of cattle, pig and poultry production.

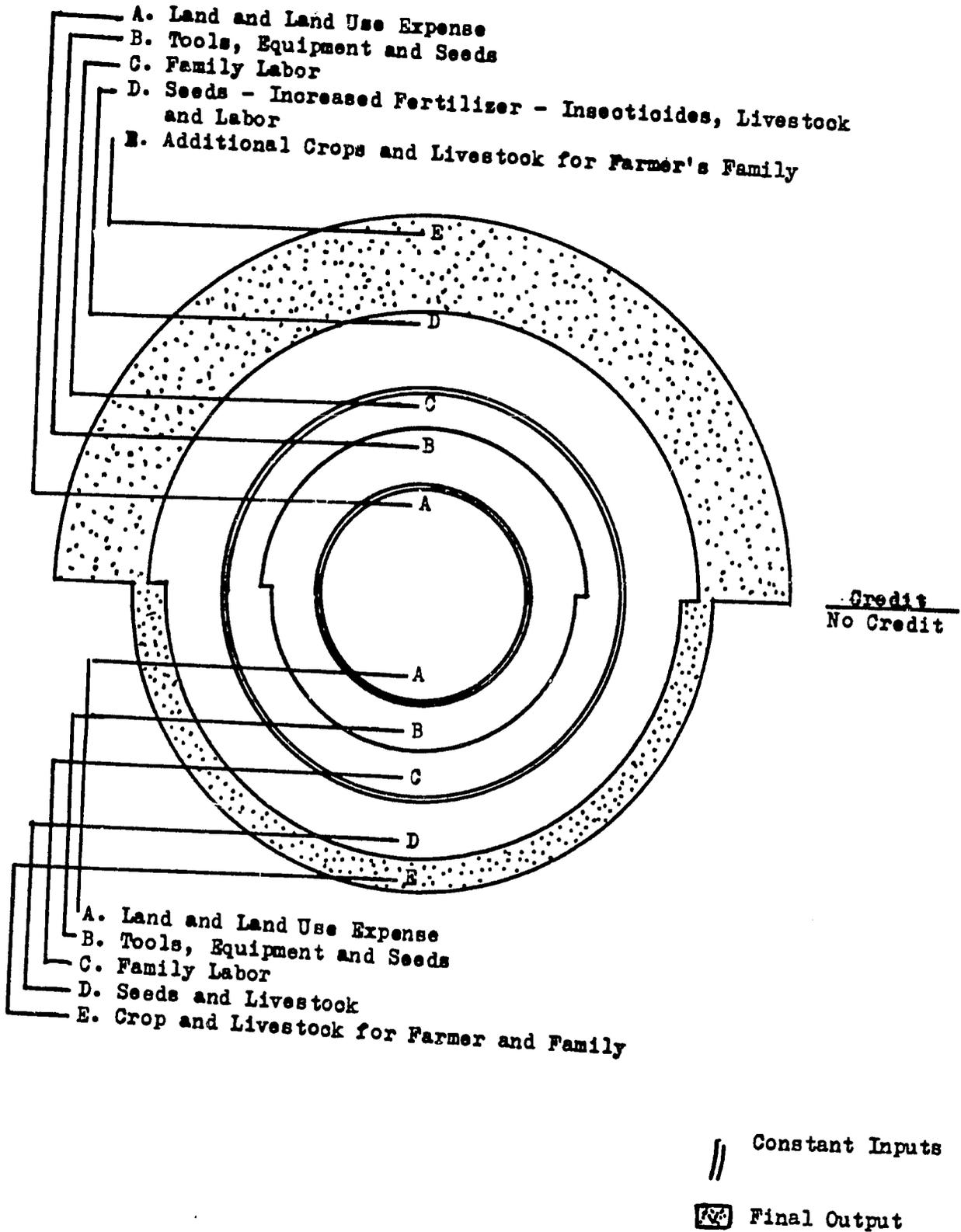
The Functions of Credit in Agriculture

As an information guideline, the following questions and statements may be used:

What is Credit?

1. Credit is the ability to obtain the use of another person's property in exchange for a promise to return it and pay for its use at the end of and agreed upon period time. The word "credit" implies trust.
2. Credit is a means of obtaining the use of such things as land, labor, equipment, seed, fertilizers, animals, and money in order to increase the profits of the borrower. The owner of the property is paid for its use according to a mutual agreement made at the time the property was exchanged for a promise. Borrower and lender must have confidence in each other.

Figure 5 - Potential Production Increases Activated by Credit Inputs



How Farmers Use Credit:

Farmers use credit as a tool to increase the production from their labor. For example, by using improved management practices it is often possible to get twice the yields of feed stuffs or cut the maturity time of animals and poultry by 25 percent with about the same cost for land preparation, cultivation, care, labor cost and harvesting. Since most of the added yields and quick maturity of animals is the farmer's gain, he may expect to make a profit by borrowing money to buy improved seed, fertilizer, animals and construct better housing and handling facilities. In the final analysis, credit is a tool.

If a man is going to use a tool efficiently and to his greatest benefit he must first learn to use it properly. In an agriculture credit system that looks upon credit as a useful farm tool, the responsibility to train the farmer in the proper use of credit should be placed on the lender. This training should provide for making use of all available technical guidance in the use of better farming practices that increase production.

Everyone has used fire. Fire properly used can be beneficial to man. Improperly used, it can be very destructive. Likewise, if the borrower and lender do not use all the controlling program factors, a credit program can be destroyed. This relates back to the statement on management.

THE SIGN OF A GOOD LOAN PROSPECT IS INDICATED BY:

1. Using recommended farm practices of cultivation, seeding, fertilizing, harvesting, feeding and breeding to increase production.
2. Performing farm operations at the right time.
3. Making full use of his time and other available--helpers.

4. Making profitable use of time during seasons when there is little or no work to be done on the farm. (See Management Schedule, Figure).

5. Keeping a favorable relationship between total production and products consumed on the farm. (Market animals and crops when normal time of marketing arrives to avoid added feed and storage cost.)

6. Increasing the salable portion of the main crop by growing where possible, other crops or livestock that will provide food for family living.

7. Retaining independent control of marketing of products.

8. Selling products through marketing channels that bring highest prices.

9. Expenditure of funds to improve existing potentials through regularly ply-back system.

"One loan received and promptly repaid as scheduled is a reusable ticket to future progress."

C. LAND CLASSIFICATION

In Ghana a sound approach to developing a farm is to first have a soils map made from which your land can be classified as to its production capabilities. Information of this sort helps eliminate development failures and saves you money.

As an example, there is one farmer in Ghana who started clearing land and planting without a complete knowledge of the soil in his area and its capabilities. Costly land clearing as well as plantings were of no value and returned no revenue. A small expenditure for this survey would have saved the owner several hundred pounds. One of the most important objectives of soil surveys is to define the adaptability of soils for crops, grasses and trees, their management requirements for sustained production and expected yields of individual crops under different systems of use and management. This cannot be achieved without an intimate understanding of the land and its possibilities, limita-

tions and needs. In order to assess the capabilities of soils, trained soil scientists will have to conduct a careful examination of the land and samples taken from it, both in the field and in a well-equipped laboratory. By so doing, information will be obtained on slope, erosion, overflow hazards, wetness, soil depth, texture, permeability, available moisture capacity, inherent fertility - including organic matter content and other characteristics which affect soil use, management and treatment. These facts can then be recorded on maps and in reports for later use by the farmer. Dr. Henry Obeng and his associates, Mr. Djokoto, of the Soil Research Institute have made classification of the soils of Ghana and are at present refining the application of this information for use in developing agriculture in the country. Soil scientists have also been able to work up a system in which the soils of the country have been grouped into capability classes and sub-classes.

In Ghana, the capability classes have been for the most part based on degree of limitations affecting kinds of soil to be used for mechanical cultivation of crops, risks of soil use and resulting needs for management. This system is patterned after that used in the United States.

Capability classes I to IV are suitable for mechanical cultivation for crops, pasture and range. Classes V to VII are unsuitable for mechanical farming but have some value for grazing; however, for best production and economical gains, grazing areas will have to be improved for free grass has never been a high producer of livestock. Ordinarily, a loan will be made only to a farmer who is developing land which is judged to be in the Class I to IV. Prior to development, the farmer should take into consideration, the following classes of soils:

Land Suitable for Mechanized Cultivation

Class I Land - Very good land with minor or no physical limitations to mechanized cultivation. The soils are deep to very deep, well-drained, medium-textured, nearly level to very gently sloping topography. They are moderately permeable and have a moderate to high water-holding capacity, medium inherent fertility, but a good capacity to utilize added fertilizers. They are subject to no more than slight erosion and are not subject to damaging overflows.

This land is suitable for intensive agriculture involving any crop which the climate of the area allows and can sustain moderate to high crop production with few, but good, management practices, such as:

1. Maintenance of fertility (mulching, manuring, addition of commercial fertilizers and establishment of a legume in the rotation.)
2. Contour plowing.

Examples of Class I soil are: Damongo, Bediese and Ejura series occupying sites which have 0 to 2 percent slope.

Class II Land - A good land with few physical limitations which can be easily corrected. The possible properties which make Class II lands not quite as good as those of Class I may be generally subdivided on the basis of:

1. Erosion - denoted by IIe.
2. Wetness - denoted by IIw.
3. Other soil properties - denoted by IIs.

The first sub-class commonly relates to upland soils and the second to lowland soils. Properties coming under the third category may be found on either topographic site. The main features of sub-class IIe. are:

1. Moderate erosion hazard.
2. Gentle slopes.

The main features of sub-class IIw are:

1. Moderately wet soils internally.
2. Heavy textured soils.
3. Presence of salts.
4. Occasional overflows.

The main characteristics of sub-class IIs which are associated with either upland IIs or lowland IIw soils are:

1. Moderately deep soils - often associated with erosion and sub-class IIs.
2. Moderately well-drained soils, often associated with sub-class IIw.
3. Either moderately rapidly or moderately slowly permeable soils.
4. Either low or moderate water holding capacity.
5. Low inherent fertility.
6. Fair capacity to utilize added fertilizers.

Moderate productivity can best be maintained on Class II land by:

1. Raising the fertility level by maintaining or increasing the organic matter in the soil by mulching, manuring, addition of commercial fertilizers, and the inclusion of a legume in rotation.
2. Contour plowing.
3. Strip cropping.
4. Water control structures.

Examples of Class II soils are: series from Northern Ghana and Oyarifa series from Bediase; Damongo and Ejura soils on 3 to 5 percent slopes; Amantin soils on 9 to 2 percent slopes.

Class III Land - Moderately good land which has more limitations for mechanized cultivation than Class II land. However, like Class II, the limitations associated with Class III lands can be corrected.

Reference - Report on Soil and Agriculture Survey of Sene-Obosum River Basins, Ghana - USAID June 1962.

Class III land may be generally sub-divided as in Class II on the basis of:

1. Erosion - denoted by IIIe.
2. Wetness - denoted by IIIw.
3. Other soil properties - denoted by IIIs.

The first sub-class (IIIe) commonly relates to upland soils and the second (IIIw) to lowland soils. The properties coming under the third category (IIIs) may be found on either topographic site.

The main features of sub-class IIIe may be one of more of the following:

1. Moderate to high erosion hazard.
2. Sloping or undulating topography.
3. Gravelly or stony texture.

The main features of sub-class IIIw are:

1. Imperfect to poor internal drainage.
2. Excessive wetness.
3. Heavy textures.
4. Presence of salts.
5. Moderate overflow hazard.

The main characteristics of sub-class IIIs which are associated with either upland (IIIe) or lowland (IIIw) soils are:

1. Moderate to shallow depth to bedrock, undulated layer, concretions or ironpan, often associated with erosion IIIe of the upland.
2. Low moisture holding capacity.
3. Excessive wetness, associated with the lowland (IIIw).
4. Shallow depth to claypan, associated with lowland (IIIw).
5. Slow to very slow sub-soil permeability, associated with IIIw.
6. Either very slow, rapid, or very rapid permeability.
7. Low inherent fertility.
8. Fair or low capacity to utilize added fertilizers.

Moderate productivity of Class III lands can be maintained by following the recommendations for Classes I and II lands, with additional water control measures, such as grass waterways, close strip cropping, and based contour terraces or bunds.

Class IV Land - Fairly good land best suited for perennial vegetation that can be mechanically cultivated occasionally with great care. Hand cultivation and/or bullock farming can be practiced. The properties which make Class IV lands not as good as Class III may generally be described under sub-classes IVe, IVw, and IVs.

The main features of sub-class IVe are:

1. Moderate to high erosion hazard.
2. Sloping to hilly topography.
3. Very gravelly or stony texture.

The main features of sub-class IVw are:

1. Either poor or excessively drained soils.
2. Heavy textured soils.
3. Moderate overflow hazard.

The main characteristics of sub-class IVs which are associated with either upland or lowland soils are:

1. Shallow depth to bedrock, ironpan, concretionary layer, or claypan.
2. Poor drainage, often associated with sub-class IVw.
3. Light textured and/or gravelly or stony soils.
4. Either very rapid or very slow sub-soil permeability.
5. Low water holding capacity.
6. Low inherent fertility.
7. Low capacity to utilize added fertilizers.

The productivity of these soils may be maintained by following intensely, the same practices recommended for Class III but rotations to be practiced should include long periods of forage or tree crop production.

Lands Not Suited for Mechanized Cultivation

Class V Lands - Land not suited for mechanized cultivation but suited for limited clearing, grazing and hand cultivation for production of perennial crops. These soils commonly occupy hilly to steep topography and are subject to moderate or severe erosion.

Deep, heavy textured and poorly drained soils on nearly level topography which are very difficult to drain also fall within this class. Upon draining, these soils can be raised to Class III or IV levels and, thus, be suitable for the production of rice, irrigated pastures, etc. Mechanized cultivation on Class V lands is not feasible because of the following properties described under sub-classes Ve, Vw, and Vs.

The main features of sub-class Ve are:

1. Moderate to severe erosion hazard.
2. Steep or rocky slopes.
3. Excessive drainage.
4. Very shallow depth and stoniness.

The main features of sub-class Vw are:

1. Wetness.
2. Heavy textures.
3. Annual overflow hazard.

The main characteristics of sub-class Vs which are associated with either upland (Ve) or lowland (Vw) soils are:

1. Extremes in textures, very light or very heavy.
2. Rapid or slow permeability.
3. Low or very low moisture holding capacity.
4. Low inherent fertility.
5. Fair or poor capacity to utilize added fertilizers.

The productivity of these soils for perennial crops can be best maintained by raising their fertility level through mulching, application of manure and/or inclusion of leguminous crops in the rotation. The establishment of stringent erosion control practices is essential even when such soils are hand cultivated. In this respect, permanent sod on the ground, grass waterways, broadbased terraces on the contour, and cover crops are recommended on the uplands, and in the wet bottom lands extensive drainage systems including tile drainage would be needed.

Class VI Land - These lands have a severe erosion hazard and are too steep, too shallow, too stony, too droughty, or too wet to be suitable for any type of mechanized cultivation. With care, limited clearing and hand cultivation, may be carried out. Perennial tree crops, forestry, controlled grazing, recreation and watershed protection are recommended.

Class VII Land - Class VII lands are non-agricultural. They are best suited for recreation, wildlife and watershed protection. They include such lands as lagoons and marshes, scarp phases, rough, stony and barren lands. The lagoons and marshes may be reclaimed, but at prohibitive costs.

Conclusions - Soils

1. Mechanical cultivation is feasible on Class I, II and III lands, with adequate conservation practices.
2. Sheet erosion, while not as spectacular as the other forms of erosion, removes large amounts of the surface soil annually. It is extremely important to check this as the loss of the organic matter in these soils is the loss of the major nutrient holding capacity of the soils.
3. Contour plowing, strip cropping, broad-based terraces, mulching, establishment of grass or sodded waterways and the restriction or the elimination of uncontrolled burning will aid materially in controlling the soil erosion problem.
4. The supplemental use of commercial fertilizer will increase the crop yields by 50 percent and is economically feasible. Split applications of fertilizer are recommended over the entire area due to the low base exchange capacity of the soils.
5. The current system of abandoning land to lay idle for a period of ten years between cropping can possibly be shortened to a minimum of five years if a grass legume is established for this period.
6. The establishment of a grass legume system of "bush-fallow" for five years will produce surpluses of hay or silage and fits in well with a livestock program.

7. The production, collection, and use of good barnyard manure is most desirable. It will aid in the maintenance of organic matter and tilth, increase the moisture and fertility holding capacity of the soils, and the crop litter will aid in the reduction of surface water runoff and erosion.
8. The soils within Land Capability Classes IV and V may be occasionally cultivated, but with extreme care, and are extremely limited in the intensity and crops which can be produced.
9. In their present conditions, the soils of Land Capability Classes V, VI and VII are best suited to the production of grasses and tree crops. The soils which occur within these capability groupings should not be mechanically cultivated.
10. With adequate drainage and water control measures, approximately 40 percent of the wet bottom lands could be cultivated and used for the production of crops.
11. Dams and ponds or tanks can be constructed on the Sene and Volta Soils in the broad bottom lands underlain by either clays or shales.
12. Soils in the sandstone areas are often too porous for the construction of dams or ponds but lined tanks could adequately store sufficient water for domestic use.

If these descriptions have been reviewed and discussed with the extension officer of the district, it is possible to save expenditure on land not suitable for the purpose desired for development.

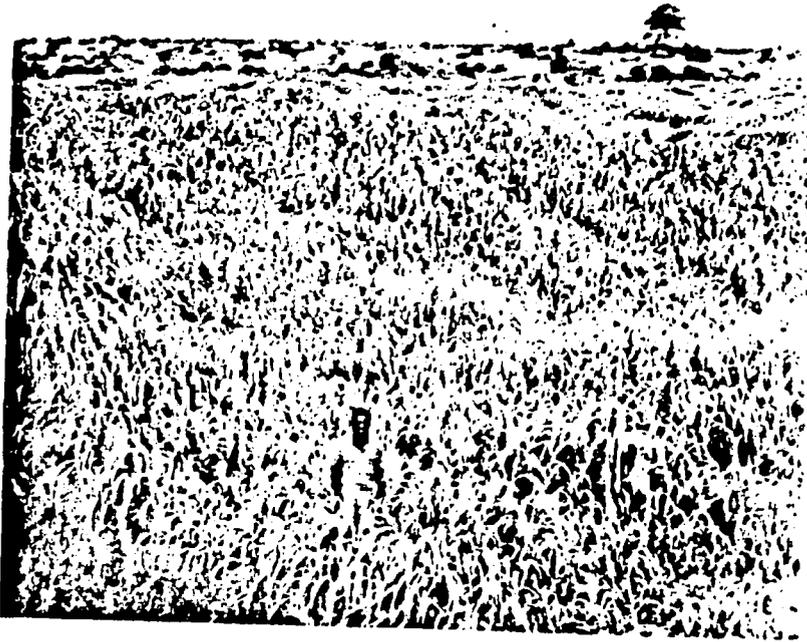


Figure 6 - Type of land suitable for development in Ghana.

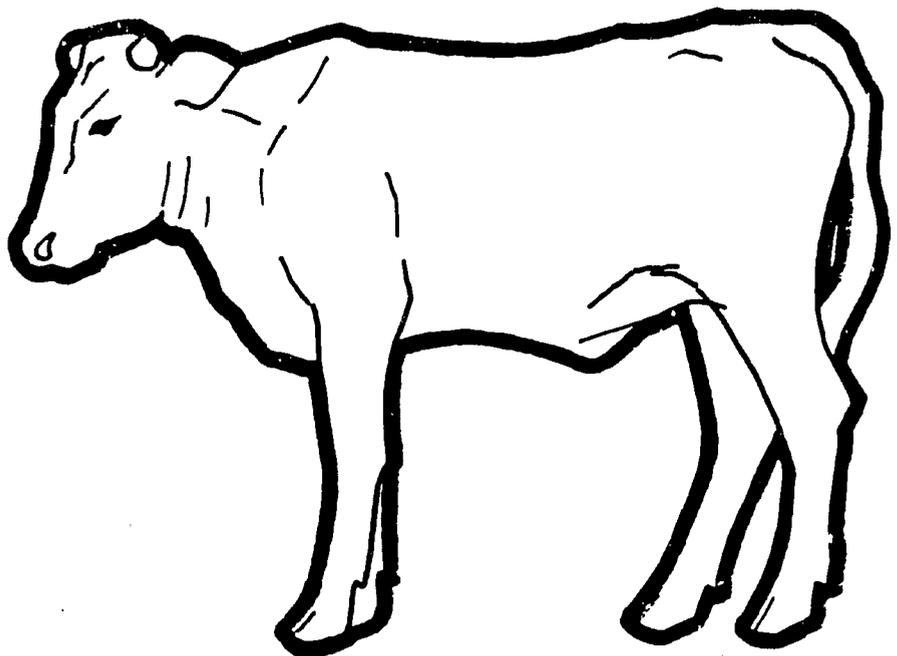
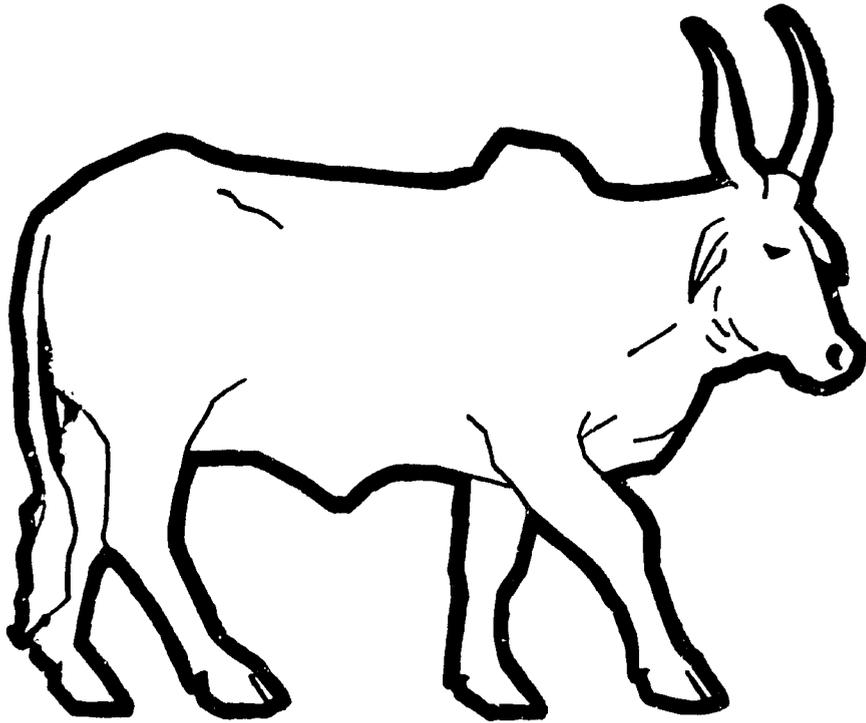
Figure 7 - Erosion can occur and cause great damage to land if proper precautions are not taken and conservation control methods applied.



