PREVALENCE OF TUBERCULOSIS IN CATTLE IN THE DANGME- WEST DISTRICT: PUBLIC HEALTH IMPLICATIONS.

BY

DR. OSEI- AGYEMANG BONSU

A DISSERTATION SUBMITTED TO THE SCHOOL OF PUBLIC HEALTH , UNIVERSITY OF GHANA, LEGON, IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF `MASTER OF PUBLIC HEALTH DEGREE.

SCHOOL OF PUBLIC HEALTH

UNIVERSITY OF GHANA

LEGON.

SEPTEMBER 1998

DECLARATION

I declare that this dissertation has been the result of my own field research, except where specific references have been made; and that it has not been submitted towards any degree, nor is it being submitted concurrently in candidature for any other degree.

CANDIDATE

DR. OSEI- AGYEMANG BONSU

ACADEMIC SUPERVISORS

PROF. E. LAING

DR. B. D. AKANMORI

DEDICATION

THIS WORK IS DEDICATED

TO

MY BELOVED CHILDREN

ELVIS and **EUNICE**

ACKNOLEDGMENT

"It is the one who climbs a good tree that gets a good push", I am therefore grateful to the good Lord for providing the opportunity, the strength and wisdom to see me through this Master's course.

I am also grateful to the Veterinary Services Department of the Ministry of Food and Agriculture for their sponsorship.

I am indebted to all my lecturers for providing me with knowledge which helped me at the Dangme-West District during my data collection for the production of this dissertation.

I wish to place on record the enormous support from my field supervisor, Dr. Irene Agyepong , District director of Medical Services , Dangme-West District and my academic supervisors: Prof. E. Laing, Botany Department, University of Ghana, and Dr. B. D. Akanmori , Head, Immunology Unit, Noguchi Memorial Research Institute for Medical Research, Legon, for their direction, supervision and constructive contributions during the preparation and implementation of the research proposal as well as they writing of this work.

I express my profound gratitude of financial material moral emotional and prayerful support from my family and friends, especially Mr. Pobee..

I register my sincere gratitude to the Director and all the staff of the school of Public Health ,Legon, the staff of Dodowa , Prampram and Ningo Health centres for assisting me in my data collection.

I thank all the respondent whom I came into contact with during this research period. Finally for all those who helped in diverse ways to get this work produced, I say may God be with you.

TABLE OF CONTENTS

LIST OF TABLES AND MAPS **PAGE**

THE PREVALENCE OF TUBERCULOSIS IN CATTLE IN THE DANGME-WEST DISTRICT, PUBLIC HEALTH IMPLICATIONS

ABSTRACT

It has been documented that in developing countries, bovine infected with Mycobacterium bovis constitute a significant reservoir for human tuberculosis and unless bovine milk is pasteurized, consumption of it can lead to the spread of gastrointestinal tuberculosis in humans.The Ghana Government through its peri-urban dairy cattle development project, is encouraging the use of milk and dairy products from local cows in selected districts of the country, including the Dangme West District of Greater Accra Region.

A survey was therefore undertaken to determine the risk of infection with tuberculosis through consumption of milk from the Dangme-West District and the level of awareness with regard to this risk . The standard single intradermal comparative tuberculin test using purified protein derivative (PPD) of M. bovis and M. avium was used.

The study established a 13.8% prevalence of tuberculosis in cattle in the district with prevalence as high as 50% in some kraals. Cattle of all ages and both sexes were affected, but the prevalence in cows was twice as high as that of heifers and bulls. This can be explained from the fact that cows being more productive are kept for much longer periods increasing their chances of getting infected . The result is significantly high compared the 5% prevalence regarded as low which makes test

and slaughter economical(Blood 1981).

The study also established that, there is a considerable lack of knowledge about bovine tuberculosis among cattle owners and herdsmen in the district and milk is often used untreated. The relatively high prevalence of the disease and the accompanying lack of knowledge about it calls for concerted effort by the Ministry of Food and Agriculture, the Ministry of Health, the District Assembly, and the local community leaders in order to put in place control measures to prevent human infection. There is also the need, first, for a nation wide survey to establish the general prevalence and distribution of bovine tuberculosis in the country as a basis for selection of animals for breeding.