D. MARKETS

The second most important concern to the Ghana livestock farmer, after a good feed supply, is a market. Marketing in Ghana can be very easy at times and extremely difficult at others. A producer should keep this in mind and make sure he will have a market for his products prior to market time. Market requirements at times are difficult to meet when certain qualities and types of products are desired. When a producer succeeds in getting a good market he should do everything possible to maintain it. This can be done by having a constant supply of standard quality products at reasonably steady prices. One should give priority consideration to regular customers and their commodity supplies. A happy customer will give free advertisements necessary for an expanding market.

CATTLE



CATTLE

The indigenous breeds of cattle in Ghana are limited. Several improved breeds have been introduced. Each of which has some special traits which are worth considering. To effectively pick a breed to suit ones need, the area in which the herd is to be established should be carefully considered. The livestock extension specialist together with the agriculture extension officer will be of help in determining what breed or hybrid would best suit the area of a developing project. The chief aim is to produce as much meat as economically as possible and in the shortest time.

CATTLE FOUND IN GHANA OR WEST AFRICA

West African Shorthorn (Indigenous) - This animal varies in size in different West African countries, but its basic characteristics are the same. First calving occurs between $3\frac{1}{2}$ to 4 years. Average calf weight is 40 to 43 pounds.



Figure 8 - West African Shorthorn

TABLE 4 - AVERAGE MEASUREMENTS FOR WEST AFRICAN CATTLE
PRODUCED IN GHANA

	MALE			FEMALE		
	1 yr.	2 yrs.	3 yrs.	1 yr.	2 yrs.	3 yrs.
Average live weight(pounds)	240	360	425	180	300	380
Height at withers(inches)	31	34	40	29.5	38	38.5
Width of hips (inches)	8.9	11.7	14.04	8.7	11	14
Heart girth (inches)	42.9	50.7	57	40	49.5	55

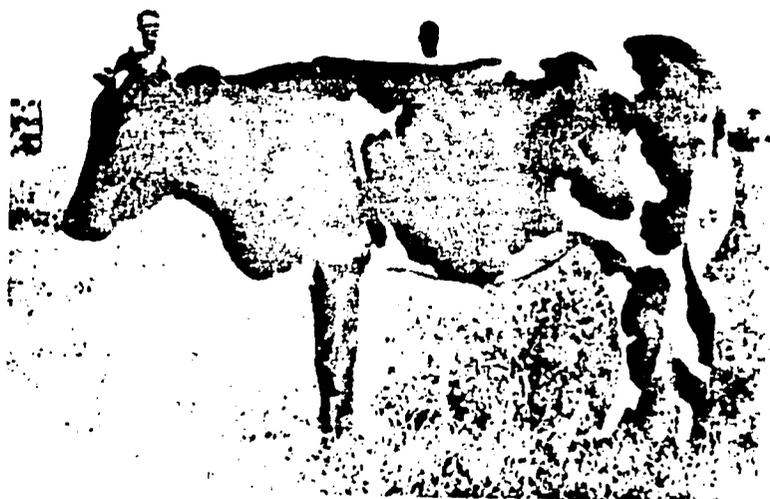


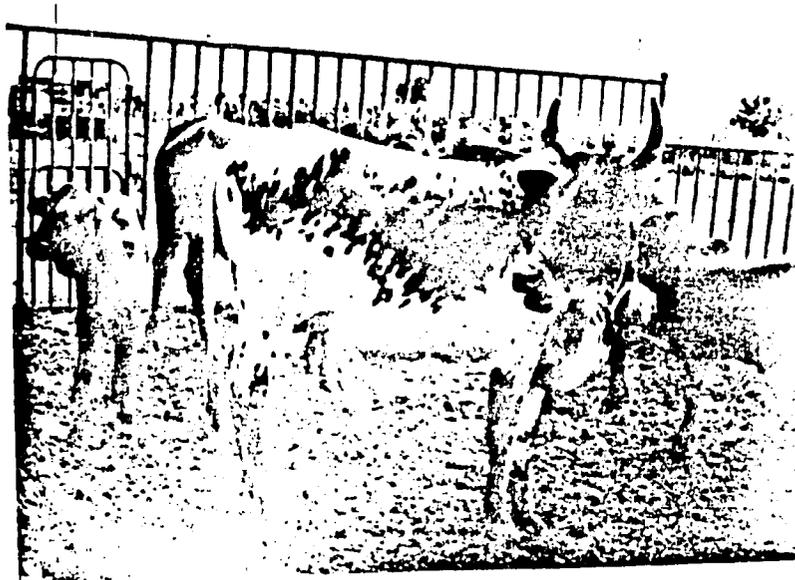
Figure 9 - West African Shorthorn

Sanga - (White Fulani bull crossed with West African cow): The term 'Sanga' is applied to many different cattle with various breeding but basically it is applied to any F₁ animal resulting from a cross between Zebu and Humpless cattle. In Ghana, there are White Sanga, N'Dama Sangas, Gudalli Sangas. First calving occurs at 3 to 3½ years. Average weight is 53 pounds.

TABLE 5 - AVERAGE MEASUREMENTS OF WEST AFRICAN SANGA CATTLE PRODUCED IN GHANA

	MALE			FEMALE		
	1 yr.	2 yrs.	3 yrs.	1 yr.	2 yrs.	3 yrs.
Average live weight(pounds)	276	552	725	265	525	675
Height at withers(inches)	41	49	51	39	48	50
Width of hips (inches)	9.5	11	17	9	11.5	15.6
Heart girth (inches)	48	58	66.5	46	58.5	64.7

Figure 10 - Sanga



African Humpless and Zebu-type cattle:

N'Dama (Mali and Sierra Leone) - This animal is reported to be resistant to Trypanosomiasis but tests in Ghana have shown that deterioration of immunity occurred when the animals are removed from their place of origin. First calving is between 3 to 3½ years. Calves weigh an average of 42 pounds.

TABLE 6 - AVERAGE MEASUREMENTS OF N'DAMA CATTLE IN GHANA

	MALE			FEMALE		
	1 yr.	2 yrs.	3 yrs.	1 yr.	2 yrs.	3 yrs.
Live weight(pounds)	232	284	574	230	356	485
Height at withers (inches)	28	38	41	26	37	40
Width of hips (inches)	10.9	11.4	11.88	9.75	11.7	15.9
Heart girth (inches)	45.6	58.4	60.4	44.9	49.5	59.8

Figure 11 - N'Dama



Sokoto Gudalli (Niger and Nigeria)

The Sokoto are short-horned zebus and they are raised in those areas of Nigeria and parts of French West African that lie between 12° and 15° north latitude and 3° and 7° east longitude. These animals are good browsers. First calving is at 3½ years. Live weight at birth is 53 to 66 pounds.

TABLE 7 - AVERAGE MEASUREMENTS OF SOKOTO GUDALLI CATTLE IN GHANA

	MALE			FEMALE		
	1 yr.	2 yrs.	3 yrs.	1 yr.	2 yrs.	3 yrs.
Live weight (pounds)	336	591	1190	315	504	734
Height at withers (inches)	42	48.5	54	41.75	46.75	50.25
Depth of chest (inches)	20.5	24.75	29.75	21.00	23.25	27.00
Width of hips (inches)	11	13.50	18.25	11	14.25	16.75
Heart girth (inches)	50	60	75	48.5	58	65.50

There is another type Gudalli bull which comes from the Cameroons. This animal is predominantly red, red and white or black with some varying brown.

Their conformation is not very pleasing to the eye, but when crossed with the local animals, the offspring have good beef qualities.

Selection of superior bulls by local farmers to improve their herd is a common way of improving the type of replacement animals for any given herd. As an example, the following picture shows what can be done by the individual farmers as a primary step to improving his herd. The sire in the picture, Figure 8, was imported from the Cameroons. The dam is a locally bred West African

Shorthorns; (Figure 9 and Figure 10). The F_1 bull (2 years old) is the results of the first cross. The second bull is the offspring of the F_1 bull which still reflects an improvement, (Figure 11). By selecting good bulls and culling non-breeders in herds, the overall value and production potential of a herd can be increased.



Figure 12 and 13 - Cameroon Gudalli bull, Accra Plains area, crossed with a

West African Short-horn female below produced the F_1 bull on the next page.



Figure 14 - F₁ generation of Cameroon Gudalli (male) X West African Shorthorn (Female)



Figure 15 - Below is the offspring of the F₁ bull above which shows that improved sires play a big part in improving a herd



Exotic and Foreign Cattle - Live cattle and semen have been imported for breeding trials in the country by various groups interested in improving Ghana's livestock industry.

TABLE 8 - BREEDS OF CATTLE IMPORTED INTO GHANA AND THEIR COUNTRY OF ORIGIN

Breed	Year	Form	Country	Purpose
Hereford	1930	Live	Britain	Beef
Brown Soeres	1959	Semen	Kenya	Dual
Jersey	1958 and 1964	Live	Britain	Dairy
Holstein	1959	Semen	Israel	Milk
Shiwal	1959	Semen	Kenya	Dual
Red Steppe	1963	Live	Russia	Dual
Brahman	1963	Semen	U.S.	Beef
Santa Gertrudis	1963-65	Semen	U.S.	Beef

Results from the introduction of the above breeds have indicated means of improving the size and production potential of cattle in Ghana. All of the cattle, with the exception of the Red Steppe, have produced first generation calves with marked improvement over the local animals. However, the imported British breeds of live animals have all succumbed to disease or have been rendered sterile under Ghanaian conditions. USAID technicians have succeeded in influencing the staff of the Ministry of Agriculture and Universities that the importation of semen is by far the most economical method of introducing imported breeds.

Figure 16 - Method of Inseminating Cow, (Mr. Ablakwa - Technician).



Figure 17 - Insemination Results 3½ Months Old Calves.



TABLE 9 - COMPARATIVE WEIGHT GAINS OF LOCAL CATTLE AND CROSSES FROM INTRODUCED BREEDS

Breed or Crosses	Weight in Pounds					
	Weight Birth	6 mo.	12 mo.	18 mo.	24 mo.	30 mo.
West African Shorthorn	40.4		240		360	418
M ⁺						
F ⁺⁺	40.8					
N'Dama	42	234	232		384	545
M						
F	39.5	214	230		356	456
White Fulani	56	223	298	325	400	565
M						
F	49	177	294	305	391	504
West Afr. X White Fulani	53		276	476	552	625
M						
F	49		252	435	498	594
White Fulani X Brown Swiss	63	265	601	823	869	837.5
M						
F	57	283	528	670	686	715
White Fulani X Sahiwal	56	286	480	620	655	753
M						
F	46	246	455	524	562.7	615
White Fulani X Holstein	56	255	366	563	585	637.5
M						
F	51	123	324	334	539	577
Sanga X	63	325	625	867	1092	1295
M						
F	59					
Santa Gertrudis						
+++						

The artificial insemination crosses resulting from the Santa Gertrudis from the United States and the local cows has resulted in hybrid animals which reach 1,000 pounds in two years. These animals are being bred on two stations, Pong-Tamale in the north and Nungua in the south. In 1966, the University of Ghana also had a breeding

+ Male; ++ Female; +++ USAID-sponsored.

program using some of the animals' semen from the American Breeders Service. Results have been uniform, the calves dropped have a birth weight of 60 pounds or more. The genetic value of these sires has been indicated in the hybrid offspring. The F₁ bulls at Pong-Tamale were bred to selected herds of the different breeds in Ghana in 1966. Their offspring have started to drop June 5, 1967 and evaluations will be made to determine which bulls and with what bred the best results can be had. When this has been determined, then all haste will be made in collecting semen and making it available to qualified cattle breeders of the country. The Ghana Government has the facilities for collecting and processing semen on the Nungua Station.

B. Management

Management of cattle is one of the most important aspects of cattle production. The best of animals will not perform economically without proper management. Good management comes from a person who has a profound interest in his work coupled with technical knowledge gained through study and hard practical work. The art of cattle raising down through the years has brought about many changes to the cattle industry. As the world population increases, so increases the need for more food to feed the masses. Production in agriculture has to increase. For the Ghanaian or West African farmer interested in developing livestock in his area, the suggestions below are made. At the close of this section, the description of Ghana cattle and some of the results of cross breeding with these animals may be found. This information should be of benefit in deciding on the type of animal best suited for your needs and specific conditions. For the beginning farmer or the farmer who wants to improve his livestock, the following suggestions are made:

1. Have suitable land for the project to be started. Control of this land for a period of time is essential and will enable the interested party to realize from the project its full value.

2. This land should be classified by qualified persons from the Ministry of Agriculture. The classification should reflect the capabilities of the soils in the area as to their potential for crops or pasture. (This information is on page 24). See Land Classification.
3. Rainfall should be sufficient to produce crops or maintain pastures in a normal season.
4. Select animals suitable for the area. This selection should be based on disease resistance, forage availability and climatic conditions. As an example, a person would not select animals known to be highly susceptible to Trypanosomiasis to be kept in the rain forest area.
5. Establish a plan of work using the advice of the livestock extension advisor in the area.
6. If the project calls for more capital than the one developing the land and if he is considered credit worthy, then he should contact one of the agriculture credit institutions. Two of these institutions are in Ghana. They are, the Agriculture Development Bank and the National Investment Bank.
7. Seeds for planting should be acquired from any reliable source but a recommended variety which has been tried in the country and suitable for the area should be sought.
8. If the project is of a size that justifies the use of a tractor then the purchase of a tractor and equipment is in order. The banks make equipment loans, however, it is considered uneconomical unless a farm contains 400 acres in general farming or 100 acres suitable for high income cash crops. Examples of these crops include maize, groundnuts and vegetables. Small holders may call on the service organizations which do custom work. As a word of caution, this type of work should be on the contracted - acre basis rather than by the day.
9. Determine the feed and water requirements of the proposed number of animals to be kept. This should balance with the productive capacity or purchasing power of the project. Animals can then be selected on these basis. A guide to feed requirements for different animals may be found in the section "Helpful Information", page ----. After these points have been considered, a person is ready to move on to the other phases of organizational management. Regardless of the breed of cattle selected, the farmer will

be concerned with the breeding of these animals. The methods which are adopted will govern several aspects of the program such as calving, farrowing and lambing time, weaning and marketing time coupled with disease control and labor cost. It would be to the advantage of a livestock farmer to set up a work plan or calender of work for the year. By doing this, he will be able to distribute his efforts and labor to fit the most important jobs to be done without interference from other duties. Members of the Extension Service can assist in this operation. An example of this type of calender or schedule can be seen in Figure 18 page 47.

Figure 18 - This is an example and a schedule similar to this should be worked out to fit the seasons in the different parts of the country

January	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Check all planting equipment and put in good order.		X	X									
Check planting seed supply and make arrangement for purchase of fertilizer and insecticides.	X	X						X	X			
Prepare land for planting.			X	X					X			
Check calving dates of brood cows.	X	X	X						X			
Put breeding bulls with herd.												
Remove bulls from herd.							X					
Harvest hay and silage.										X		
Dehorn and castrate young stock and cull old stock.	X				X	X		X				
Dip cattle for external parasites.	X	X	X	X	X	X	X	X	X	X	X	X
Market cattle.					X				X	X		
WEAN CALVES							X	X	X			

PASTURE DEVELOPMENT

Pasture development in Ghana is essential to the progress of the livestock industry. The methods by which this is accomplished is varied in different parts of the country. This is due to the soil, type of terrain, and vegetative cover.

As stated in the foregoing pages, legumes are one of the most important forages in the overall livestock program. To establish legumes in pasture or range, it requires basic land preparation and management. This preparation is not an easy job and it costs money.

The system by which this can be done here in Ghana has been established by the Animal Husbandry Division and the equipment necessary for doing the work is available from the Mechanization and Transportation Division of the Ministry of Agriculture on rental basis.

Many farmers of the country have seen various types of tractors from all parts of the world clearing land in Ghana for the past few years. Different systems of clearing have been used but one of the most successful operations has been as follows:

Phase One

Clear bushes and generally level the land, windrowing the debris. Great care should be taken so that very little top soil is disturbed. As mentioned before, many different crawler tractors can do this part of the work.

Phase Two

This is the beginning of the most important part of the whole operation. The piece of equipment used for this work requires a crawler tractor with at least 200 horse power to pull it. It is a giant disk weighing seven or eight tons. This implement cuts all roots and loosens the soil so it may be plowed with the ordinary wheel tractor. The number of times required over the

field to complete the job is governed by the number of roots under the ground but normally, twice over will be sufficient. There are other pieces of equipment which will serve the same purpose but to date, none are in the country. These are the giant root sweeps pulled by the same heavy crawler tractor. When this job is done, it is possible to use mechanical planting equipment pulled by the wheel tractors and to use inter row cultivation methods. If these roots are not cut to small sizes, then the inter row cultivation is almost impossible and the job half done.

Phase Three

After the plowing and disking, the slope of the land should be determined. If the slope is 5 or 6 percent, then the land should be terraced using the broadbase terrace. (A Scale as to the distances between terraces on different slopes may be found in the Section, Useful Tables and Figures). The importance of this is also mentioned in the Land Use and Classes Section.

Phase Four

Planting or seeding can be done now. Grass and legume seeds are in short supply in Ghana, but a certain amount of seed may be collected by hand from various parts of the country. The Farm Supplies Division of the Ministry is starting a program of multiplication. The use of local grasses which can be started from cuttings or rizhomes is highly recommended. This method is slow and costly but well worth doing.

Phase Five

The pasture or grazing area should be properly managed by controlling the movement of the cattle and keeping out fire. Grass can be kept in a green, growing state by keeping the animals on a green forage area until they have grazed it down to proper height. This has a two-fold action: one, it compels cattle to graze vegetation which they would normally bypass, but which makes grazing of desired grasses difficult when they reach maturity.

The same results can be achieved if a slasher or rotary mower is used. This piece of equipment is one of the most versatile pieces of equipment used in livestock work; also, when grasses are kept from maturing, the stage of dormancy which normally develops with the advent of seed heads is disrupted and the plant stays green longer and thus, their value as forage is prolonged for as much as one month. This extra month in effect, shortens the dry season and the need for supplemental feeding time reduced.

Recommended Seeds and Practices

Good seeds in Ghana for pasture are few. In the future, it is essential that an adequate supply is made available within the country.

Maize seed - Diacol 153 (white) open pollinated maize. This is a variety of maize which is heavy yielding and matures much sooner than the local varieties. The Farms Supplies Division has a limited amount of this seed. Yields are high as 2,000 pounds per acre of shelled corn have been obtained with 250 pounds of mixed fertilizer applied at seeding time.

Legumes - Legumes for Ghana are difficult to find. Climatic and soil conditions make it a difficult crop to grow. The number and types of legumes suitable are few in number, however, there are some which do well under proper management. The most difficult part is finding available seed. Some of the legumes which are suitable are as follows: Stylothansia gracilis and Centrosema pubescens are very good crops which produce large amounts of forage. They are slower to establish themselves than other legumes and require a growing season to really establish themselves. In the initial stage, it is necessary to control the weeds. Once established, they can compete with any weed growth which might put up a challenge. Seeds are difficult to harvest mechanically, but it is possible to do so by hand. Seed yields are reasonably high. Seeds imported from Australia cost approximately N¢3.00 per pound in Accra. Seeding

Figure 19 - Mr. Ablakwa, Nungua Farm Manager, checking seed development of Alyoe Clover



Figure 20 - Improved variety of grain sorghum

rate is about 14 pounds per acre planted in rows.

Alyce Clover - This is a legume which has been tried at the Nungua Livestock Station, and it is very promising. Management and yield of both forage and seed make it a desirable forage crop for the Ghanaian farmers.

Sowing can be done by broadcasting the seed over newly-prepared ground and then rolling or dragging with a log or big timber. In Ghana it will mature and produce viable seeds in 70 days. If allowed to mature, the seed will drop and re-seed itself. It is possible to collect the seed by cutting them on a hard floor and allowing it to dry. The hand method of faling will thrash the seed which can later be swept from the floor, cleaned and held for planting. Seed from an acre will usually be sufficient to plant 20 acres.

Brabham Cowpeas - Seeds of this variety of cowpeas were imported by the USAID Mission and planted in several locations in Ghana. This variety is highly recommended. It can be used for forage, silage and hay. It is quick-maturing and will stand the local dry weather conditions very well. Seed collection must more or less be hand operated for pod setting and maturing is a continual process.

It may be mowed for hay when it reaches a height of 18 inches. Curing time requires one full day under favorable trying conditions, so bailing may take place the middle of the next day.

Grasses - The native grasses which grow in Ghana can produce many pounds of beef if they are properly managed. The biggest shortcoming of the local grasses is their inability to produce viable seed. Andropogon gayanus, Bachiaria falcifera, Pennestum and Rattaellia and Panicum maxium are grasses which when managed well produce good grazing. Heavy grazing or clipping will improve the quality of herbage harvested from these pastures. Star grass, Bermuda grass and Pangola grass are two grasses which can be planted mechanically by scattering

over prepared land. An indication as to the best method of doing this can be gained from Table 12 below.

Seeding the Andropogon can be satisfactorily accomplished by using three bags of uncleaned seed to one acre. Seeding can be accomplished by broadcasting over plowed land.

TABLE 10 - PLANTING METHODS AND RATES FOR PASTURE GRASSES

<u>Treatment of Planting Material</u>	<u>Planting rate per acre</u>	<u>Treatment after planting</u>	<u>Number of plants after 5 weeks per 100 linear ft.</u>
Fresh grass scattered	1/2 ton	disked and packed	30
Fresh grass scattered	1/2 ton	dull bladed roller and packed	22
Baled and kept 8 days	1/2 ton	disked and packed	63
Cut by slasher	1/2 ton	disked and packed	25
Crown sections 4 ft. rows	not weighed	packed	29
Cross section in 2 ft. rows	not weighed	packed	45
Fresh grass scattered	1/2 ton	disked	10

Artificially reseeded dry land pastures are costly since they are man-made, although like native pastures they are harvested by animals. Seeded pastures may, however, produce greater yields of high quality forage than native ranges since many of the undesirable species present on most sites are destroyed or materially produced in the process of preparing the seedbed. Even so, many of the shortcomings of native ranges are likewise apparent in artificially-reseeded dry land pastures.

Irrigated pastures are a valuable supplement to native ranges, particularly during the hot dry seasons. Since irrigated pastures are generally green throughout the season of grazing use, they furnish many of the essential nutrients and vitamins needed by livestock.

Reference - University of Florida, ONA Cattle Station Publication Report 64-1.

There are a few irrigated pastures in Ghana at this time, but in the future it will come into its own as the water resources of the country are developed and good land management practices are applied during wet and dry seasons.

In addition to reserves of range grasses, a certain amount of other forage reserves should be maintained. These may include such feeds as corn silage and grass silage plus various fodder crops. Hay, silage and similar roughages must be grown and harvested and are, therefore, more costly than native grass or free range. They are, however, essential to improved livestock production for all types of livestock enterprises except the nomadic type and in Ghana this system could use some hay to very good advantage. When the weather is hot and lands dry, hay and other forage reserves should always be available.

Concentrates, such as groundnut cake, cereals, corn or mineral supplements are, of course, the most costly of all animal feeds. For this reason, they are best suited to complement other types and their judicious use is a profitable means of increasing animal productivity.

The kinds of forage reserves which are most desirable will depend upon a number of factors. Generally, however, all forage reserves should and must be planned and provided in keeping with sound economic principles. If possible, reserve forage should be produced by the livestock operator and the kind of feed grown will normally depend upon the types of feed that can be harvested on the operator's land.

Where the weather is suitable for curing hay and soil, water and other factors are suitable for production, a good source of livestock feed is legume and grass hay. Legumes, in particular, produce good quality hay where soils are high in lime. This is

the reason why it is difficult to find forage legumes that grow well in West Africa. The soils lack phosphorus and calcium bases. However, where rainfall is high and moisture conditions are unfavorable, legume and grass silage are often preferable to dry and cured hay. Corn silage is also a good supplementary feed source. Corn fodder, sudan-grass, andropogon and other annual crops may have to be relied upon as the best source of reserve forage.

Here in Ghana, in areas where peavines, groundnut cake and other crop by-products are available, their full use as livestock feed should, obviously, be encouraged. However, they should be used primarily as supplementary source of feed and should not be depended upon to provide the balance necessary in a livestock ration.

Grass-Legume Rotations - In most areas, an important source of livestock feed is provided by means of forage and other crop rotations. The practice involves merely a regular and planned rotation of crops on agricultural land. Grass and legume crop-rotation systems are those in which grasses and legumes are used as one of the crops. The production of grasses and legumes can be justified in many ways. Moreover, their production in rotation with other agricultural crops is generally well-accepted in modern farming, largely because of their important contribution to range management and particularly to livestock production. Certain areas in Ghana can produce grass and legumes together but at present most are planted separately.

Legume and grass hay, as well as irrigated and improved pastures containing a mixture of the better grasses and legumes, are nearly perfect livestock feeds. When pastured, legumes as well as grasses, are substantially higher in total digestible nutrients and especially in protein and vitamins. In addition, when they are properly cured, dried and stored, their feeding value is surprisingly high. For example, groundnut hay contains as much as 6.9 percent protein, 58.4

percent total digestible nutrients (TDN) and 42 percent nitrogen free extract. From the standpoint of reserve forage, legumes and grasses are of great importance both for their feeding value and in the ease with which they can be handled, processed and stored.

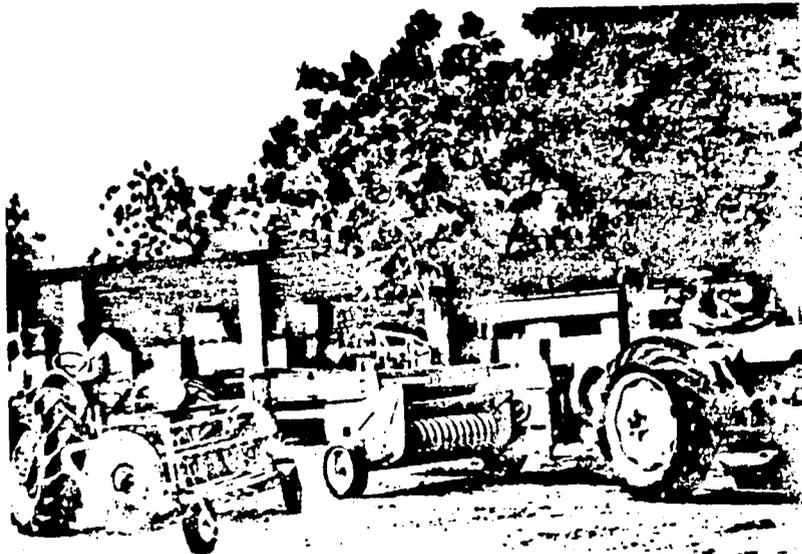
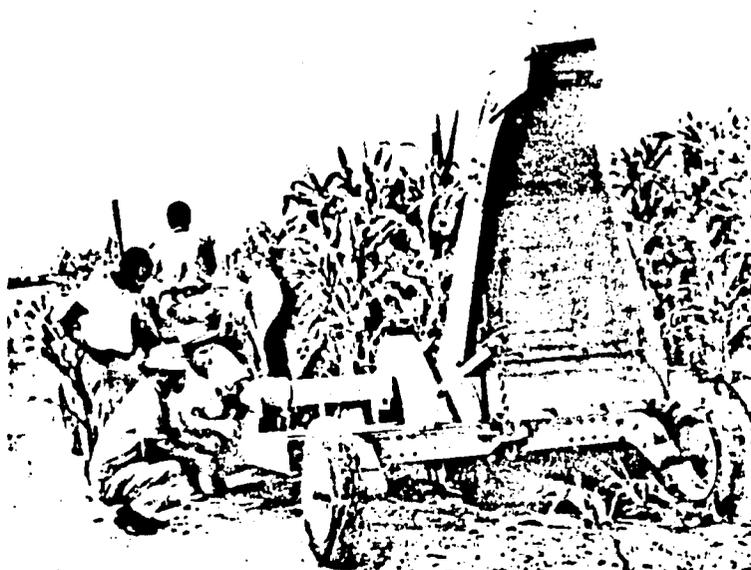


Figure 21 - Forage equipment need for hay production (side delivery rake and hay baler)

Figure 22 - USAID Advisor checking silage corn for maturity



Figure 23 - One type of modern forage harvester used in silage production



FORAGE

The production of forage is essential for a well-rounded livestock program. It is necessary to keep animals growing during the dry seasons when grazing is at a minimum. Forage consists of hay and silage. Livestock must be kept growing at all times for they are the only economic producers of animal products.

Silage - Silage is a very palatable livestock feed which can be described as fermented forage plants.

Crops Suitable for Silage - In general, crops for silage may be divided into four groups which are: (a) corn, (b) sorghum, (c) grasses, and (d) other forages (legumes). The first three groups apply to Ghana.

Corn or Maize - Maize is one of the oldest crops available for silage and considered to be the most desirable. Its use is effectively incorporated into the overall farm plan. Generally, maize that is to be used as silage should be grown so as to obtain the maximum yield of grain per acre as grain is the most nutritious part of the plant.

When to Harvest

A. Maize should be harvested when the grain is in the late dough stage. Conditions in Ghana sometimes merit earlier harvest due to weather conditions mentioned in the background section of this publication. The total nutrients available may drop if it is harvested too early.

B. Sorghum - Sorghum is the second choice and may be grown in drought areas where corn will not grow. This pertains to improved varieties and not the local ones grown in northern Ghana. Maturity date of sorghum should be reasonably short.

When to Harvest

The time of harvesting sorghum will differ from maize since a lot of the nutrients are in the stalk and varied amounts in the seed head. If a late harvest time is set, then, the grain will pass through the animal undigested. If cut too soon, the amount of nutrients drops as in maize.

C. Grasses - Grasses are becoming more popular as a silage as time goes on and the process of production is constantly changing. They can be used in Ghana to a good advantage since the normal grass type such as Sudangrass, Elephantgrass, and hybrid grasses (sorghum X grass) which are planted in other countries, grows naturally here. With a little work, these grasses could be cropped.

When to Harvest

Grass silage should be harvested when the seed heads are in the dough stage or when you would cut to make good hay.

Other Forages

This can be made up of peavines, surplus fruits and vegetables, waste from canning factories and distillery grains. Most of these, however, are not available in Ghana; therefore, silage is not feasible.

Silage Production Suggestions

Silage making in Ghana is new to the average livestock farmer and it has not played an important part in the local management program. This, however, will be short-lived since traditional livestock farm methods are giving way to new ideas. The art of making silage is not difficult but once the operation is started it is very important to carry through until harvest is finished or the structure which is being filled is topped.

Harvesting Methods and Machinery

There is no one best silage making method or kind of equipment. These must necessarily vary with the size of silo, kind of silage and available labor and machinery and their cost. Corn and sorghum may be harvested as follows:

1. Cut by hand, haul to the silo and put through a chopper or silage cutter.
2. Cut with a field chopper, blown into carts or wagons and dumped into a trench or put into a silo. Grass silage is generally harvested by one of the three basic systems:
 - i. Mowed, raked, hand loaded and unloaded, hand fed through a chopper;
 - ii. Mowed, raked, machine loaded, hand unloaded and fed through a chopper;
 - iii. Mowed, raked, picked up by a field chopper without allowing provision for wilting and dumped into a trench silo.

Characteristics of Good Silage

In order to make good silage, the farmer needs to know what constitutes silage quality. They need to be acquainted with those recognizable characteristics of silage which indicate high palatability and nutrient content.

For the novice in Ghana who wishes to see this silage operation, it would be desirable to visit one of the Government stations which make silage. In the north of Ghana, Pong-Tamale, and in southern Ghana, the Nungua stations of the University of Ghana and the Ministry of Agriculture.

The easily recognized characteristics of silage of high feeding value are:

1. Odor - it has a 'clean' rather pleasing acid odor, in conjunction to the foul or objectionable odor of poor silage. In some ways, it smells very similar to the local fermented 'kenkey'.

2. Taste - the taste is pleasing; and causes slight action of the salivary glands.
3. Mold or Rot - there is no visible mold, and it is not musty or slimy.
4. Uniformity - it is uniform in moisture and color. Generally, it is greenish-yellow or brown in color if it is good. A tobacco-brown or dark-brown color indicates that the silage has become too hot (warm) and black silage is rotten.
5. Animal acceptance - animals like and thrive on good silage.

Where labor is plentiful, the method of baling the silage may be used. In Ghana, this method could be utilized where adequate chopping machinery is not available.

Bales can be placed by hand in the trench silos and then the strings cut to allow them to expand and close out the air spaces. Packing by running a tractor over the bales is possible. This method requires more hand labor but this is offset by the larger number of tons of silage handled in one shift.

Moisture Content

Moisture content of good silage should contain about 60 to 70 percent. Field methods for determining this vary but a simple method is as follows:

If maize silage is harvested at the proper stage mentioned in the foregoing paragraphs, it will be satisfactory for silage. On the other hand, grass silage should be wilted and it will drip moisture when loaded on a wagon and hauled a short distance if it is at the proper stage. Twisting is another method by which forage will show proper moisture. If it can be twisted without the stems breaking and the leaves are wilted but show no signs of dryness, then the forage is ready for processing.

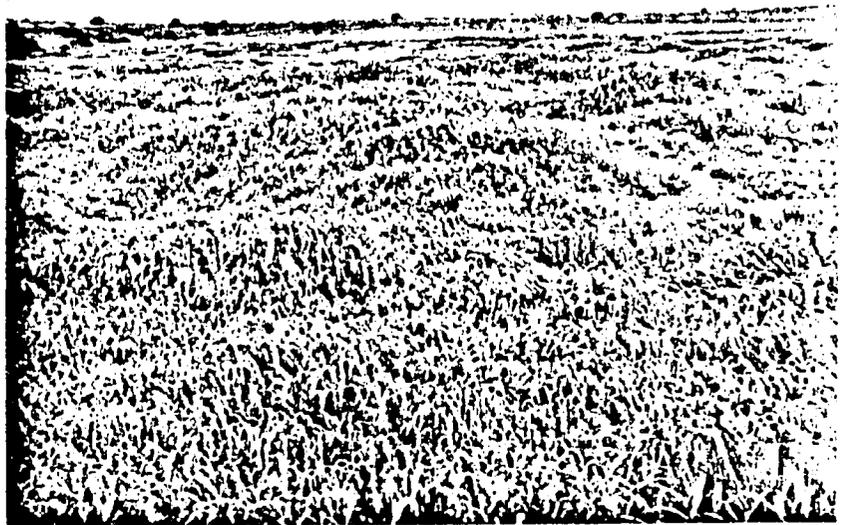
The squeeze method is another good test. This consists of taking a handful of chopped silage and squeezing it for a minute or two. Then open the hand slowly. If the material falls apart in small

pieces, then it is too dry and moisture should be added. If it remains in a tight wet ball, then it is too high in moisture. If the squeezed handfull of forage slowly expands as the hand opens and falls apart in large pieces, then it will be satisfactory for ensiling.



Figure 24 - Construction of a trench silo capable of maintaining 1,000 cows for three months.

Figure 25 - Field of guinea corn planted for silage; Winneba Junction.



Silos

There are many types of silos, several of which are found in Ghana but the most practical one is the trench silo. Usually, the silos are constructed by excavating a large trench in the side of a slope. This will give adequate sides and afford drainage when needed.

The size of a silo is determined by the number of animals which you have to feed and for what period. In Ghana, a minimum supply sufficient for each animal for 3 months is recommended. This will usually carry animals through the dry season. Ideal supplies should be for 120 days which would allow extra feeding for growing animals.

One mature West African cow can consume approximately 20 pounds of silage a day and the large animals use 25 to 30 pounds. These figures multiplied times the two periods allotted for feeding compile the following table:

TABLE 11 - TOTAL POUNDS OF SILAGE NEED FOR 90 AND 120 FEED AT DIFFERENT RATES

Silage per day (pounds)	Number of days fed	Pounds of Silage required
20	90	1,800
20	120	2,400
25	90	2,250
25	120	3,000
30	90	2,700
30	120	3,600

Hay

Hay is a form of forage which is very important in livestock program. Similar to silage when it is properly harvested, it can be stored for several years without losing its value provided it is protected from the weather. Hay can be made from a number of

crops but in Ghana grass is the basic raw material used. It can be stacked as loose hay or baled with a machine, cut by hand or with a machine.

Modern hay methods use a series of different machines to cut, condition and prepare the grass for preserving. The pieces of equipment most readily found in Ghana that are satisfactory for lay cutting and conditioning are the "slasher" or gyromower. This piece of equipment if properly handled, can cut and condition at the same time. With a windrow attachment, it will do three jobs at once.

Good quality hay can be made in Ghana in the period of a normal work day provided the weather is satisfactory.

Grass cut on a day when the sun is bright and humidity below average can be cured and baled by late afternoon. The method involved is as follows: (One tractor operation)

- 06:00 - Start cutting with the slasher and cut until 11:00 o'clock.
- 11:15 - Start windrowing or turning if the slasher had a windrow attachment. Continue until the area mowed is finished.
- 15:00 - Start the baler and continue until all the grass is baled. When the bales are dropped have a laborer stand them on end and leave until mid-morning of the next day or until the night moisture is gone. By standing them on end, it allows the cool evening air to remove any excess heat which might generate from high moisture content.

The method of determining moisture works very well. If the twisted grass from the windrow does not show surface juice or sap, it is ready for baling.

Good quality hay retains its bright green color and has a very pleasing aroma which cattle like. Hay which turns brown or yellow has lost most of its feed value.

The tall growing local grasses should be cut when they are young and tender rather than wait until seed starts to form. Protein content is higher and curing time short. Heavy stems also do not make good hay and have a tendency to retain excess moisture.

MANAGEMENT OF BREEDING STOCK

Management of breeding stock is an art. Good animals do not just happen, better strains or breeds of livestock do not come naturally. They are the result of specific breeding programs designed to satisfy a given need. To this end, the breeding system in Ghana has been geared to improving the local animals by crossing them.

A. Breeding Bulls (Management)

1. Breeding bulls should be in the ratio of one to 24 cows.
2. They should be kept apart from the herd except during the time of breeding. This is done for a two-fold purpose: (1) To regulate calf drop and (2) the time of year the calf drop occurs. This enables the calves to arrive at a time when they will have the best chance to grow and the dam has ample feed.
3. Prior to the breeding season, bulls should be given extra feed to condition them.
4. The breeding season should be for a period no longer than 90 days.

B. Cows (Breeding)

1. The normal useful life of a cow in Ghana is 11 years or five calves which ever comes first. Beyond this time, the potential drops. This applies to range cattle.

Figure 26 - "Ponoho" 1,000 pounds weight as a two-year old; 1/2 Santa Gertrudis, 1/2 Sanga, product of Artificial Insemination located on the GOG station at Pong-Tamale.

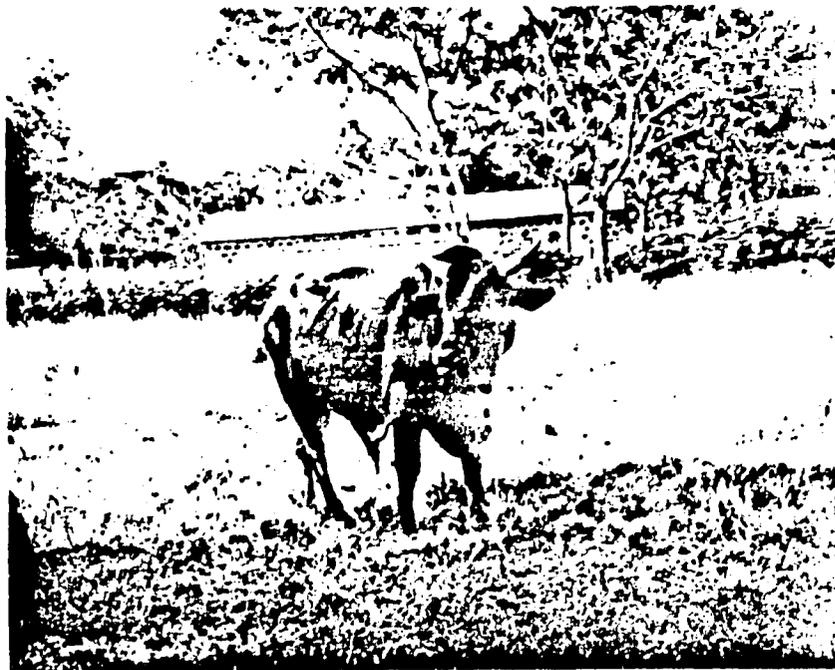


Figure 27 - Young Artificial Inseminated calf which has averaged gaining 76 pounds a month since birth.