CHAPTER ONE

INTRODUCTION

Human tuberculosis appears to be increasing globally as well as in Ghana . Even though tuberculosis seemed to be under control in the developed countries, the disease is re-emerging, and it is becoming even more of a problem due to the emergence of drug resistant strains in immmunocompromised individuals, especially those with AIDS .

W H O estimates that, one third of the world's population is infected with tuberculosis, and many more are at risk. Mobility is also high and most of it occur in developing countries.(W H O 1997).

Bovine tuberculosis caused by Mycobacterium bovis at one time caused much infection in cattle in Europe and the Americas . Infection was passed on to man through milk . With control of tuberculosis in cattle by killing infected animals and pasteurization of milk , these countries have largely prevented bovine tuberculosis in man.

In UK, the proportion of tuberculous cattle has shown a gradual reduction since 1950 when tuberculosis eradication scheme was introduced , and at the end of 1960 all cattle were in officially tubercle-free herds.

Tuberculosis in humans is caused by Mycobacterium bovis and Mycobacterium tuberculosis. Though, the majority of cases of human tuberculosis is caused by the human type of bacillus, it is probable that all human beings are as susceptible to the bovine type as they are to the human, but the chances of infection by the bovine type have been reduced in most countries as a result of the eradication of the disease from the cattle population.

It can not be overemphasized, however, that the bovine bacillus is probably just as virulent for man as the human bacillus and is a deadly and killing organism, while it must also be stressed that it is erroneous to believe that small doses of living bovine tubercle, taken accidentally with food, raise the specific resistance of individual without producing disease. It is thought that bovine tuberculosis is rare in developing countries , but there is as yet not enough information on this .It is thought that , perhaps , the disease seems to be rare because in some of these countries , milk is boiled before use, whilst in others milk is not used at all. There is therefore the opinion that there is the need for more information about how much bovine tuberculosis exists and its distribution in Africa , both in animals and man (Crofton , 1992).

It has been documented that in developing countries bovine infected with M. bovis constitute a reservoir for human tuberculosis and also unless bovine milk is pasteurized, it can lead to the spread of M. bovis causing gastrointestinal tuberculosis in humans. (Warren 1994).

It is currently estimated that there will be 10 million new cases of tuberculosis per year during the next decade. If the hope of Health For All by the year 2000 is to be approached, effective tuberculosis control must be a priority for all involved in health. The Government of Ghana, through its peri-urban dairy cattle development project, is encouraging the use of milk from local cows in selected districts of the country including the Dangme-West District of the Greater Accra Region in southern Ghana . As very little is known about how much bovine tuberculosis exists in Ghana, and in Africa as a whole, a study was conducted;

- To determine the number of cattle infected with TB bacilli by means of the intradermal tuberculin test.
- To determine the safety of milk from the district for human consumption.
- To describe possible ways/ methods to help control tuberculosis in man and animals.

CHAPTER TWO

LITERATURE REVIEW

2.1 MYCOBACTERIA.

Mycobacterium was first isolated by Robert Koch in 1882 (Bakulov 1987).

There are five types of Mycobacteria: M. tuberculosis which is responsible for most human tuberculosis, M. bovis responsible for cattle tuberculosis , M. avium for birds, M. macroti for mouse and M. thamnopheose for reptiles. These organism can infect other animals rather than their natural hosts.

There are also several types of atypical mycobacteria.

The other pathogen in this group is Mycobacteria leprae, the cause of leprosy.

Table 1.

Medically important mycobacteria and their modes of transmission.