Animals which receive special care can be expected to have a longer productivity period.

2. After calving the cows should not be bred for a period of 90 days. This is to allow the internal organs to recover from calving. If calving is at the proper time of year, then there will be available ample feeds for a balanced diet, most essential to recovery. Observation of this rest period will insure a higher rate of conception.

A study made by the USAID Livestock Advisor on the Accra Plains and Volta Region showed that herds averaging 45 head of cattle rate as follows:

<u>No. of Cows</u>	<u>Classification</u> <u>(by local standards)</u>
2	outstanding
7	above average
25	average
11	culls or aged cattle

From these figures, it is possible to realize how much improvement can be made in a herd just by culling. Removal or culling allows more pasture and feed for the more productive cows. High nutrition rates will increase calf crops and condition animals to withstand the periods of poor pasture.

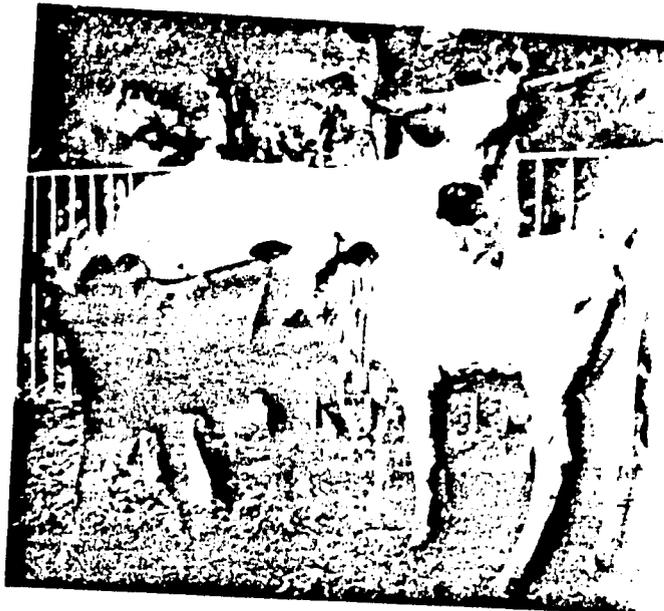
C. Calves

1. Special attention should be given to cows during calving to eliminate possible damage to the calf from mal-positioning.
2. After the calf has been cleaned, the navel cord should be disinfected.
3. The calf should be assisted if necessary to nurse on the first milk or colostrum.

Figure 28 - Healthy calves grow into good breeding stock



Figure 29 - Cows of improved breeding can improve production



4. The calves should be weaned when they are six months of age. At this time, the most promising calves should receive extra feed to maintain their growth rates.
5. Records should be kept on all calves. These records should show: sire, dam, birth weight, identification marks and sex.
6. Controlled breeding season allows all calves to be weaned and marketed at the same time.

FORAGE PRODUCTION

Some plants have the ability to pass into a state of dormancy when adverse climatic or moisture restrictions make their required nutrients inaccessible. Livestock, however, must continue to eat if they are to stay alive. As a matter of fact, if livestock are to live, flourish and maintain production, they not only require feed continuously at fairly regular intervals, but their feed must also be provided on a suitable nutritional level. About 60 percent of the food an animal is able to eat is required for such functions as body maintenance, metabolism, circulation of blood, respiration and reproduction. Livestock gains and profits for the owner, are dependent upon the feed an animal has available and is able to eat over and above the amount required for maintenance purposes. This being true, it immediately becomes evident that profitable returns from livestock are directly dependent upon good feeding.

In order to do well, livestock require adequate supplies of carbohydrates, proteins, vitamins, various minerals and water. These can be partially provided from various sources and kinds of feeds. However, the bulk of the requirements of an animal's diet can be most economically supplied in the form of forage which can be grazed directly or hand-fed to the animal. In instances where seasonal, climatic or other limitations make this impractical, nutrients must be made available either by providing hay and dry roughages, silages,

and crop by-products or through various concentrated feeds. The important thing to keep in mind is that livestock cannot stop eating. Feed must be constantly provided.

Since drought, hot weather, insect pests and other factors make feed production of range lands very hazardous and uncertain, it is desirable to produce and maintain good feed reserves. This practice is important, first, in order to provide at all times for the nutritional requirements of the animal and, secondly, to avoid overtaxing and overgrazing the ranges in times of low production. In addition, high levels of nutrition tend to protect the vigor and health of livestock and less difficulty is encountered from breeding, disease, parasites and other problems which result in high death losses.

By maintaining high forage reserves, there is also a better chance of keeping animals growing and thriving. This results in the fullest economy of production. There cannot be good economy where the condition of animals fluctuates as it does during the dry season, as they are being grown and fattened for market. Good feed makes a high quality product which will generally bring a better price on the market and provide a greater profit for the producer. In other words, it is possible to starve the profit out of an animal. It is good business to feed well.

Four principal ways to harvest forage crops are: (1) grazing directly from the field; (2) cutting and chopping of forage and feeding it directly to enclosed livestock; (3) making dry hay and (4) making silage.

When forage can be grazed, no problem of preservation is encountered. Making hay or silage is the common way to preserve forage for the use of animals when range forage is not available or when animals are kept at some distance from forage producing areas.

Hay is dried forage. As such, it is what the farmer makes of it - hay can be excellent feed on which animals thrive and produce good economical returns or it can be poor and supply little more

than body maintenance and heat. Musty or extremely dusty hay may have harmful effects upon the animals to which it is fed.

An encouraging fact in making hay is that it is easier to make good hay than poor hay. The first step in making good hay is to have a standing crop of forage plants, free from weeds and trash or debris and undamaged by insects. Combinations of companion crops are usually superior to stands of a single species because they normally result in better weed control, more palatable feed, greater yields per unit area and more support for each other with better utilization of plant nutrients and water from the soil.

Kinds of Feed Reserves

When we speak of animal feeds, we usually think of five general sources or types including: (1) native ranges, (2) artificially reseeded (dryland) pastures, (3) irrigated pastures, (4) roughages, such as hay and silage, and (5) concentrates. Of these, native range is the one that herded animals are almost exclusively dependent upon. Moreover, livestock in West Africa derive their main sustenance from this source. Because man neither plants nor harvests the feed, native-range forage is the least costly of all animal feeds, but it does have its limitations. Continued heavy grazing and burning results in production that is far below the potential for the site, both in quality and in quantity. Moreover, the size of the crop fluctuates with weather and growing conditions and may, at times, be insufficient for current needs. In some areas, it may even be made unavailable by prolonged droughts. In addition, and perhaps most important of all, serious losses of nutrients take place during the long period following the cessation of plant growth or annual burning. The result is that, during an appreciable portion of the year, range forage may be little better than straw in supplying the essential nutrients for normal growth and reproduction of livestock.

SWINE

Ashanti Black - The only recognized breed of swine in the country is the "Ashanti Black." No attempt has been made to improve this breed. A trial was conducted at the University in Kumasi by a British professor to determine the efficiency of feed utilization. The results were as follows: The Ashanti Black, after seven months of feeding reached an average weight of 90 pounds without additional gains. The "Large Whites" weighed 140 pounds at seven months and continued to increase in weight with further feeding. It appears from these findings that the Ashanti Blacks are not economical to produce in Ghana.

As a result of this test, further work was not pursued until 1965 at which time five selected sows were bred to a "Large White" boar. The offspring will be tested to determine whether it is possible to upgrade these pigs and increase the size. At the same time, it is extremely desirable to maintain the ability of the "Ashanti Black" to live under the poor condition encountered in villages.

Large Whites - This breed makes up 90 percent of all imported swine in Ghana today. The original basic stock was held at the Pokoase, 14 miles northwest of Accra. The offspring were distributed and re-distributed without any record of the original breeding. Unfortunately inbreeding thus occurred at many of the stations, and the malpractice was pointed out by the USAID Livestock Advisor. In 1965-66, two hundred and forty registered Large Whites and Landrace gilts were imported from Holland. These pigs will be multiplied and used by the Animal Husbandry Division of the Ministry of Agriculture as a source of good breeding stock for the farmers.

SWINE

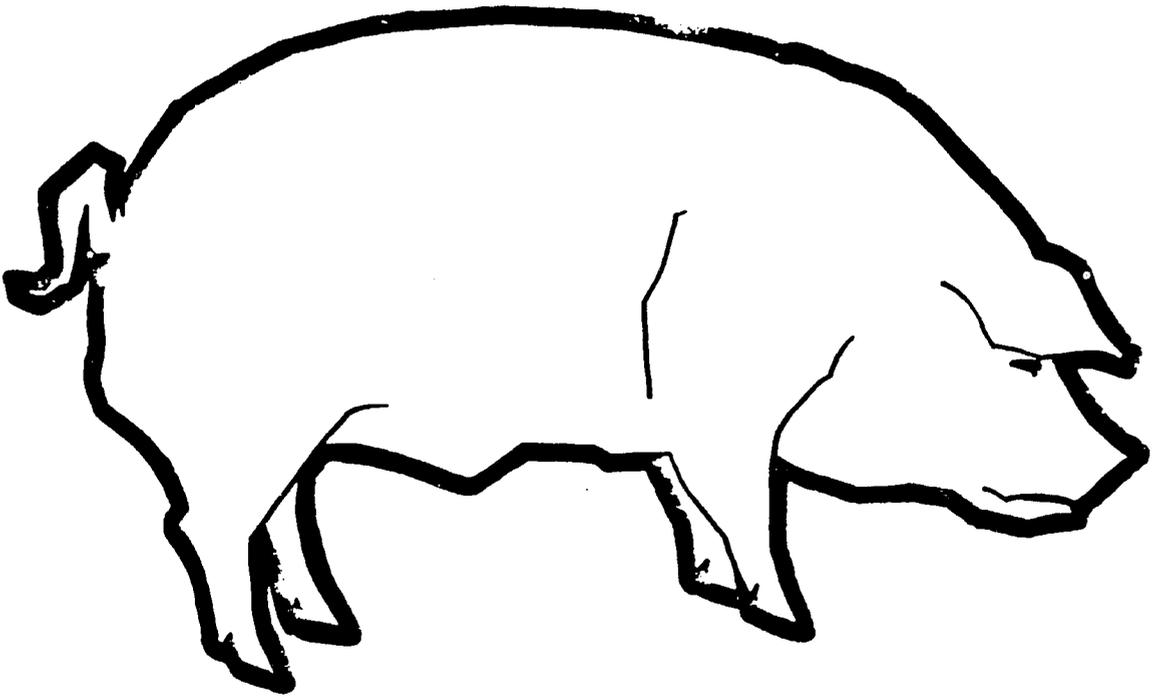




Figure 30 - A Large White gilt with her first litter. Note: evenly spaced teats and length of body.

Housing in Ghana is necessary for the best results for the Large White breed. The Ashanti Black does not require any refined type of housing. The area where hogs are to be raised determines the type of building required. If the area is in the open savanna, then a fly-proof house is not essential; however, the common house fly problem will be evident if strict sanitation is not carried out.

In areas of the rainforest and coastal bush, the fly-proof houses are necessary to protect the swine from the tsetse fly. Examples of the houses at present being used in Ghana and those that have proved satisfactory are illustrated in the following pictures.

Figure 31 - Screen hog house

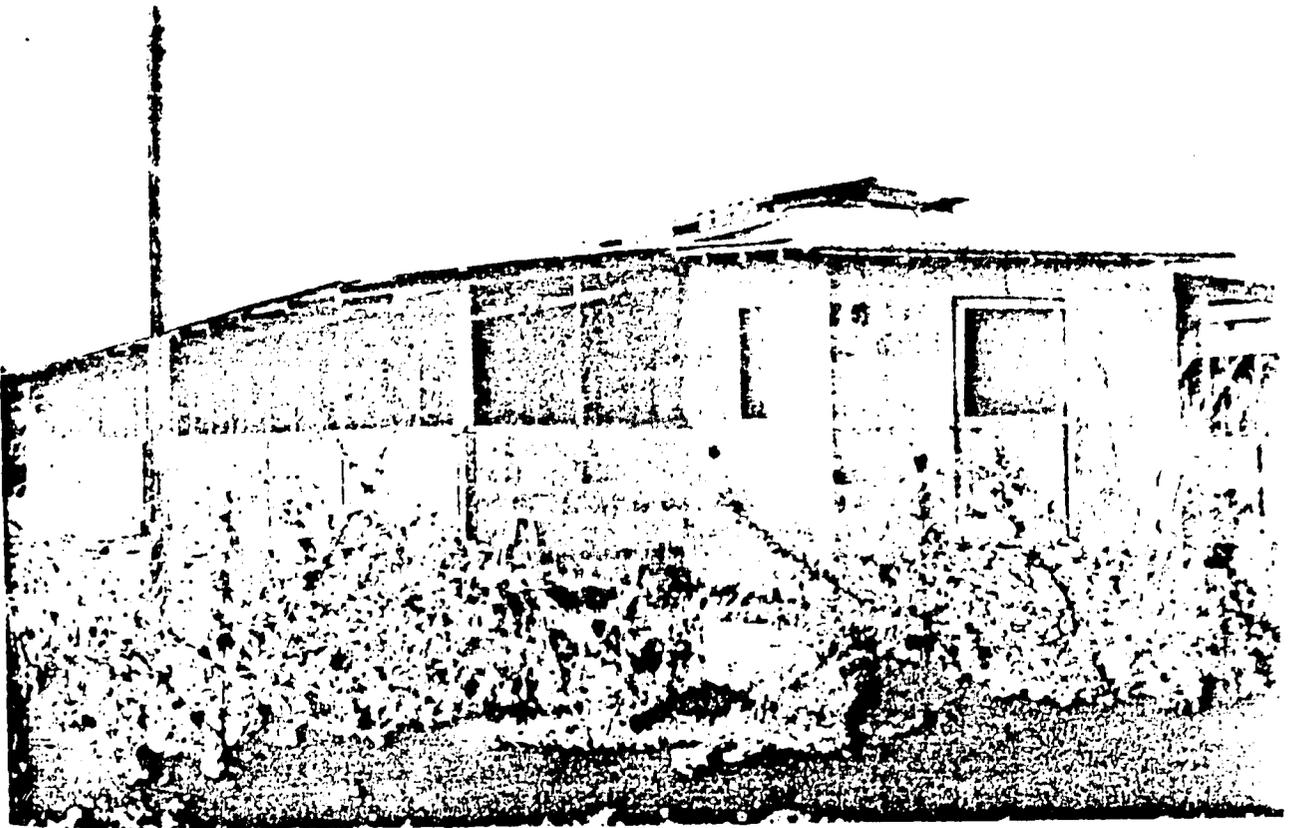
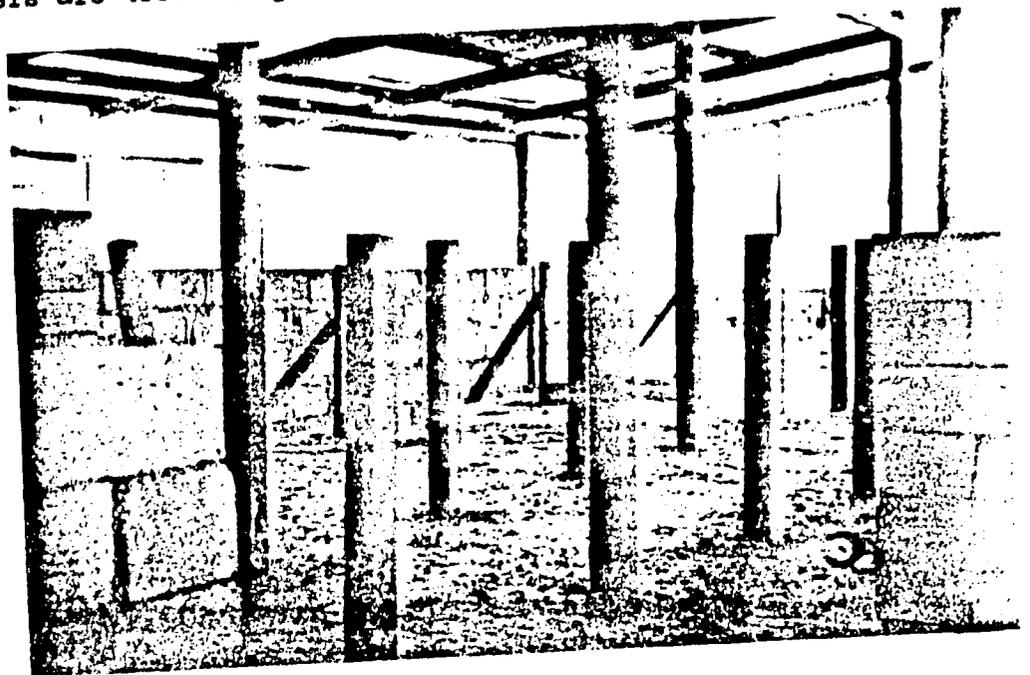


Figure 32 - Basic construction of screened hog house being inspected by Mr. H.E. Thompson, Chief of the Animal Husbandry Division.



Figure 33 - Outer walls and pen dividers are concrete blocks. Odum timbers are treated against termites and moisture.



Breeding and Management

The key to future hog business profits in Ghana is increased feed production and improved breeding methods. These breeding methods should be geared to take advantage of every aspects of economic operation and management. Producing the most meat for the least amount of feed in the shortest period of time requires the best of management.

Breeding is one of the best methods of improving the herd. A program which involves improved breeding requires careful study and work on the manager's part. Nothing can be left for chance. Performance and meat quality can be influenced by feeding but the full effects cannot be expected unless the animals have inherited the ability to produce superior meat carcasses.

Meatiness is one of the easiest things to change in hogs provided a plan for improvement is used. As an example in a period of five years, it is possible to reduce the back fat thickness and increase the meat/fat ratio. Carcass length improvement can be made through selection. Careful follow up on the market pigs will give the information necessary to produce pigs which exceed the following traits:

- Weight in excess of 200 pounds at 210 days
- Measure less than 1.5 inches back fat
- Have more than 29 inches carcass length
- Form eye area of over 3.5 square inches
- Lean out percentage of over 52 percent

Such hogs should average over 1.2 pounds of daily gain from weaning to market and produce 100 pounds of gain on less than 400 pounds of feed.

The ability to produce hogs which exceed these measurements depends on (1) variations within a herd; (2) the amount of selection or follow up information you use in upgrading the herd and (3) the heritability of the specific traits.

TABLE 12 - GENETIC ASPECTS OF SWINE TRAITS (Swine Breeding Research Laboratory)

Characteristics	Average Heritability
Length of carcass	60
Belly thickness	60
Percentage fat cuts (based on carcass weight)	60
Percentage ham (based on carcass weight) ^{1/}	55
Loin eye area	50
Back fat thickness	50
Percentage shoulder (based on carcass weight)	45
Lean cuts (based on carcass weight)	45
Economy of gain	40
Growth weight to 200 pounds	30
Five-month weight	20
Pigs weaned	20
Pigs farrowed	15
Litter weaning weight	15

} High heritability
 } Medium heritability
 } Low heritability

Half of the increased inheritance comes from the gilt and half from the boar.

Records

Earlier, it was mentioned that records are needed for a good job of management. The records carry this type of information on each sow and litter:

1. Number of pigs farrowed, date and or total litter weight either individual.
2. Number of pigs weaned birth or total litter weight date and either individual. If all litters are not weaned at the same age, it is necessary to adjust weights to the same age by the following process:

^{1/} In Ghana, this aspect of the hog has been grossly neglected due to heavy concentration on bacon production and has resulted in extremely poor ratios of fat and red meat in the hours.

- a. Subtract birth weight from weaning weight.
- b. Divide this by days of age and multiply this figure by standard weaning time of 42 days. This gives a comparative measure of the sows performance.
- c. Weights at sale time gives a measure of growth rate. Pick about $1\frac{1}{2}$ times as many gilts as needed for replacements, based on sow performance, growth rate, and if possible, back fat. (This service is available from some of the trained Animal Husbandry Civil Servants located on the Government stations.)

Measure the carcass traits - Select one or two pigs from each of the best litters and have a cooperating butcher slaughter and determine grade and yield. At present, the only place which can render this service is the Accra/Tema Slaughter House located in Tema. It might be possible to get the member of the Food Research group experienced in carcass grading to perform this service. Whoever does it, it is well worth the trouble required of the breeder for he can use the information in making a final sort of the gilts needed for breeding.

Boar Selection - The boar contributes half of the genetic make up of the entire pig crop. Since his genetic characteristics contribute so much to upgrading the herd, there is almost no price too high to pay for a boar that carries outstanding traits needed in a breeding program.

As an example, suppose an extra N¢15 or N¢20 is paid for a good boar; if he is used twice in one year on 20 sows one would expect to market 300 or more pigs. If used only one year, the boar would add about 1.5 pesewas to the cost of each pig marketed, but this would easily be offset by more efficient gains and meat/fat ratio values.

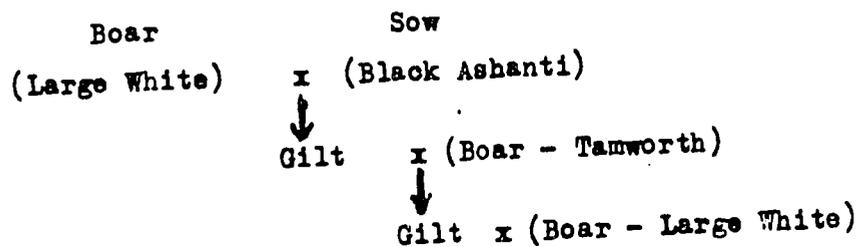
Superior Boars

Finding superior boars has been simplified for the Ghana farmer in that the Government is maintaining a supply of pure bred breeding stock on some of its stations. These hogs are imported and plans for periodic imports will keep the blood lines under control. Large Whites and Tamworth are the two breeds which they maintain.

Buying a Boar

Pick one which has the traits needed to upgrade the herd. Different breeds have desirable individuals that can add genetic power to the herd. However, there are some that tend to have longer carcasses; others have larger hams and loins. Considering this, the hog producers will find it best to utilize some cross breeding program such as the one shown below.

At present in Ghana, this program will be limited due to the availability of breeds, but a possible cross would be as follows:



Future breeding programs may find that the importation of a breed or breeds from the United States will make a more rugged or vigorous hog. One way to obtain larger litters is in multi-mating, using more than one boar.

Farrowing Time

Farrowing time is a very critical period and the manager should be on hand when the sow is delivering. Mashed pigs and difficult births are sure ways of losing money. If at all possible, farrowing pens or crates should be used. These help to eliminate the common problems of the management. When the pigs arrive, they should be dried off, their eight needle teeth cut, navel painted with iodine and placed with the sow to nurse early to obtain the colostrum milk. If farrowing crates are not used, then railings should be put across the corners and around the walls to protect the young pigs. Needle teeth can be cut with ordinary side cutter pliers. Removing these teeth protects the sows udder from damage.

For pigs which are raised on concrete in Ghana, it is necessary to give iron shots at an early age to keep the pigs from developing an anemic condition.

Sow Management at Farrowing Time

Reduce ration at farrowing time by making two changes in her ration.

Make the ration bulky by substituting rice bran for at least a third of the ration.

Reduce the amount of feed.

Avoid feeding the sow for 12 hours before farrowing but allow her all the fresh water she will drink.

It is recommended not to feed the sow for 24 hours after farrowing.

Feed her the same bulky ration for a few days after farrowing.

Increase the sow's ration gradually, taking about seven days to get her back on full ration.

Nutritional Requirements

Swine requires rations according to the purpose for which they are kept. The rations for the pigs are different from the sows and the breeding boar. There are, however, basic nutritive or essential needs for all classes of swine:

1. proteins of good quality
2. energizing feed for maintenance and fattening
3. minerals for body framework and physiological process
4. vitamins essential to growth and body well being
5. water

Protein Needs

Protein feeds are essential for maintenance and building body tissue.

Energy Needs

Energy is the first essential for necessary life process of animals which governs the metabolism rates of the body. Chief sources of energy in swine rations are carbohydrates and fats of available feeds.

Mineral Needs

Minerals of all types are needed by the pig and it is one of the animals quickest to suffer from mineral deficiency. Salt is one of the common minerals which is often neglected in Ghana. Proper use of salt in the ration can increase the rate of gain with less feed. Salt may be added at the rate of 1/2 pound per 100 pounds of feed.

Vitamins Required

Vitamins A, D, B-12

Water Needs

Water is a very essential item in the ration. It should be clean and plentiful. Feeding wet rations is no substitute for a free choice of water but is a practice carried on in Ghana by some pig raisers and it is not recommended. Water needs vary from 1/2 to 1 1/2 gallons per day per 100 pounds of live weight. A sow which weighs 300 to 400 pounds will require 3 to 4 gallons of water. Water, if not distributed automatically, should be replenished at least twice every day.

Green Feeds

Green feeds are relished by all classes of swine. Green grass, peavine, rape and dry hay are all readily eaten. A source of calcium is derived from these green feeds as well as vitamins.

As a guide to feed and water consumption and expected manure, the following table is provided:

TABLE 13 - FEED AND WATER CONSUMPTION AND MANURE PRODUCTION OF HOGS

Weight lb.	Ave. Daily Gain lb.	Ave. Daily Feed. Cons. lb.	Ave. Daily		Ave. Daily Manure Production lb.
			Water lb.	Cons. gal.	
50	0.75	2.7	5.1	0.61	2.5
100	1.27	4.7	8.9	1.07	4.3
150	1.56	6.3	12.0	1.45	5.8
200	1.71	7.6	14.4	1.73	7.3
250	1.67	8.2	15.6	1.88	7.8
300	1.53	8.4	16.0	1.93	7.9

Rations

Mr. T.F. Buamah, Chief Nutritionist for the Animal Husbandry Division, has been experimenting with formulas for rations to serve the needs of Ghana. The same ration that is being used successfully by Government and private farmers is listed below:

TABLE 14 - SWINE BREEDING MASH (Pregnant and lactating sows; may also be fed to boars)

	<u>Percentage</u>
Corn	60.0
Fish meal	7.0
Groundnut cake	25.0
Rice bran	4.5
Bone meal	3.0
Salt	0.5
	<hr/>
	100.0

In addition:

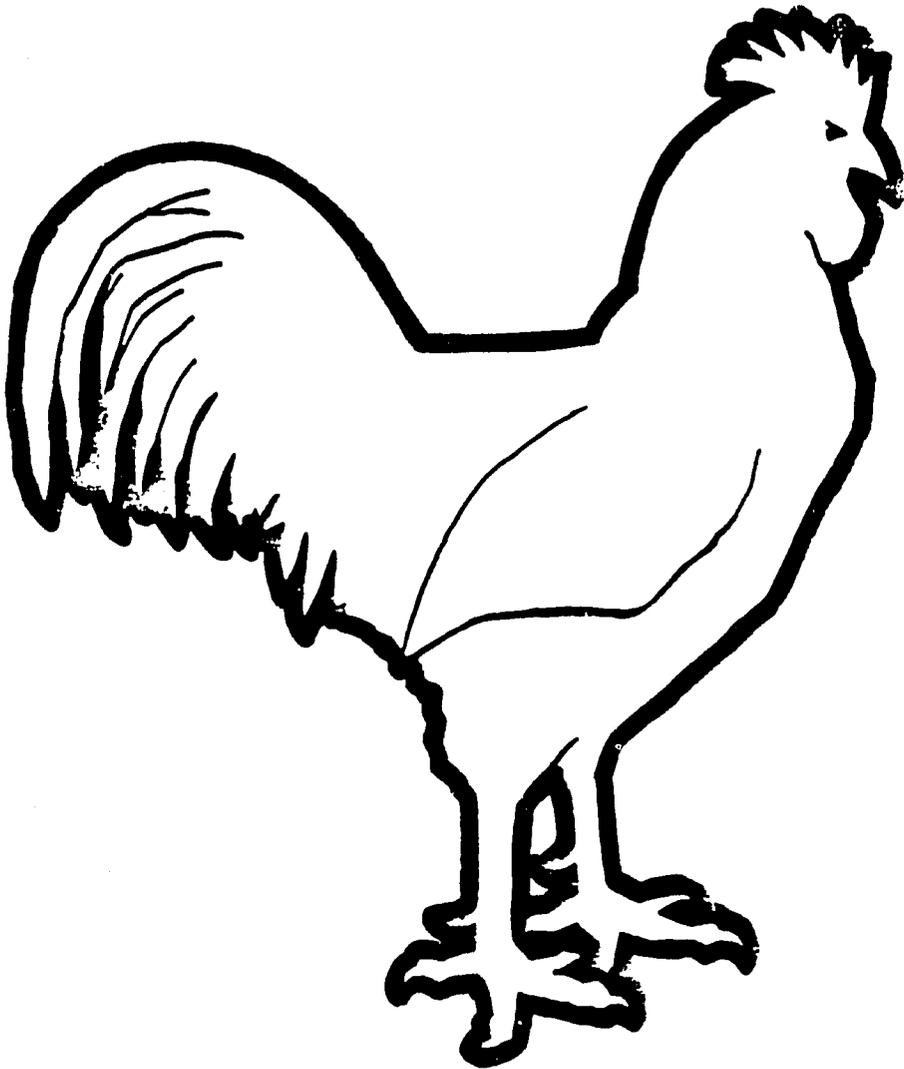
1. Coopavite Vitamin mineral premix as advised. If the information is not shown, you may use the poultry kind at 0.2 percent.
2. Feed plenty of green succulent vegetables especially to pregnant and lactating sows. Piglets should be allowed access to the green feed as early as possible.

TABLE 15 - PIG RATION: Pig fattening ration (weaning to market)

Maize	70 lbs.
Fishmeal	10 "
Groundnut cake	17 "
Bone meal	2 "
Salt	0.5 "
Coopavite	0.5 "
	<hr/>
Total	100.0 lbs.

For a high energy ration, use ingredients the same as in the above but increase the oil or animal fat.

POULTRY



POULTRY

Of all the possible livestock industries in Ghana, poultry has the greatest potential for rapid development. The basic problem is the shortage of feed, particularly corn which comprises 85 percent of the poultry ration. Corn and grain sorghum production will be the determining factor in the growth and development of the poultry industry. Breeds of poultry in Ghana are as numerous as there are recognized breeds. The chickens in Ghana are the same as those found throughout the rest of Africa. The imported breeds mostly from Europe and England, are of all types and strains; the predominant breeds of layers are: American and Canadian hybrids, Italian Leghorns, a few Speckled Sussex and Rhode Island Reds.

TABLE 16 - POULTRY BREEDS IN GHANA

Breeds	Source	Production Type
Hyline	U.S.A.	Egg
Shaver	Canadian	Egg and broiler
Leghorn	Italy/Britain	Egg
Redbreast broiler	Holland	Meat
Sussex	Britain	Dual purpose
Turkeys:		
Broadbreasted Bronze and Broadbreasted Whites	U.S. and Britain	Meat
Local	Origin, unknown	Meat

Housing

There are many different types of poultry houses in the country and these incorporate many different systems of the industry. For all practical purposes, two types and systems are used. These two are deep litter, open houses and those with caged birds in open or shelter houses. Construction of the houses and shelters can be of wood, bamboo, mud or grass. Due to the climate

in Ghana, extremely tight houses are not necessary. Ways of controlling drafts is the most important.

When building a house, care should be taken in the planning. This should take into consideration many aspects needed to assist in making it an efficient unit. Consideration should be made as to whether it will be cleaned by hand or by machinery. To date, few houses in Ghana are built with the idea of using machines to clean them. If machinery is available, by all means use it and save added labor required to change the litter. As an example, Ghana Chix Poultry Farm located at the Tema Junction on the coast road uses bamboo in a very effective way. It is operated by Mr. Kojo Plange. Caged laying birds are raised in these inexpensive houses or house-shelters. An open-sided poultry houses located on the Government Farm at Winneba Junction is illustrated on page 91. Concrete block (breeding) houses may be seen at the same location. Wood-sided plank houses which have double doors giving access to the interior for cleaning, Disneyland Farm, located at mile nine, north of the road junction at Sege.

All of these different houses have both good and bad features. Cost of construction varies greatly and the house best suited for any one location is a matter of choice. If there is uncertainty as to the house needed in an area, it would be best to contact the Agriculture Extension Officer in your area.

Breeding and Management

Breeding poultry cannot be carried on by every farmer for if properly done, it requires special training and is expensive. In Ghana, there are several specialized poultry breeders. These breeders are producing day-old chicks of the type needed by the average poultry producer in the country. In a country the size of Ghana, there is not a great need for many poultry breeders, that is, provided a supply of chicks acceptable for the development of the industry is available at reasonable prices. Both egg type and broiler type chicks are available in Ghana today. These chicks are hatched from eggs coming from some of the best commercial parent stock to be found.



Figure 34 - Interior of finished hog house showing arrangement of feed and water troughs

Figure 35 - A young gilt in one of the pens.



These birds are hybrids and are bred and selected for their efficiency in either egg or meat production. Strict controls are required to establish and maintain these breeds.

Taking this into consideration, the average lay poultry man should limit his activities to raising chickens for either egg or meat production. It is seldom recommended to produce both at one time as the rations required for each type is different.

The largest hatchery and producer of day-old chicks in the country is the Odorkor State Farm. On this farm, there are 40,000 birds producing eggs from which 10,000 baby chicks are hatched each month. (Chief parent stock is the Hyline, U.S-bred).

Second largest producer of hatching birds is the Animal Husbandry Division with 8,500 eggs. At present, incubators are being installed with a 100,000 eggs capacity per hatch. Peak operation is planned by 1972. This scheme is to be carried out as a production program of the Animal Husbandry Division. The first year's production is expected to be two million day-old chicks.

The Ghana Chix farm has a breed which is said to be especially developed and suitable for West Africa.

Management

Strict records are required in poultry raising to determine the economics of the system. It is through records that it is possible to detect weaknesses in the operation. As an example, on one of the Government farms, the laying percentage progressively dropped towards the center on one side of the laying house. At first no explanation could be given but after watching the house, it was determined that the daily routine feeding and watering pattern did not vary. The birds which had the lowest percentage

of laying were the last to receive feed and water in the morning and this resulted in less feed and water consumed and thus lower egg yield. Re-arranging the feed and watering pattern corrected this problem.

Equipment

Adequate equipment for feeding and watering should be available at all times. This is one of the most common complaints about poultry raisers as it is hard to have an excess feeders and waterers. In order to keep feed waste to a minimum, the feeders should be at a height of the birds' back. Selecting equipment that can be adjusted in height will save the producer money by cutting down on the number of pieces needed.

Equipment Sanitation

This is very important for without it, the poultry grower is asking for trouble. Between each run of chickens a program of thorough disinfecting and clean should be carried out. House walls, ceiling, and floors are all included. A good basic and inexpensive disinfectant commonly used by poultry men is made by adding one pound can of caustic soda (sodium hydroxide) to 100 gallons of water. This solution can be used in scrubbing down floors, wood work and dividing partitions. For utensils and equipment, the strength may be increased by half. After disinfecting, allow free circulation of air and dry the equipment in the sun. Caution should be exercised while using this solution for it is harmful to the skin and eyes.

Successful poultry raisers are usually proud of their handwork, especially if they actually participate in the husbandry work rather than leaving it to a laborer to do. This trait can sometimes lead to disaster through allowing visitors to enter the poultry houses without disinfecting their feet. Even this will not always suffice if the traffic is heavy. Few people realize how important this protective step can be. Disease can be carried on the feet of people without them even knowing it. A man can very easily carry some disease to his friend's flocks by stepping in poultry or bird droppings

on the street and then leaving the residue from his feet on the farm he visits. It is highly recommended that the following procedure be observed to maintain strict control of outside diseases: (1) Do not allow any one in the poultry house but the persons responsible for feeding and watering. If possible, have two sets of boots, keeping one inside the door of the poultry house. Wear one pair to work outside but change at the door of the poultry house in the anti-room and wear the extra pair when working inside the building. If these precautions are followed, then there will be little chance of contamination.

Operational Management

When a person decides to go into business, he must consider all aspects of that business and what it involves. In a poultry operation, there are many things that are important but in Ghana, there are three major ones to consider: First is an adequate and steady supply of balanced feed to run the project. This can be critical for the basic ingredient of a poultry ration is maize and the availability of maize at an economical price has been uncertain over the past few years. Poultry will disrupt their production cycle if feed formulas are changed and this can cost the producer money. Second is the market consideration. One must be careful not to overload the market in the country. Egg production can very easily get out of balance in Ghana and create a problem for the producer whereas broiler or meat producers would not have quite as big a problem. A regular marketing system is needed in both cases to maintain a steady supply to the market and maintain a level of production which will stimulate production in the country. Distribution and storage is very important in this system. The Ghana Government is working on increasing its services in the form of "package deals" to the farmer. This is a program of assisting the farmer who has received a bank loan or has sufficient capital to start a new project. In the case of poultry, day-old chicks, enough feed to carry them for several weeks and technical help in starting the chicks are provided. For the cooperating farmer, a supply of

feed may be purchased, sufficient to carry the project to completion; when possible, markets are found for the farmer.

Disease Control

A regular schedule for vaccination and debeaking should be set up. The veterinarian in the area will help decide the time. If the local veterinary representative is notified of the time of arrival of chicks, he can set up a routine schedule to take care of them. A small charge is made for New Castle vaccination. This disease and coccidiosis are the main diseases within Ghana of commercial importance.

As an assistance in proper management, the following check list can be used in determining what is needed to get maximum egg production. If the questions can be answered yes, then the production should be high:

1. Are simple but accurate records kept?
2. Is the laying house constructed so drafts can be controlled?
3. Can the house be partially opened on any side?
4. Is the poultry house area well drained?
5. Is the house protected from rodents, soldier ants and snakes?
6. Is the house in good repair?
7. Is the house cool in the hot season?
8. Is there at least $2\frac{1}{2}$ square feet of floor space per layer in a deep litter house?
9. Is the house divided so that the flock can be in units?
10. Is there ample overhang on roof to prevent rain from blowing into the house?

Sanitation

1. Was the house thoroughly cleaned and disinfected prior to putting in the birds?
2. Are entrances protected by disinfectant troughs?
3. Have chicks been properly vaccinated for New Castle, fowl pox and other diseases?

4. Has the veterinarian set up a vaccination schedule or routine flock check?
5. Is equipment fixed so birds cannot roost on it at night?
6. Are waterers properly fixed so wet spots will not develop?
7. Are dead birds properly disposed of (burned or put in a proper disposal pit)?
8. Are feed rooms free of mice and rats?
9. Are waters cleaned and disinfected each week?

Equipment

1. Is the nesting space adequate for the number of hens? (one next to four hens); (community next equivalent space.)
2. Is one of the feeders used: trough feeders - 36 linear feet (3 six foot long feeders per 100 birds). Hanging tube feeders - 16 ft. of space per 100 layers?
3. Are six linear feet of grit hopper space and one linear foot of muscle, sea shell hopper space per 100 birds provided? This space is usually inadequate in Ghana.
4. If roosts are used, is a space of 6 to 8 inches of roosting space provided per bird?
5. Is artificial light provided (Lanterns) where electricity is not available? (Seldom done in Ghana and day is fairly short).

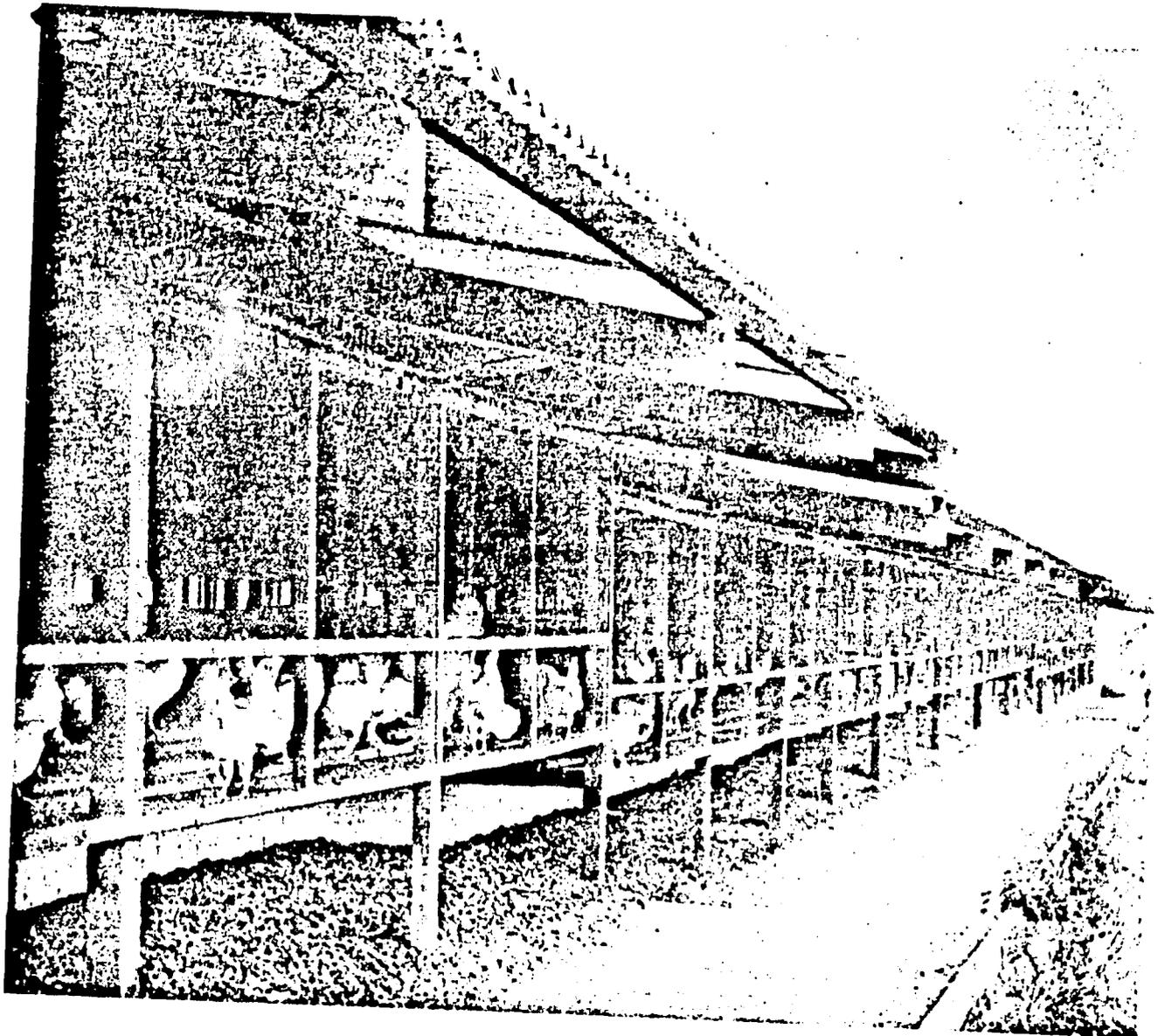
General

1. Are all birds debeaked?
2. Are sick birds removed when first noticed?
3. Are nests cleaned periodically?
4. Are birds culled at regular intervals?
5. Is litter ample and evenly distributed throughout the house?
6. Are nests properly placed for different stages of egg laying? (lowered to take care of the ground layers when pullets start to lay).