ORGANISM	GROWTH ON BACTERIOLOGIC MEDIA	PREFERRED TEMPERATURE IN VIVO(DEGREES)	SOURCE OR MODE OF TRANSMISSION
M. tuberculosis	Slow (weeks)	37	Respiratory droplets
M. bovis	Slow (weeks)	37	Milk from infected animals
M. leprae	none	32	Prolonged closed contact
M. kansali	Slow (weeks)	37	Soil and water
M. marianum	Slow (weeks)	32	Water
M. avium	Slow (Weeks)	37	Soil and water
M fortuitum	Rapid (days)	37	Soil and water

Source; Warren E . L. Medical Microbiology and Immunology 1994

2.2.1 MYCOBACTERIUM TUBERCULOSIS/ BOVIS

Important properties

Mycobacterium tuberculosis/ bovis grows slowly (it has a doubling time of 18 hours, in contrast to most bacteria which can double in number in 1 hour or less).

Because growth is slow, cultures of clinical specimens must be held for 6- 8 weeks before being recorded negative. M. tuberculosis/bovis can be cultured on bacteriologic media which contain complex nutrients (e.g. egg yolk) and dyes (e.g. malachite green). The dyes inhibit the unwanted normal flora present in the pathological sample.

M. tuberculosis is an obligate aerobe ; this explains its predilection for causing disease in highly oxygenated tissue such as the upper lobe of the lung and kidney.

Its cell wall contains several complex lipids . Cord factor (trehalose dimycolate) is correlated with virulence of the organism . virulent strains grow in a characteristic "serpentine" cord like pattern , whereas avirulent strains do not .The organism also contains several protein , which, when combined with wax, elicit delayed hypersensitivity PPD (purified protein derivative)skin test (Warren. 1994).

Although the organism does not form spores, it is relatively resistant to acids and alkalis. It is also resistant to dehydration and so survives in dried expectorated sputum ; this property may be important in its transmission by aerosol(Bakulov 1987).

2.2.2 Transmission /Epidemiology

Mycobacterium tuberculosis is transmitted from person to person by respiratory aerosol, and its initial sites of infection is the lung.

In the body, it resides chiefly within cells of reticuloendothelial system.

In the USA , tuberculosis is almost exclusively a human disease.

In developing countries, cows infected with M. bovis constitute a reservoir for the human disease. Unless pasteurized, cow's milk can spread M. bovis. causing gastrointestinal tuberculosis in humans (Warren . 1994).

Abdominal tuberculosis is common in developing countries , especially in females , but it is rare in industrialized countries. It may arise in the gastrointestinal tract with spread to the mesenteric nodes . There are three forms of abdominal tuberculosis : primary, secondary and hyperplastic ileo-caecal tuberculosis. Clinically , the primary and secondary forms may be very similar.

Tuberculosis can reach children through milk or food and infection can then begin in the mouth or intestine. Milk can carry bovine tuberculosis if the cows in the area have tuberculosis and milk, not boiled before it is used. When that happens, the primary infection is in the intestine or sometimes in the tonsil. In Europe, primary tuberculosis was usually caused by M bovis with cow's milk as source of infection. In Africa, the disease is thought to have arisen from blood borne spread through the lymph nodes or the peritoneum, as bovine tuberculosis is thought to be rare , but there is still no sufficient information on this (Crofton. 1992).

In the secondary form, patients with pulmonary tuberculosis may swallow their sputum, the tuberculosis in the sputum infects the wall of the intestines and cause ulceration. Fistula may occur . Infection may spread into the abdominal cavity and causes acites.

Bovine tuberculosis is suspected in any patient who is losing weight, has fever, and has vague abdominal pain.

Be even more suspicious if there is an abdominal mass or fluid in the abdomen (Crofton 1992).

The disease tuberculosis occurs in only a small proportion of infected individuals. In the USA , most tuberculosis is due to reactivation in elderly malnourished men. The risk of infection and disease is highest among socio-economically disadvantaged people, who have poor housing and poor nutrition. These factors rather than genetic ones probably account for the high rate of infection among native Americans , Blacks and Eskimos.

Mycobacterium bovis is the common cause of tuberculosis in cattle. The source of infection is usually other infected cattle, although in some pulmonary or genitourinary tuberculosis of man caused by bacilli of bovine type, is the source of infection in up to 60% of re infected herds (Veterinary Manual 1986).