Feeding

1. Is a feed-consumption-record made for each day?
2. Is whole grain provided in addition to all mash ration (if all mash ration is fed)?
3. Is green feed made available for birds?

Figure 36 - Open-side poultry house located at Winneba Junction on the Government farm.



Negative answers to six or more of the questions may indicate that the percentage of profits is on the borderline.

Extra Profits in Poultry Manure

Poultry manure, if properly managed, can be an extra source of revenue for the large poultry farm. The smaller one will benefit by using it on the home garden.

To give some idea of the amounts of manure which birds produce, the following figures are listed:

1,000 broilers can yield 2.1 tons of manure in 10 weeks.

200 hens can yield five to six tons of manure a year if deep litter is used.

Chicken manure to be at its best should be used before it is 10 to 11 weeks old to avoid sharp reduction in chemical losses. Chicken manure dried, run through a pulverizer and bagged in polythene bags makes excellent lawn or flower fertilizer. Maize production can be boosted if from 4 to 8 tons per acre of manure is scattered and worked into the soil. Hay production can be boosted if 3 to 4 tons of chicken manure is broadcast on each acre.

Rations

Recommended rations which have given good results and are being formulated by the Animal Husbandry Nutritionist are as follows:

TABLE 17 - BROILER STARTER RATIONS (Starting feed for broiler chicks up to 6 weeks old)

	<u>Percent</u>	<u>Pounds per ton</u>
Corn	50.00	1,000
Groundnut cake	32.50	650
Fishmeal	15.00	300
Bonemeal	1.25	25
Oyster shell	0.25	5
Salt	0.50	10
'Coopavite' P-mix	0.50	10
	<u>100.00</u>	<u>2,000</u>

- (1) Feed also Terramycin poultry formula (Pfizer).
- (2) Chicks should also have a suitable coccidiostat.

The use of 1 and 2 will maintain the health of the chick and prevent disease.

TABLE 18 - LAYER - BREEDER MASH RATION

	<u>1 lb. per 100 lbs.</u>	<u>1 lb. per ton of 2,000 lbs.</u>
Grain	57.0	1,140
Groundnut cake	25.0	500
Fishmeal	7.0	140
Rice bran	2.0	40
Bonemeal	3.5	70
Oyster shell	4.5	90
Salt	0.7	14
Coopavite Premix	0.3	6
Total	<u>100.0</u>	<u>2,000</u>

Add per 100 lbs. total feed.

1. Palm oil - 30 fluid ounces added at time of feeding.
2. Use Pfizer Terramycin poultry formula as directed.
3. Reliable coccidiostat may be fed through water or feed but strictly as instructed by manufacturers.

TABLE 19 - BROILER FINISHING MASH FED FROM SIX OR EIGHT WEEKS TO MARKET

	<u>Percent</u>	<u>Pounds per ton</u>
Corn	63.00	1,260
Groundnut cake	20.00	400
Fishmeal	15.00	300
Bonemeal	1.00	20
Salt	0.50	10
Coopavite P-mix	0.50	10
	<u>100.00</u>	<u>2,000</u>

1. Feed also Terramycin poultry formula.
2. And coccidiostat as recommended by poultry advisors.
3. Feed palm oil at 40 fluid oz./100 pounds of feed.

Broiler rations should contain high energy nutrients to keep the growth rate higher than for layers. Animal fats and tallow may be used when available. Premix or commercial concentrates are used in compounding rations using maize. Local ingredients such as palm oil are added in some cases to give color to the eggs and to maintain vitamin levels. The calcium content of the local rainforest snail has been found to contain a higher percentage of calcium than muscle or oyster shells. A breakdown of the ration analyses is made in the following table as well as the premix:

TABLE 20 - NUTRIENT ANALYSIS OF MAIN INGREDIENTS EXCLUDING PREMIX OF RATION IN TABLE 21

Protein	about	18%
Lysine	"	0.9%
Methionine	"	0.4%
Cystine	"	0.35%
		} 0.75%
Calcium	"	3%
Total Phosphorus	"	0.75%
Available Phosph	"	0.5%
Choline	"	5.80 oz.lbs.
Pantothenic acid	"	2.1 oz. lbs.
Riboflavine	"	1.0 oz. lbs.

TABLE 21 - PREMIX (COOPAVITE 'E' FOR POULTRY) Contents

<u>Supplies</u>	<u>Per lb. of feed</u>
Vitamin A	400,000 I.U.
" D3	600,000 I.U.
" E	5 I.U.
Riboflavine	1.2 mg/lbs.
B12	Trace
Niacin	10 mg./lbs.
Pantothenic Acid	2.25mg/lbs.
Choline	150mg/lbs.
Vitamin K. Menndione	
Sodium bisulphite	1mg.
Iron	5mg.
Manganese	35mg.
Copper	0.5 mg.
Iodine	0.6 mg.
Zino	25 mg.

Caution should be exercised in buying locally-manufactured feed to make sure that it has not been mixed for a very long period. The vitamin A content drops after several days of storage. Calcium levels should be maintained at high levels in this climate. Locally-manufactured feeds properly formulated, have given equally as good results as imported ones. The hatcheries and breeding farms all sell formula chicken feeds. When buying, insist on an analysis or formula for the feed.

TURKEYS

Turkey raising in Ghana is not done on a commercial scale but only by a very few people. Problems of turkey raising in the country, in comparison with other parts of the world, are nil. Turkeys fair well under Ghana condition if kept free of worms. Range condition are good and production is high if good management practices are applied. The local turkeys are not meaty birds, but they could be developed very easily by crossing the turkey hens with imported toms.

Breeds

The local Bronze, which to my knowledge does not have a known origin, is very much like the wild turkeys in the United States; also, its bearing and structure are similar. Hens are prolific egg layers and will produce a large number of poults if maintained on a supplemental diet while ranging.

The imported Beltsville Small White and Broadbreasted White do well under the system of confinement in Ghana, but have to have higher protein rations than chickens to do well. This level should be any where from 22 to 30 percent protein.

A recommended ration for Ghana is as follows:

TABLE 22 - TURKEY GROWER RATION (MASH)

<u>Ingredient</u>	<u>lbs. per 100 lbs.</u>	<u>lbs. per ton 2,000 lbs.</u>
Corn (or any grain)	58.0	1,160.0
Groundnut cake	25.0	500.0
Fishmeal	10.0	200.0
Rice bran	1.0	20.0
Bone meal	3.0	60.0
Oyster shell	2.0	40.0
Salt	0.5	10.0
Coopavite premix	0.5	10.0
	<u>100.0</u>	<u>2,000.0</u>

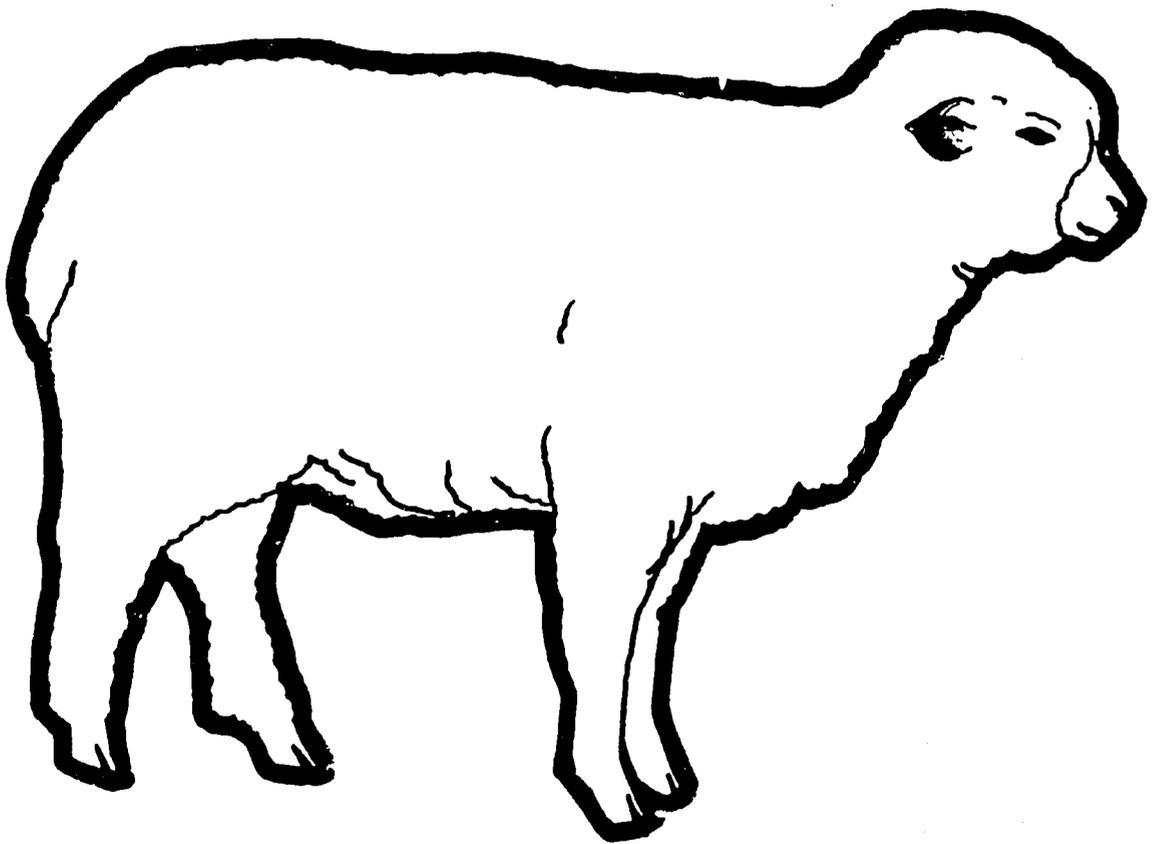
Added per 100 pounds of Feed

Pfizers Terramycin A and B crumbles 1/4 pound.

Feed good amounts of succulent green vegetables or green grass.

Reliable coccidiostat may be fed through water or feed strictly as instructed by manufacturers.

SHEEP



SHEEP AND GOATS

Economic Potential

In West Africa, sheep and goats are a neglected segment of the economy although they play a very important part in supplying animal protein to the people. Of all animals in Ghana, they receive less management and care than any of the others. The University of Ghana has done some good work in selection, size and uniformity and results show the potential of these animals. The division of Animal Husbandry has gotten some excellent results in crossing the imported milk goat on the local Arabic type female. Several local people have become extremely interested in these crosses and established herds using billies bought from the government farm. A sheep and goat farm has been established in the Ejura district at which only the breeding of sheep and goats will be carried out. The potential of cross bred goats for producing milk is a possible answer for the family interested in extra milk at reasonable cost. Crosses have produced the equivalent of two beer bottles per day. Considering the average yield of the West African Shorthorn cow $3/4$ of a liter this is very good. The local nannies are prolific and the kids from a Saanen billy grow to an intermediate height of their parents in a period of five to six months, meaty quality also improves.

TABLE 23 - BREEDS OF SHEEP (AND GOATS) IN GHANA

Breed	Region commonly raised	Height at wither (inches)	Weight (lbs.)
Black head	Accra	22-23	50
Black head	Rainforest	21-22	40
Fellata	Northern Ghana	26-27	60

Sheep are not nearly as much in demand throughout the country as goats. This is evident from the number of sheep and goats imported from the surrounding countries. During the years the borders have been opened, an average of 110,000 goats and 56,000 sheep were imported.

Foot-rot, internal parasites and pneumonia are the primary limiting factors to sheep production in Ghana.

Figure 37 - Milk goat billies used for crossing with the local goats (left to right) Arabic type billy from Egypt's third generation Saanen billy originally imported from Israel.



Figure 38 - A local female goat with offspring resulting from crosses between the Arabic and Saanen; local nanny in right foreground. Arabic cross are all black and Saanen cross are all white.



Goats

The indigenous goats are dwarf in size, in some cases, almost miniature, but very prolific. A female goat commonly delivers three kids.

Several breeds of goats have been introduced for breeding purposes. In 1965 the Animal Husbandry Division recognized the value of hybridization and four field trials are at present in progress. Goats which were imported are as follows: Saanen, Arabio, Nubian and Sudan.

TABLE 24 - MEASUREMENTS OF GOATS USED FOR BREEDING IN GHANA

Breed	Height at withers (inches)	Type	Weight (pounds)	Origin or Location
Local dwarf	12-18	meat	7-35	throughout Ghana
Sudan type	23-26	meat	24-45	mostly north Ghana
Saanen	31-36	milk	100-135	Israel/Nungua
Arabio Nubian	29-34	dual	85-90	North Africa

Breeding and Management

Recommended breeding for sheep depends on the area of the country where they will be raised. In the rainforest belt, little can be done in the way of breeding other than selection and castrating. Supplement feeding will give some improvement but as a whole, the rainforest breed will remain much as it is.

In northern Ghana and on the Accra plains, improvement can be made rather quickly by the selection and cross breeding methods. Crosses between the Fellata (Sudan type long-legged desert sheep) and black head results in a well bodied sheep which lends itself to selection. The body is deeper than either parent and shows the same vigor and resistance as the smaller blackhead breed. Close selection is recommended as a basic management practice. Good ewes to build a herd may be found in Ghana by traveling in different sections of the country and buying animals which fulfill the conformation requirements of establishing a basic herd.

Management

Sheep should have constant care and supervision to maintain a high rate of production. The following schedule is suggested:

December-January-February and March - ewes should receive supplemental feed to maintain condition during the dry season and lambing time. During this time when the sheep will most likely be confined, it is a good practice to inspect each animal's feet, ears and underline for parasites.

April-May-June - at the onset of the rains, special care should be given the feet especially if the animals are ranging. Trim hoofs and then apply a solution of 30 percent copper sulfate or 10 percent formalin if it is available. The veterinarian may be able to help locate if for you. Worms and pneumonia usually occur with the onset of fresh grass and rains. Use any one of the antihelminths that can be bought. Pipazan, Coopane and Antipar are examples of trade name products. For mating, provide one ram to 25 ewes.

Marketing Animals

Sell all old ewes and non-breeders when they have reached their peak condition on the new pastures. Select ewe lambs which will be kept for breeding and prepare the rest for the market by increasing their feed. Ground corn mixed with rice bran is an excellent supplemental ration.

General

Make available a mineral mixture of good quality. Calculate that 90 percent of the sheep's rations should come from pasture and forage. If sheep are grazed in rotation with cattle, allow approximately one week to pass before cattle are moved on the area. (Cattle do not like to follow immediately behind sheep or goats).

When worming, keep sheep confined for 24 hours after treatment to limit further infestation of pastures.

Sprinkle pens where sheep were wormed with a solution of one pound of caustic soda to 50 gallons of water. Then turn the soil with a hoe or plow. Dip or spray for ticks and fly once a month during fly season.

During breeding season, allow rams to be with ewes at night and remove them during the day. Application of grease to the chest of the ram will mark ewes which have been served.

Rations

Sheep like a certain amount of browse but they also like good grass and should be provided with it all year round if possible. During the dry months, adequate amounts of good hay should be provided.

Good water is another essential for the well being of sheep. It is consumed at the rate of one gallon a day. Cracked grain is recommended for feeding sheep.

GOATS

Goats have one of the highest potentials for developing an income of any member of the livestock family. Some of the dwarf goats in Ghana are no bigger than a good size commercial breed of rabbits or a big grass-cutter rat. They receive no special care but maintain a constant supply of young kids. Triplets are not uncommon in Ghana. As mentioned in Table 24, most of the indigenous goats are of dwarf size. Some of the imported goats are as heavy as the average man in Ghana. Between the two breeds lies a fertile field of improvement, by crossbreeding. Intermediate goats, which are cross breeds and found in the northern and border areas of Ghana, have some very good traits and it is desirable characteristics needed for improving the breeds. Selection is one of the best basic methods of improvement available to

the average Ghanaian farmer. Superior billies are available in limited numbers from the Government farm at Nungua.

Marketing

Young kids should be marketed for meat at about 8 weeks of age. This allows the kid which remains to have a maximum supply of milk. Select replacement stock at the rate of 25 percent of the total number of mature breeders in the herd. This type of replacement system allows a steady income the year round.

USEFUL MEDICAL FORMULAS

When keeping the improved cross bred goats as well as sheep, a supply of various medicines should be on hand, especially during the change in seasons. Listed are some remedies which have been proved reliable. If any of the drugs which make up the solution are not available, then consult the veterinarian for substitutes.

Cough and Cold Mixture:

Chlorate of Potash	4 drams
Chloride of Ammonia	2 ounces
Tincture of Iron Chloride	4 drams
Fluid extract stramonium	1 ounce
Glycerin	1 pint
water to mix	

Mix, shake before using. Give adult goats one teaspoonful three times a day.

Digestive Tonic and Appetite Promoter:

Powdered Mix Vomica	1 ounce
Powdered Centian	1 ounce
Bicarbonate of Soda	4 ounces

Mix thoroughly, give adult goats one teaspoonful twice daily.

Worm Mixture:

Copper sulfate (blue stone)	
Crystals	1 ounce
Black leaf 40 or Nicotine sulfate	1 ounce
Boiling water	3 quarts

Dissolve copper sulfate crystals in water 3 quarts, allow solution to cool. Strain, then add the nicotine sulfate.

Give goats from one to three ounces of the above solution, depending on the size and age of the animal.

Give with dose syringe or bottle after removing food for overnight. Dose animal slowly to avoid strangling.

(The assistant veterinary in the area can show the proper way to drench animals).

Eye Infection:

Yellow Mercuria oxide 1%

This is good for clearing cloudiness in eyes due to simple injury or infections from dust or weed pollen.

For indolent ulcers or sores which do not heal, Allanton Ointment 2% is beneficial if applied twice daily.

Swollen joints or arthritis iodex ointment applied daily and rubbed in thoroughly.

Mineral Mixture - one pound each of common baking soda:

Sulfur	1/4 lb. clear crystals or
Charcoal	pulverized blue stone
Salt peter	(copper sulfate) thoroughly
Air slashed lime	mixed
Crushed tobacco	

Then add above to 15 lbs. common salt and again thoroughly mix. Keep dry if possible and available at all times in pens. This mixture can be used in place of mineral blocks when they are not available.

Ringworms:

Paint infected area with tincture of iodine for several days.

Diarrhoea:

Bismuth subnitrate	2 ounces
Powdered catechu	3 ounces
Sodium bicarbonate	4 ounces
Powdered charcoal	4 ounces

Mix thoroughly. For kids, give one teaspoonful and adult goats, one tablespoonful three times daily. Another useful medicine for kids is:

Milk of Bismuth	2 ounces
Paragorio	2 ounces

Give one teaspoonful three times daily.

Oil Dressing for Wounds:

Carbolic acid (liquid)	1 ounce
Oil of Tar (pine oil)	4 ounces
Turpentine	2 ounces
Linseed oil to make	1 quart

Paint on wounds to promote healing and repel flies and maggots.

Goat pox - (local treatment)

Paint eruptions and vesicles with the following mixture:

Tincture of iodine	1 ounce
Tincture of Benzoin compound	1 ounce

Ointment for Swollen Udders:

Extract of Poke root	10 %
Canphor	2 %
Petrolatum	88 %

Apply morning and evening after bathing with warm water. Protect udder from irritation by contact with grass or brush.

For Chapped and Cracked Teats:

Oil of Theaja	6 %
Zinc Oxide	13 %
Petrolatum	81 %

Remedy for Scoures:

Four ounces each of the following: Ground ginger, powdered chalk or clay, ground catachu. Mix and feed one teaspoonful night and morning and omit grain (if fed) until well.