Tuberculous animals with open lung lesions throw infected droplets into the air by coughing . Such animals also swallow sputum and thus contaminate pasture and cow sheds via the feces. Adult animals are infected by inhalation of air bone dust particles as well as contaminated feed and water facilities.

Young calves may be infected by drinking unpasteurized infected milk.

Early lesions are usually found in the chest and sometimes in the lymph nodes of the head or intestines .

In the advanced stages of the disease, lesions may be found in many organs and tissues that are seldom affected primarily; thus, infection of the udder, uterus, lymph nodes, kidneys and the meninges occurs with varying frequency. The skeletal muscles are very seldom affected , even in advanced cases. (Veterinary Manual 1986).

Tuberculosis of the udder is of special significance because of contamination of milk

with infective organisms.

Apart from its Public Health importance, bovine tuberculosis is important for its detrimental effects on animal production. Housing predisposes to the disease as zero grazing , so the disease is more common and serious where these forms of husbandry are practiced. In spite of the low overall incidence of the disease in countries where cattle are at pasture all the year round, individual herds with 60-70 % morbidity may be encountered (Blanco .1974).

An initial tuberculin test in some kraals at Ashie in the Tema district and Kasoa in the Ehutu Seya district showed a 2% tuberculin positive reactors. Another work done at Aveyime in the Dangme- East district showed a 4% positive reactors. As high as 50% positive tuberculin reactors was recorded in a kraal with a total stock of 75 at Adedome in the Volta Region . A 60% morbidity was also encountered at Nsawam in the Eastern Region. (Report on TB veterinary services Accra 1997).

Among beef cattle, the degree of infection is usually much lower because of the open range condition under which they are kept. However, individual beef herds may suffer a high morbidity if infected animals are introduced and large number of animals have to drink from stagnant water holes, especially during dry season(Blood . 1981).

Spread of tuberculosis from animals to man makes it an important zoonosis. Infection in man occurs largely through consumption of infected milk, but spread can also occur by inhalation .All species and age groups of animals are susceptible to M. bovis , with cattle, goats and pigs most susceptible, and sheep and horses showing natural resistance.(Blood. 1981).

Tuberculosis spreads in the body by two stages, primary complex and post- primary dissemination. The primary complex consist of the lesion at the point of entry and in the local lymph node. Post primary dissemination from the primary complex varies considerably in rate and route. It may take the form of acute milliary tuberculosis, discrete nodular lesions in various organs, or chronic organ tuberculosis cause by endogenous or exogenous re- infection of tissues rendered allergic to tubercul protein.

In cattle, horses, sheep and goats, the disease is a progressive one and , although generalized tuberculosis is not common in pigs, localization as non progressive abscesses in the lymph nodes of the head and neck is the most common finding.

2.2.3 Clinical Diagnosis of Bovine Tuberculosis.

Some cows with extensive miliary tubercular lesions are clinically normal, but progressive emaciation unassociated with other signs should always arouse suspicion of tuberculosis. A capricious appetite and fluctuating temperature are also commonly associated with the disease. Pulmonary involvement is characterized by a chronic cough due to bronchopneumonia. The cough is never loud or paroxysmal, occurring only once or twice at a time and is low, suppressed and moist. It is easily stimulated by squeezing the pharynx or by exercise and is most common in the morning or in cold weather. In the advanced stages when much lung has been destroyed; dyspnoea with increased rate and depth of respiration becomes apparent. The most common sign of alimentary involvement are caused by pressure of enlarged lymph nodes on surrounding organs(Veterinary Manual 1973).

Retropharyngeal lymph nodes enlargement causes dysphagic and noisy breathing due to

pharyngeal obstruction.

Because of the chronic nature of the disease, and the multiplicity of signs caused by the variable localization of the infection, tuberculosis is difficult to diagnose on clinical examination.

In cattle , other chronic pulmonary diseases which may be confused with tuberculosis pneumonia are; lung abscess due to aspiration pneumonia , pleurisy and pericarditis following traumatic reticulitis and chronic contagious bovine pleuropneumonia.