PRESENT AND FUTURE DEVELOPMENTS IMPORTANT TO THE
GHANA LIVESTOCK FARMER

A. Marketing

The livestock farmer should be very interested in the development of livestock markets within the country. Through these markets the farmer will be able to get a fair price for his animal. There has been a start made by the Accra/Tema Development Council. They have developed one square mile for a holding ground of cattle which will be slaughtered at the new slaughterhouse located in Tema. In conjunction with this, the Government plans on establishing markets in two places on the Accra plains. These markets will operate in the following manner: Farmers interested in selling their livestock, (cattle, sheep, goats and pigs) will bring them to this market which will be held at specified intervals. These animals will be weighed and sold on the per/pound basis. Buyers from the Government and private concerns will be on hand to buy. A small handling charge will be made for each animal that moves through the market. This charge will be applied to the operation cost of the market. Basic prices will be set by the market operators to assure the seller a fair share of the current price. In the initial stages, an effort should be made for all the animals to be brought to the market. As the market grows there will be an increased demand for better handling of animals which are to be bought through these markets.

SUGGESTIONS FOR REDUCING SHIPPING AND HANDLING
LOSSES IN CATTLE

1. Outlaw clubs, whips, and persuaders which cause bruises.
2. Eliminate protruding nails, bolts and broken boards in trucks, pens and chutes.
3. Remove stumps, posts and machinery from feed-lots that will cause bruises.
4. Avoid horn damage by dehorning and keeping horned animals separated from polled animals.
5. Bed the truck properly with straw or grass.
6. Have trucking equipment in good order. A conscientious trucker can prevent many losses and reduce shrinkage.
7. Load carefully. Take it slow and easy when loading. Rough handling is an expensive way to speed up loading and unloading.
8. Load properly. Use partitions to prevent fighting, trampling and suffocation.
9. Protect cattle from the weather. Provide proper ventilation.
10. Drive carefully. Avoid sudden stops, sharp turns and quick starts. Check the load frequently.
11. On long hauls, provide water and feed for stock and a chance to rest.

SUGGESTIONS FOR KEEPING SHRINKAGE LOW

1. Keep physical activity of cattle at a minimum during marketing. Cattle shrink more when they are moving around than when they are quiet.
2. An overnight stand, or at least a few hours, off-feed and water before loading results in less shipping shrinkage and animals will be more likely to take on a good fill at destination.
3. Make full use of the feed and rest stops for cattle shipped long distances, but extra feed and rest stops probably do not pay for short hauls. Send an attendant if shipment is large. Excessive shrinkage should be avoided because it means loss of tissue weight and a decline in carcass quality.

4. Plan your loading job with care. Much unnecessary shrinkage occurs while animals are held in strange pens or in rail cars or trucks for several hours before departure.
5. Feed hay before shipping if the cost and bother are not too great. Decrease succulent feeds and increase hay in the ration. Animals accustomed to hay will not only shrink less enroute but will take to hay at the sale yards or feed and rest stops much quicker than those not used to hay.
6. Make sure the stock have a chance to rest and feed at the destination before sale time, if shipped long distances. Shrinkage can be cut in half. It will pay to allow from 24 to 36 hours for a refill.
7. Fill-back time is not recommended for cattle in transit only a few hours. They won't be hungry enough to take on a fill for 10 or 12 hours.
8. Don't try to get the stock to fill excessively. Overfilled stock are spotted easily by buyers, and they lower the price in retaliation.

How Many Animals Make a Load?

A practical guide for shippers and livestock truckers with respect to the numbers of hogs, cattle, and sheep that should be loaded on various sizes of trucks and trailers to reduce crippling, or pre-market death, and bruise injury of livestock in transit is as follows:

Delivery of livestock in good condition at its destination is important to the trucker as it is to the shipper. An improperly loaded truck results in crowding, excessive shrinkage and increased bruising.

A properly loaded truck provides for the animals' comfort and general well-being while in transit. It represents applied "safe livestock handling." Loading TOO MANY OR TOO FEW animals poses the GREATEST SINGLE transportation hazard to both trucker and shipper.

Cattle are easier to haul than people. If given an opportunity to see the road they will compensate for curve sway by leaning in the proper manner, making truck handling easier.

Sudden stops by the driver are very bad on cattle, all moves should be deliberate and slow to avoid bruising.

Preparing Livestock for Shipment

Sort the animals several hours before shipment and, if possible, move to an area near the loading site in order that the stock may become accustomed to new surroundings and avoid unnecessary movement and excitement when loading. Livestock should never be hurried while loading because this increases nervousness, and is one of the greatest causes of bruising.

Empty livestock travel best so that it is advisable to withhold the green grass feed from cattle and allow them to fill on the driest grass available.

Livestock trucks should always be loaded with lesser total weights of light animals as compared with allowable weights for heavier animals, as indicated by the tables. Numbers suggested are based primarily upon the loss and damage experience at major markets over a period of years.

TABLE 25 - SUGGESTED LOADINGS FOR LIVESTOCK

Floor Length	Hogs and calves (Single-deck trucks)								
	100 lb.	150 lb.	175 lb.	200 lb.	225 lb.	250 lb.	300 lb.	350 lb.	400 lb.
8 ft.	27	21	19	18	16	14	13	11	9
10 ft.	33	26	24	22	20	18	16	14	12
12 ft.	40	31	28	26	24	22	19	17	14
15 ft.	50	39	36	33	30	27	24	21	17
18 ft.	60	47	43	40	36	33	28	25	21
20 ft.	67	52	48	44	40	35	32	28	24
24 ft.	80	62	57	52	48	44	38	34	28
30 ft.	100	77	72	66	60	55	47	42	35
32 ft.	107	83	76	70	64	58	51	44	38
36 ft.	120	94	86	79	72	66	57	50	42
42 ft.	140	109	100	92	84	77	63	55	49

Floor Length	Cattle					
	450 lb.	600 lb.	800 lb.	1000 lb.	1200 lb.	1400 lb.
8 ft.	8	7	5	4	4	3
10 ft.	10	8	7	6	5	4
12 ft.	13	10	8	7	6	5
15 ft.	16	13	10	9	8	7
18 ft.	20	16	13	11	9	8
20 ft.	22	18	14	12	10	9
24 ft.	27	22	17	15	13	11
28 ft.	31	25	20	17	15	13
30 ft.	34	27	22	19	16	14
32 ft.	36	29	23	20	17	15
36 ft.	41	33	26	22	19	17
42 ft.	48	39	31	28	22	20

Animals tied with ropes to the side of the truck do not have enough freedom of action for balance and causes excess bruising.

TABLE 26 - SUGGESTED LOADINGS FOR HOGS AND CALVES WHEN DOUBLE DECK IS USED

Floor Length	Divide Equally for Double-deck Trucks								
	100 lb.	150 lb.	175 lb.	200 lb.	225 lb.	250 lb.	300 lb.	350 lb.	400 lb.
8 ft.	43	33	31	29	27	24	21	18	18
10 ft.	53	41	38	36	33	30	26	23	20
12 ft.	63	50	46	43	40	36	31	28	24
15 ft.	79	62	56	54	50	45	39	34	30
18 ft.	95	75	70	65	60	55	46	41	36
20 ft.	105	83	77	72	67	61	52	46	40
24 ft.	127	100	93	87	80	73	62	55	48
28 ft.	148	116	109	101	93	86	73	64	56
30 ft.	158	125	116	108	100	91	78	68	60
32 ft.	169	133	130	115	107	97	83	73	64
36 ft.	190	150	140	130	120	110	94	82	72
42 ft.	220	172	164	151	142	128	109	96	80

Partition each class of livestock -- it is a sound investment.

Judgment in loading should be tempered by such variables as distance of haul, class of livestock, and weather and road conditions.

When hogs are loaded for a short haul of only an hour or more, it is advisable to omit the last feeding entirely and plan to arrive early enough to feed at the market. Moving transport tires fat hogs, and they often will not eat before having rested two or three hours. When shipping to distant markets, arrival for

all kinds of livestock should be planned to allow adequate time for rest and feeding before the market opens.

The proper loading of a livestock truck is the most important way to save on your transportation costs.

B. Feeding

With the development of the sugar mills, there will be a new source of cattle feed, molasses. The use of molasses make roughages more palatable and enables the feeding of low quality roughage. It can be substituted in livestock feed since up to one-third of the more expensive carbohydrates ingredients such as maize can be replaced with molasses. Six and one half gallons of molasses have approximately the same feed value as 56 pounds of maize. When it is possible to buy this quantity of molasses for less than 56 pounds of maize, then it pays to feed molasses. Sugar cane molasses (blackstrap) has a sweet taste and odor and are readily eaten by all kinds of animals. Get a barrel full and try them. Another by-product of sugar industry is bagasse. This can be utilized for the feed lot or as an extender for molasses feeding.

Poultry by-product

As the poultry industry develops, an increase in processing plants is expected. Feathers left from dressing the birds will be surplus and it is highly possible that Ghana can follow the example of other countries by using feathers for feeding livestock. This is not something unheard of; infact, hydrolized and dried, poultry feathers can be used in poultry and pig feed formulas. The percentage of digestable proteins and fats in the feathers is high. Feather meal is especially recommendable when the formulator wishes to increase cystine and methionine levels. Increases in these are desirable in West African climates.

TABLE 27 - DIMENSIONS, CROSS-SECTION AREA OF TRENCH SILO AND WEIGHT OF SILAGE IN 4-INCH SLICE AND PER LINEAL FOOT

Side Slope per foot of depth(inches)	Depth	Bottom Width	Top width		Cross Sectional Area	Weight of Silage	
						4-in. Slice	1 ft. Slice
	ft.	ft.	ft.	ins.	sq. ft.	lb.	
3	4	5	7	0	24	280	840
4	4	6	8	8	29	338	1015
5	4	7	10	4	33	385	1155
3	6	6	9	0	45	525	1575
4	6	7	11	0	54	630	1890
5	6	8	13	0	63	735	2205
3	8	6	10	0	64	747	2240
4	8	7	12	4	77	898	2695
5	8	8	14	8	91	1062	3185
3	10	6	11	0	85	992	2975
4	10	8	14	8	113	1318	3955
5	10	10	18	4	142	1657	4970

C. Controlled Heat Periods

As mentioned in all the different livestock breeding plans, it is desirable to have all of the lambs, calves and pigs born as possible to the same time as possible. To aid in this, it will be possible to get livestock estrogen to control the estrus of animals on breeding farms.

Frequent visits to the offices responsible for animal production will keep one abreast of these new developments and the part they play in Ghana.

B - BREEDING INFORMATION ON CATTLE AND PIGS

TABLE 20. EXAMPLE CRISS-CROSS BREEDING PLAN FOR USE WITH HERD OF 50 COWS

First Four Years Required To Establish Crossbred Herd

	Herd I Pasture	Calf Pasture	Yearling Pasture	Herd II Pasture
1964	25 MA cows breed to 1 WF bull 11 heifer calves			25 MA cows breed to 1 WF bull 11 heifer calves
1965	25 MA cows breed to 1 WF bull 11 heifer calves	22 heifer calves (1/2 MA., 1/2 WF.)		25 MA cows breed to 1 WF bull 11 heifer calves
1966	17 MA cows (8 sold) Breed to 1 WF bull 8 heifer calves	22 heifer calves (1/2 MA., 1/2 WF.)	22 yearling heifers (1/2 MA., 1/2 WF.) breed to 1 S. Gudalli bull sell offspring	17 MA cows (8 sold) Breed to 1 WF bull 8 heifer calves
1967	Sell 17 MA cows 22 crossbred cows (1/2 MA., 1/2 WF.) breed to 1 WF bull 9 heifer calves	16 heifer calves (1/2 MA., 1/2 WF.)	22 yearling heifers (1/2 MA., 1/2 WF.) breed to 1 S. Gudalli bull sell offspring 3 yearlings 19 yearlings	Sell 2 MA cows 15 MA cows breed to 1 WF bull 8 heifer calves
1968	29 crossbred cows (1/2 MA., 1/2 WF.) breed to 1 WF bull 11 heifer calves	9 heifer calves (1/2 MA., 1/2 WF.) 8 heifer calves (1/2 MA., 3/4 WF.) move to yearling pasture in 1973	16 yearling heifers (1/2 MA., 1/2 WF.) breed to 1 S. Gudalli bull sell offspring Keep only 10 of 16 yearlings	Sell 15 MA cows 19 crossbred cows (1/2 MA., 1/2 WF.) breed to 1 MA bull 8 heifer calves
CONTINUOUS PROGRAM AFTER CROSSBRED HERD IS ESTABLISHED				
	HERD I 25 crossbred cows (1/2 MA., 1/2 WF.) breed only to WF bull ↓ Herd I heifer calves ↓ Replacements for Herd I	CALF PASTURE 11 heifer calves (1/2 MA., 1/2 WF.) 8 heifer calves (3/4 MA., 1/4 WF.)	YEARLING PASTURE 9 yearling heifers (1/2 MA., 1/2 WF.) 8 yearling heifers (1/2 MA., 3/4 WF.) breed to Gudalli bull sell offspring	HERD II 19 crossbred cows (1/2 MA., 1/2 WF.) breed, only to MA bull ↓ Herd II heifer calves ↓ Replacement for Herd II
1971	Herd I cows will standardise after several generations 2/3 MA., 1/3 WF.			Herd II cows will standardise after several generations 1/3 MA., 2/3 WF.
Barnack or brand calves of Herd I different than those of Herd II starting in 1971. Replacement heifers may be kept at the rate of 15 to offset culling and death loss.				

TABLE 29 - BASIC PIG PRODUCTION CALCULATOR

Actual No. of Sows*	No. of Sows Farrowing Per Group	MONTH OF FARROWING												Farrowings	Pigs By Litter Size			No. Stalls Req'd.	No. of Nursery Pens 10' x 12'	
		J	F	M	A	M	J	J	A	S	O	N	D		8	9	10			
1. 10 Sows - 1 Group - 2 litters	10	X						X							20	160	180	200	10	5
2. 12 Sows - 1 Group - 2 litters	12	X						X							24	192	216	240	12	6
3. 20 Sows - 1 Group - 2 litters	20	X						X							40	320	360	400	20	10
4. 24 Sows - 1 Group - 2 litters	24	X						X							48	384	432	480	24	12
5. 20 Sows - 2 Groups - 2 litters	10	X			X			X				X			40	320	360	400	10	5
6. 40 Sows - 2 Groups - 2 litters	20	X			X			X				X			80	640	720	800	20	10
7. 48 Sows - 2 Groups - 2 litters	24	X			X			X				X			96	768	864	960	24	12
8. 30 Sows - 3 Groups - 2 litters	10	X	X			X		X		X			X		60	480	540	600	10	5
9. 60 Sows - 3 Groups - 2 litters	20	X	X			X		X		X			X		120	960	1080	1200	20	10
10. 72 Sows - 3 Groups - 2 litters	24	X	X			X		X		X			X		144	1152	1296	1440	24	12
11. 40 Sows - 4 Groups - 2 litters	10	X	X	X	X			X	X	X	X				80	640	720	800	10	5
12. 80 Sows - 4 Groups - 2 litters	20	X	X	X	X			X	X	X	X				160	1280	1440	1600	20	10
13. 96 Sows - 4 Groups - 2 litters	24	X	X	X	X			X	X	X	X				192	1536	1728	1920	24	12
14. 100 Sows - 2 Groups - 2 litters	50	X			X			X					X		200	1600	1800	2000	50	25
15. 200 Sows - 2 Groups - 2 litters	100	X			X			X					X		400	3200	3600	4000	100	50

Example: Farmer wants to raise 500 pigs per year - consult chart showing totals of pigs.

No. 8 indicates 30 sows in 3 groups at 2 litters per year. This results in 60 farrowings per year. Range of pigs produced is 480 for 8 pigs saved to 540 for 9 pigs saved. This size operation requires 10 stalls and 5 nursery pens. A big advantage of this schedule is Alternate Monthly Farrowings allowing for clean up, sanitation, etc..

See No. 9 for 1000 pig volume.

Rule of thumb for corn is 3 acres per sow and 2 litters to market weight yearly. Based on approximately 75 Bu. Acre Yield.

*Additional sows should be bred based on herd conception rate.

TABLE 30 - COMBINATION SOW MANAGEMENT SCHEDULE BASED ON 4 FARROWINGS PER YEAR

	BREEDING DATES		FARROWING DATES		WEANING DATES		MARKETING	
	SET 1	SET 2	115 DAYS		56 DAYS		180 DAYS	
			SET 1	SET 2	SET 1	SET 2	SET 1	SET 2
A	Jan. 1	April 1	April 25	July 24	June 20	Sept. 18	Oct. 22	Jan. 20
B	Jan. 15	April 15	May 9	Aug. 7	July 4	Oct. 2	Nov. 5	Feb. 1
C	Feb. 1	May 1	May 26	Aug. 23	July 21	Oct. 18	Nov. 22	Feb. 19
D	Feb. 15	May 15	June 9	Sept. 6	Aug. 4	Nov. 1	Dec. 8	Mar. 5
E	Mar. 1	June 1	June 23	Sept. 18	Aug. 18	Nov. 18	Dec. 20	Mar. 22
F	Mar. 15	June 15	July 7	Oct. 7	Sept. 1	Dec. 2	Jan. 3	Apr. 5
G	Apr. 1	July 1	July 24	Oct. 23	Sept. 18	Dec. 18	Jan. 20	Apr. 21
H	Apr. 15	July 15	Aug. 7	Nov. 6	Oct. 2	Jan. 1	Feb. 7	May 5
I	May 1	Aug. 1	Aug. 23	Nov. 23	Oct. 18	Jan. 18	Feb. 19	May 22
J	May 15	Aug. 15	Sept. 6	Dec. 7	Nov. 1	Feb. 1	Mar. 5	June 5
K	Jun. 1	Sept. 1	Sept. 23	Dec. 24	Nov. 18	Feb. 18	Mar. 22	June 22
L	Jun. 15	Sept. 15	Oct. 7	Jan. 7	Dec. 2	Mar. 4	Apr. 5	July 6
M	Jul. 1	Oct. 1	Oct. 23	Jan. 23	Dec. 18	Mar. 20	Apr. 21	July 22
N	Jul. 15	Oct. 15	Nov. 16	Feb. 6	Jan. 1	Apr. 3	May 5	Aug. 5
O	Aug. 1	Nov. 1	Nov. 23	Feb. 23	Jan. 18	Apr. 20	May 22	Aug. 22
P	Aug. 15	Nov. 15	Dec. 7	Mar. 9	Feb. 1	May 4	June 5	Sept. 5
Q	Sept. 1	Dec. 1	Dec. 24	Mar. 25	Feb. 18	May 20	June 22	Sept. 21
R	Sept. 15	Dec. 15	Jan. 7	Apr. 8	Mar. 4	June 3	July 8	Oct. 5
S	Oct. 1	Jan. 1	Jan. 23	Apr. 25	Mar. 20	June 20	July 22	Oct. 22
T	Oct. 15	Jan. 15	Feb. 6	May 9	Apr. 3	July 4	Aug. 5	Nov. 5
U	Nov. 1	Feb. 1	Feb. 23	May 26	Apr. 20	July 21	Aug. 22	Nov. 22
V	Nov. 15	Feb. 15	Mar. 9	June 9	May 4	Aug. 4	Sept. 5	Dec. 6
W	Dec. 1	Mar. 1	Mar. 25	June 23	May 20	Aug. 18	Sept. 21	Dec. 20
X	Dec. 15	Mar. 15	Apr. 6	July 7	June 3	Sept. 1	Oct. 5	Jan. 3

REBREEDING SCHEDULE

	SET 1	SET 2	SET 1	SET 2	SET 1	SET 2	SET 1	SET 2
A	Jun. 24	Sept. 22	Oct. 16	Jan. 14	Dec. 11	Mar. 11	Apr. 14	July 13
B	Jul. 8	Oct. 6	Oct. 30	Jan. 28	Dec. 25	Mar. 25	Apr. 28	July 21
C	Jul. 25	Oct. 22	Nov. 16	Feb. 13	Jan. 11	Apr. 10	May 15	Aug. 12
D	Aug. 8	Nov. 5	Nov. 30	Feb. 27	Jan. 25	Apr. 24	May 29	Aug. 26
E	Aug. 22	Nov. 22	Dec. 14	Mar. 16	Feb. 8	May 11	June 12	Sept. 12
F	Sep. 5	Dec. 6	Dec. 28	Mar. 30	Feb. 22	May 25	June 25	Sept. 26
G	Sep. 22	Dec. 22	Jan. 14	Apr. 15	Mar. 13	June 10	July 13	Oct. 12
H	Oct. 6	Jan. 5	Jan. 28	Apr. 30	Mar. 25	June 25	July 27	Oct. 27
I	Oct. 22	Jan. 22	Feb. 13	May 16	Apr. 10	July 11	Aug. 12	Nov. 12
J	Nov. 5	Feb. 5	Feb. 27	May 30	Apr. 24	July 25	Aug. 26	Nov. 26
K	Nov. 22	Feb. 22	Mar. 16	June 16	May 11	Aug. 11	Sept. 12	Dec. 13
L	Dec. 6	Mar. 8	Mar. 30	June 30	May 25	Aug. 25	Sept. 26	Dec. 28
M	Dec. 22	Mar. 24	Apr. 15	July 18	June 10	Sept. 10	Oct. 12	Jan. 12
N	Jan. 5	Apr. 7	Apr. 30	July 30	June 24	Sept. 24	Oct. 27	Jan. 26
O	Jan. 22	Apr. 24	May 16	Aug. 16	July 11	Oct. 11	Nov. 12	Feb. 12
P	Feb. 5	May 8	May 30	Aug. 30	July 25	Oct. 25	Nov. 26	Feb. 26
Q	Feb. 22	May 24	June 16	Sept. 15	Aug. 11	Nov. 10	Dec. 13	Mar. 14
R	Mar. 8	June 7	June 30	Sept. 29	Aug. 25	Nov. 24	Dec. 28	Mar. 28
S	Mar. 24	June 24	Jul. 16	Oct. 16	Sept. 10	Dec. 11	Jan. 12	Apr. 14
T	Apr. 7	Jul. 8	Jul. 30	Oct. 30	Sept. 24	Dec. 25	Jan. 26	Apr. 28
U	Apr. 24	Jul. 25	Aug. 16	Nov. 16	Oct. 11	Jan. 11	Feb. 12	May 15
V	May 8	Aug. 8	Aug. 30	Nov. 30	Oct. 25	Jan. 25	Feb. 26	May 29
W	May 24	Aug. 22	Sep. 15	Dec. 14	Nov. 10	Feb. 8	Mar. 14	June 12
X	Jun. 7	Sept. 5	Sep. 29	Dec. 28	Nov. 24	Feb. 22	Mar. 28	June 26