Snoring respiration is relatively common in cattle and some differentiation of the cause is necessary and practicable. But the final differentiation is by tuberculin test.

In tuberculous mastitis, fibrosis begins at the base of the gland instead of the cistern as in most other forms of mastitis, and abnormal milk commonly comes at the end of milking instead of the first few streams and is not marked until the late stages of the disease.

Peripheral lymph node enlargement should be suspected of having tuberculosis origin, but abscesses caused by mixed infection or infection with Actinobacillus lignieresi of the lymph nodes of the head are much more common.

2.2 .3 Clinical Pathology.

Because of the universal dependence on the tuberculin test for diagnosis and the policy of slaughtering all positive reactors whether they are open cases or not, few clinico pathological test are now carried out.

Sputum or discharges may be examined by inoculation into guinea pigs, but improved cultural techniques make animal injection test unnecessary (Hall. 1977).

The basis of all tuberculosis eradication schemes is therefore the tuberculin test.

2.3. THE TUBERCULIN TEST.

2.3.1 The single Intradermal Test. (SID test).

This test is applied by the intradermal injection of tuberculin into an anal fold.

The reaction is read between 72 and 96 hours after the injection and a positive reaction constitute diffused swelling at the injection site(Blood , 1981).

The main disadvantage of the SID test is it's lack of specificity and the number of No Visible Lesion reactors (N V L) which occur.

2.3.2.The Short Thermal Test.

Intradermal tuberculin is injected subcutaneosly into the neck of cattle with rectal temperature of not more than 39 degrees Celsius at the time of the injection and for two hours later . If the temperature at 4, 6, and 8 hours after the injection rises above 40 degrees, the animal is classed as a positive reactor.

The disadvantages are that , it requires a lot of labour and also there are occasional deaths due to anaphylaxis.

2.3.3 Intravenous Tuberculin Test.

This test has been used experimentally , but requires a special research tuberculin (Kopecky 1971).

2.3.4. Stormont Test.

This test has been devised to select those animals which are poorly sensitized for any reason. The test is performed similarly to the SID test in the neck with further injection at the same site 7 days later (Larsen 1969).

An increase in thickness of 5mm or more , 24 hours after this second injection is a positive result. Cattle injected with M. avium do not give positive reaction but skin tuberculosis cases do.

A practical difficulty is the necessity for three visits to the farm. Special purified protein derivative tuberculin of a specified potency must be used to fulfill the requirements of the test.

2.3.5. The Comparative Test.

This test has been dealt with in chapter three.

Serological Test For Diagnosis Of Bovine Tuberculosis

Serological test including complement fixation, fluorescent antibody ,direct bacterial agglutination precipitation and haeagglutination tests are under review but seem to have little potential value (Blood . 1981).

2.4. TREATMENT OF BOVINE TUBERCULOSIS

Because of the progress being made in the treatment of human tuberculosis with such drugs as isoniazid, combination of streptomycin and para- aminosalicylic and other acids,

the treatment of animals with tuberculosis has undergone the efficiency of long term oral medication with isonizid both as treatment and prophylaxis (Kleeberg. 1968).

2.5. CONTROL OF BOVINE TUBERCLOSIS.

Eradication of bovine tuberculosis has been virtually achieved in many countries.

The test and slaughter policy has been the only one by which effective eradication has been achieved (Kleeberg 1968, Bakulov .1991).

2.5.1. Control Of Bovine Tuberculosis On Herd Bases

This rests on:

- removal of infected animals.
- prevention of spread of infection.
- avoidance of further introduction of the disease.

All the three points are of equal importance and neglect of one may result in breakdown of the eradication Programme.

Detection of infected animals depend largely upon the use of tuberculin test.

Hygienic measures to prevent the spread of infection should be instituted as soon as the first group of reactors is removed.

It is most important that calves being reared as herds replacements be fed on tuberculosis free milk either from known free animals or pasteurized.