TABLE 30A - COMBINATION MANAGEMENT SCHEDULE BASED ON 6 FARROWINGS PER YEAR

	BREEDING DATES			FARROWING DATES 115 DAYS			WEANING DATES 56 DAYS			MARKETING 180 DAYS		
	SET 1	SET 2	SET 3	SET 1	SET 2	SET 3	SET 1	SET 2	SET 3	SET 1	SET 2	SET 3
A	Jan.1	Mar.1	May 1	Apr.25	Jun.23	Aug.23	Jun 20	Aug 18	Oct 18	Oct 22	Oct 20	Feb 19
B	Jan.15	Mar.15	May 15	May 9	Jul.7	Sep.6	Jul.4	Sep.1	Nov.1	Nov.5	Jan.3	Mar.5
C	Feb.1	Apr.1	Jun.1	May.26	Jul.24	Sep.23	Jul.21	Sep.18	Nov.18	Nov.22	Jan.20	Mar.22
D	Feb.15	Apr.15	Jun.15	Jun.9	Aug.7	Oct.7	Aug.4	Oct.2	Dec.2	Dec.6	Feb.7	Apr.5
E	Mar.1	May 1	Jul.1	Jun.23	Aug.23	Oct.23	Oct.18	Oct.18	Dec.18	Dec.20	Feb.19	Apr.21
F	Mar.15	May 15	Jul.15	Jul.7	Sep.6	Nov.6	Sep.1	Nov.1	Jan.1	Jan.3	Mar.5	May 5
G	Apr.1	Jun.1	Aug.1	Jul.24	Sep.23	Nov.23	Sep.18	Nov.19	Jan.18	Jan.20	Mar.22	May 22
H	Apr.15	Jun.15	Aug.15	Aug.7	Oct.7	Dec.7	Oct.2	Dec.2	Feb.1	Feb.7	Apr.5	Jun.5
I	May 1	Jul.1	Sep.1	Aug.23	Oct.23	Dec.24	Oct.18	Dec.18	Feb.18	Feb.19	Apr.21	Jun.22
J	May 15	Jul.15	Sep.15	Sep.6	Nov.8	Jan.7	Nov.1	Mar.4	Mar.4	Mar.5	May 5	Jul.6
K	Jun.1	Aug.1	Oct.1	Sep.23	Nov.23	Jan.23	Nov.18	Jan.18	Mar.20	Mar.22	May 22	Jul.22
L	Jun.15	Aug.15	Oct.15	Oct.7	Dec.7	Feb.6	Dec.2	Feb.1	Apr.3	Apr.5	Jun.5	Aug.5
M	Jul.1	Sep.1	Nov.1	Oct.23	Dec.24	Feb.23	Dec.18	Feb.18	Apr.20	Apr.21	Jun.22	Aug.22
N	Jul.15	Sep.15	Nov.15	Nov.6	Jan.7	Mar.9	Jan.1	Mar.4	May 4	May 5	Jul.6	Sep.5
O	Aug.1	Oct.1	Dec.1	Nov.23	Jan.23	Mar.23	Jan.18	Mar.20	May 20	May 22	Jul.22	Sep.21
P	Aug.15	Oct.15	Dec.15	Dec.7	Feb.6	Apr.8	Feb.1	Apr.3	Jun.3	Jun.5	Aug.5	Oct.5
Q	Sep.1	Nov.1	Jan.1	Dec.24	Feb.23	Apr.25	Feb.18	Apr.20	Jun.20	Jun.22	Aug.22	Oct.22
R	Sep.15	Nov.15	Jan.15	Jan.7	Mar.9	May 9	Mar.4	May 4	Jul.4	Jul.6	Sep.5	Nov.5
S	Oct.1	Dec.1	Feb.1	Jan.23	Mar.25	May 26	Mar.20	May 20	Jul.21	Jul.22	Sep.21	Nov.22
T	Oct.15	Dec.15	Feb.15	Feb.6	Apr.8	Jun.9	Apr.3	Jun.3	Aug.4	Aug.5	Oct.5	Dec.6
U	Nov.1	Jan.1	Mar.1	Feb.23	Apr.25	Jun.23	Apr.20	Jun.20	Aug.18	Aug.22	Oct.22	Dec.20
V	Nov.15	Jan.15	Mar.15	Mar.9	May 9	Jul.7	May 4	Jul.4	Sep.1	Sep.5	Nov.5	Jan.3
W	Dec.1	Feb.1	Apr.1	Mar.25	May 26	Jul.24	May 20	Jul.21	Sep.18	Sep.21	Nov.22	Jan.20
X	Dec.15	Feb.15	Apr.15	Apr.8	Jun.9	Aug.7	Jun.3	Aug 4	Oct.2	Oct.5	Dec.6	Feb.7

REBREEDING SCHEDULE

	SET 1	SET 2	SET 3	SET 1	SET 2	SET 3	SET 1	SET 2	SET 3	SET 1	SET 2	SET 3
A	Jun.24	Aug.22	Oct.22	Oct.16	Dec.14	Feb.13	Dec.11	Feb.8	Apr.10	Apr.14	Jun.12	Aug.12
B	Jul.8	Sep.5	Nov.5	Oct.30	Dec.28	Feb.27	Dec.25	Feb.22	Apr.24	Apr.28	Jun.26	Aug.28
C	Jul.25	Sep.22	Nov.18	Nov.18	Jan.14	Mar.16	Jan.11	Mar.11	May 11	May 15	Jul.13	Sep.12
D	Aug.8	Oct.6	Dec.6	Nov.30	Jan.28	Mar.30	Jan.25	Mar.25	May 25	Jul.27	Jul.27	Sep.26
E	Aug.22	Oct.22	Dec.22	Dec.14	Feb.13	Apr.15	Feb.8	Apr.10	Jun.10	Jun.12	Aug.12	Oct.12
F	Sep.5	Nov.5	Jan.5	Dec.28	Feb.27	Apr.30	Feb.22	Apr.24	Jun.24	Jun.26	Aug.26	Oct.27
G	Sep.22	Nov.18	Jan.22	Jan.14	Mar.18	May 16	Mar.11	May 11	Jul.11	Jul.13	Sep.12	Nov.12
H	Oct.6	Dec.6	Feb.5	Jan.28	Mar.30	May 30	Mar.25	May 25	Jul.25	Jul.27	Sep.26	Nov.26
I	Oct.22	Dec.22	Feb.22	Feb.13	Apr.15	Jun.16	Apr.10	Jun.10	Aug.11	Aug.12	Oct.12	Dec.13
J	Nov.5	Jan.5	Mar.8	Feb.27	Apr.30	Jun.30	Apr.24	Jun.24	Aug.25	Aug.26	Oct.27	Dec.28
K	Nov.22	Jan.22	Mar.24	Mar.16	May 16	Jul.16	May 11	Jul.11	Sep.10	Sep.12	Nov.12	Jan.12
L	Dec.6	Feb.5	Apr.7	Mar.30	May 30	Jul.30	May 25	Jul.25	Sep.24	Sep.26	Nov.26	Jan.26
M	Dec.22	Feb.22	Apr.24	Apr.15	Jun.16	Aug.16	Jun.10	Aug.11	Oct.11	Oct.12	Dec.13	Feb.12
N	Jan.5	Mar.8	May 8	Apr.30	Aug.30	Aug.30	Jun.24	Aug.25	Oct.25	Oct.27	Dec.28	Feb.26
O	Jan.22	Mar.24	May 24	May 16	Jul.16	Sep.15	Jul.11	Sep.10	Nov.10	Nov.12	Jan.12	Mar.14
P	Feb.5	Apr.7	Jun.7	May 30	Jul.30	Sep.29	Jul.25	Sep.24	Nov.24	Nov.26	Jan.26	Mar.28
Q	Feb.22	Apr.24	Jun.24	Jun.16	Aug.16	Oct.16	Aug.11	Oct.11	Dec.11	Dec.13	Feb.12	Apr.14
R	Mar.8	May 8	Jul.8	Jun.30	Aug.30	Oct.30	Aug.25	Oct.25	Dec.25	Dec.28	Feb.26	Apr.28
S	Mar.24	May 24	Jul.25	Jul.16	Sep.15	Nov.16	Sep.10	Jan.11	Jan.12	Mar.28	May.28	Jul.28
T	Apr.7	Jun 7	Aug.8	Jul.30	Sep.29	Nov.30	Sep.24	Nov.24	Jan.25	Jan.26	Mar.28	May 29
U	Apr.24	Jun.24	Aug.22	Aug.16	Oct.16	Dec.14	Oct.11	Dec.11	Feb.8	Feb.12	Apr.14	Jun.12
V	May 8	Jul.8	Sep.5	Aug.30	Oct.30	Dec.28	Oct.25	Dec.25	Feb.22	Feb.26	Apr.28	Jun.26
W	May 24	Jul.25	Sep.22	Sep.15	Nov.16	Jan.14	Nov.10	Jan.11	Mar.11	Mar.14	May.15	Jul.13
X	Jun.7	Aug.8	Oct.6	Sep.29	Nov.30	Jan.28	Nov.24	Jan.25	Mar.25	Mar.28	May 29	Jul.27

E. Multiple Farrowing Production Schedules

On these pages are tables which can be used in starting a multiple farrowing program to determine breeding dates for uniform spacing of farrowings, either four times a year or six times a year.

The procedure for using the tables is as follows:

1. Divide sows into two groups or sets for four farrowings a year.
2. Select a breeding date for set one from the lefthand column on this page. Breeding dates for group two will be in the next column. Read across for farrowing, weaning and marketing dates.
3. For a rebreeding schedule, check the letter in the lefthand column. Rebreeding dates appear in the lower half of the chart opposite the same letter.
4. An example - Breed group one on March 1, group two would be bred on June 1. This is in line E. Drop down to the lower half of chart and line E shows rebreeding dates for set one on August 22 - for set two, November 22.
5. For six farrowings a year, divide females into three groups and use the chart on the back of this page in the same manner.

F. Estimated Cattle Weights Using Ordinary Tape Measure

Use of an ordinary tailor's tape for getting estimate weights of cattle can be of great benefit to the ordinary Ghana livestock farmer. When selling at the corral to a butcher it will help in bargaining if an estimated weight of the animal is known and assure a reasonable price.

The following table can be used as a reference. The cattle to be checked should not have had access to a regular feed source for a period of twelve hours. Taking this into consideration, the best time for the weighing of cattle in Ghana would be the first thing in the morning before the animals are turned out to graze or feed.

Procedure:

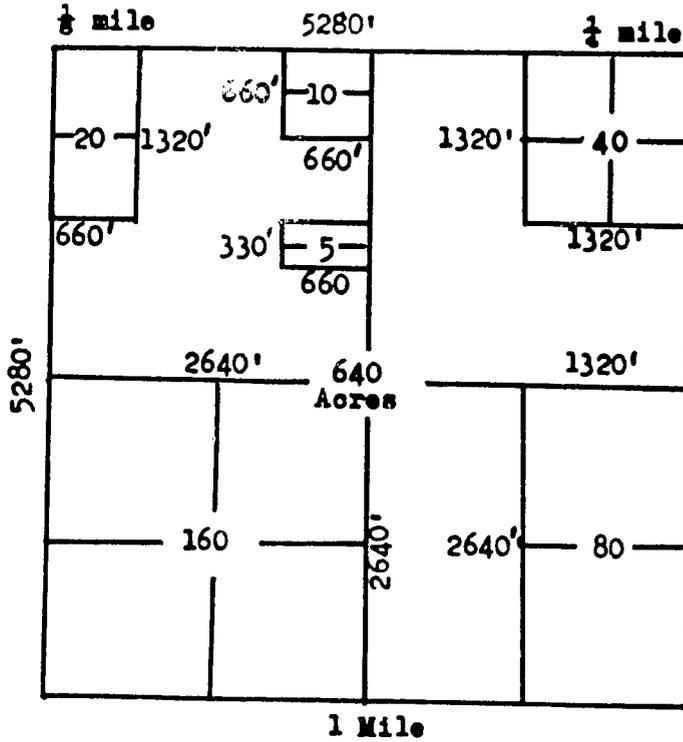
The animal should be standing on level ground. Place the tape around the animal just behind the front legs and withers. Pull the tape snug but not tight. Read the inches on the tape and refer to the table below. If properly done, weights indicated will be within several pounds plus or minus of the true weight of the animal.

TABLE 31 - CALCULATING CATTLE WEIGHT, USING TAPE MEASUREMENT

Heart Girth (inches)	Approximate Weight (pounds)	Heart Girth (inches)	Approximate Weight (pounds)
Based on mean size of West African Cattle			
49	313	63	715
50	341	64	744
51	370	65	773
52	399	66	801
53	428	67	830
54	456	68	859
55	485	69	877
56	514	70	916
57	543	71	945
58	571	72	973
59	600	73	1002
60	629	74	1031
61	657	75	1060
62	686	76	1080

G. Land Measurements and Related Information on Fencing Materials

LAND MEASUREMENTS
U.S. STANDARD GOVERNMENT LAND SURVEY



STANDARD SECTION OF LAND

TABLE OF MEASUREMENTS			
MILE	CHAINS	RODS	FEET
$\frac{1}{8}$	10	40	660
$\frac{1}{4}$	20	80	1320
$\frac{1}{2}$	40	160	2640
1	80	320	5280

One Chain = 4 Rods = 66 Feet One Rod = $16\frac{1}{2}$ Feet
 One Acre = 43,560 Sq.Ft. = 10 Sq. Chains
 208.7' x 208.7' = One Acre

WATER MEASUREMENTS

One Acre Foot = 43560 Cu.Ft. = 325850 Gallons = $\frac{1}{2}$ Sec.ft.per day
 One Acre 1 inch=27156 Gallons - 1,000,000 Gallons =3.0689 Acre Feet
 One Gallon=231 cu.inches=0.134 cu.feet=8.345 pounds
 One Cu.Foot = 7.4805 Gallons=1728 Cu. inches
 One Cu.Foot per second=One Second foot=448.836 P.M.
 =50 Miners Inches (Ordinary)
 =40 Miners Inches (Legal)
 One Miner Inch (Ord.)=96PM=One Miners Inch(Legal)=11.226 P.M
 One Cubic Foot Water =62.4 Lbs.

TABLE 32 - STAPLES (BENT NAILS) REQUIRED BASED ON 7 STAPLES PER/POST PLUS 5 PERCENT

Post Spacing (ft.)	No. of Posts per 80 rds.	Weight (lbs.) of staples per 80 rds. (160 rds. covers one size 160 Acres)				No. of staples per pound No.9 size
		1"	1 $\frac{1}{8}$ "	1 $\frac{1}{4}$ "	1 $\frac{1}{2}$ "	
8	165	11.5	12.5	15.0	16.8	1" - 106
10	132	9.2	10.0	11.1	13.4	1 $\frac{1}{8}$ " - 97
12	110	7.6	8.3	9.2	11.2	1 $\frac{1}{4}$ " - 87
16 $\frac{1}{2}$	80	5.6	6.1	6.7	8.1	1 $\frac{1}{2}$ " - 72

3/4" Poultry wire
Staple
No.14-499

FURTHER INFORMATION CAN BE GOTTEN FROM THE MINISTRY OF AGRICULTURE BULLETIN NO. C-11 BY THE AUTHOR OF THIS PUBLICATION

TABLE 33 - HANDY WOVEN WIRE FENCE CHART

Kind of Stock	Recommended wire Height (ins.)	Recommended + Weight of Stay wire gauge	Recommended Mesh ins.	No. Recommended Strands of Barb-wire Top Woven	Comments
Cattle	47, 48 or 55	9 or 11	12	1 strand on top 3 or 4 ins. spaced	Satisfactory; all farm animal, less swine
Sheep	32	11 or 12 $\frac{1}{2}$	12	2 strands on top	
Swine	26, 32 or 39	9 or 11	6	1 strand on bottom	Barbwire prevents rooting
Horses or Donkeys	55 or 58	9 or 11	12	2 strands on top with 3 or 4" spacing	Also satisfactory; all farm animals, except pigs
All farm animals	26 or 32 32	9 or 11 9 or 11	6 6	3 strands on top, 1 strand bottom	
Main support wires which are very important strength factors.				2 strands top; 1 strand bottom	

Electric fences will be utilized in Ghana in the future for controlled grazing. Table Number 31 gives the proper height of wire required for different animals:

TABLE 34 - NUMBER OF ELECTRIC WIRES AND SPACING NEEDED BY DIFFERENT CLASSES OF LIVESTOCK

Animal	No of wires	Height in inches	Post Spacing Feet
Cattle (West African Shorthorn)	1	30-40	40-50
Calves	1	12-18	40-50
Sheep and Goats	2	18-10 16-18	25-40
Swine	2	6-8 14-16	25-40
Horses	1	30-40	40-50
Donkeys	1	30-40	40-50

H. Terracing

As recommended by the section dealing on Land Classification, certain land needs terracing using the broad base type to control run-off of rain water. An example of this terrace may be seen on the farm located at the Winneba Junction. The following table will give the layman some idea of size and spacing of these terraces under different land conditions.

TABLE 35 - TERRACING TABLE

Slope of land in feet per 100 feet	1	2	3	4	5	6	7	8	9	10	11	12
Desirable spacing in vertical fall between terraces in feet	1½	2	2½	3	3½	4	4½	5	5½	6	6½	7
+Maximum vortical fall between terraces in feet	2	2½	3	3½	4	4½	5	5½	6	6½	7	7½
Distance between terraces using maximum spacing in feet	200	125	100	88	80	75	71	69	65	67	64	63
Fall per 100 feet along terrace	Use 0 fall (none) if water conservation is an important factor. Maximum fall under any condition 4 inches +++ less than 4 inches more desirable											
Base width to build terraces first year in feet	22	22	20	20	20	20	20	18	18	18	16	16
Height to build terraces above water corner	16	18	18	18	20	20	22	22	22	22	24	24
Lineal feet of terrace per acre if maximum spacing is used	218	348	436	495	544	581	614	631	650	670	681	691

♦ Vertical fall = $\frac{\text{Slope of land in feet} + 3\text{feet}}{2}$

♦♦ Vertical fall = $\frac{\text{Slope of land in feet} + 2\text{feet}}{2}$

♦♦♦ When in doubt about fall, and conditions, do not demand water conservation - 2 inches per 100 feet will not be far wrong.

LOCATION OF VETERINARY OFFICES

<u>Sections</u>	<u>In-Charge</u>	
C.W.R.V.S.	Senior Stock Superintendent	Cape Coast Sekondi/Takoradi Winneba Tarkwa Dunkwa Essiama Komenda Swedru Assin-Manso Awutu Senya
V.V.S.	Vetarinary Officer	Ho Denu Amelorkope Jasikan Kete Krachi Sogakope Kpandu Peki Anloga Kpedze
B.A.V.S.	Stock Superintendent	Wenchi Kintampo Sunyani Techiman Prang Yeji Kwame Danso Berekum Bechem Banda Nkoranza D/Ahenkro
C.V.S.	Prinoipal Veterinary Officer	Accra Tema Akuse Dodowa Koforidua Nsawam

Sections

In-Charge

A.V.S.

Veterinary Officer

Kumasi
Mampong
Ejisu
Konongo
Juaben
Kumawu
Bekwai
Obuasi

M/W.D.V.S.

Senior Stock Superintendent

Pong-Tamale
Tamale District
Savelugu "
Walewale
Gambaga
Kumbungu

Gonja Vet. Section: Stock Superintendent

Damongo
Salaga
Bole
Bamboi
Tuna

N.W.V.S.

Principal Stock Superintendent

Wa
Lawra
Tumu
Nadawli
Jirapa
Hamile
Kupulima

E.D.V.S.

Stock Superintendent

Yendi
Bimbilla
Gushiegu
Saboba
Zabzugu
Demon
Chereponi

N.E.V.S.

Veterinary Officer

Navrongo
Bawku
Bolga
Pusiga
Sandema
Zabilla
Paga