After reactors have been removed, steps should be taken to prevent reinfection. This can be done by preventing use of communal watering facilities or pasture and maintaining adequate boundary fences.

2.5.2. Control Of Tuberculosis On An Area Basis.

The method used to eradicate bovine tuberculosis from large areas depends on the incidence of the disease, methods of husbandry , attitude of the farming community and the economic capacity of the country to stand loses from a test and slaughter Programme. An essential first step in the inauguration of an eradication Programme is the prior education of the farming community (Blood.1981).

Livestock owners must be appraised of the economic and public health significance of the disease. Eradication must be compulsory since voluntary schemes have never achieved more than limited control and always leave foci of infection.

It is essential at the beginning of a Programme to determine the incidence and distribution of the disease by tuberculin testing of samples of cattle population and meat inspection services. The information collected in this way can indicate areas that are free of tuberculosis or which have low incidence .

The disease can be readily eradicated from the low incidence areas, thus providing a nucleus of tuberculosis free cattle which can supply replacement for further areas as they are brought into the eradication scheme. Finally, the eradication Programme can be extended to the residual area.

When the incidence of tuberculosis is high a routine test and slaughter programme may be economically impossible.

2.5.3. Vaccination as a Measure of Control Of Bovine Tuberculosis.

Vaccination may be considered when an eradication programme cannot be instituted for

some time but it is desired to reduce the incidence of the disease in preparation for eradication. BCG vaccination is the only method available for field use.

When the overall incidence is low, (5% or less) Compulsory testing and slaughter of reactors is the only satisfactory method of eradication (Blood .1981)

CHAPTER THREE

METHODOLOGY/MATERIALS.

3.1.1. Study Area

Data collection is important in any study because its analysis will lead to making good or reasonable conclusions and subsequently, valid recommendations.
The Dangme West District was chosen for the following reasons :

1. It is the district where the author was posted for field practice.

2. It is one of the districts selected for the peri- urban dairy cattle development project.

3. The district has a large cattle/ human population ratio (1 : 2).(Dangme- West Assembly 1996.)

4. The district was selected by the U N D P as the poorest district in the coastal savanna zone and has instituted a three year poverty reduction program , which among other things is to help the cattle farmers in the area to improve on the production of milk to increase their income .Whilst trying to help the farmers to produce more milk , the milk they produce must be free from tuberculosis .

5. This is a percieved problem of interest to the district Health and the veterinary / Animal production departments.

3.1.2 Location of the District

The Dangme- West District is in the Greater Accra Region . It is situated in the south eastern part of Ghana. It lies between latitude 5.45 degrees and 6.05 degrees north, and longitude 0.05 east and 0.20 west.(fig. One)

It is one of the 45 new districts created in 1988 as a result of the government redemarcation

exercise carried out in respond to decentralization reforms.

3.1.3 Population.

The district has an estimated population of about 100000 based on the 1984 census; 48.2% are males and 51.8% females. About 20% of the population are below the age of 15.

3.1.4. District Land Area.

The district has a land area of 1442 square kilometers.

The district is the largest in the Greater Accra Region, claming about 41.5% of the regional land area.

3.1.5. Administrative Units.

The district, in spite of its proximity to the national capital, is basically a rural district with a poor state of socio- economic and infrastructural development.

The district administration is the implementing arm of the district assembly which is the highest political power in the district. the district administration is headed by the district Coordinating Director under the overall supervision of the District Chief Executive.

The name of the District Chief Executive is Hon. Seth Ayertey Kpabitey.

3.1.6. Economic Activities.

The main economic activities of the people in the district are farming, fishing and forestry.

65% of the labour force engage in agriculture. The district has a cattle population of about 50 000 . The cattle human ratio is about 1:2 . There are over 5000 sheep and 6000 goats in the district. The people also keep poultry.

The main crop farming season at the district starts from April and ends in September.

There are no major industries. The small scale industries present are agro based, wood related, mining/ quarrying, construction and building.

3.1.7. Education.

About 62.5 %of the inhabitants can read and write(District Assembly 1996). This compares favorably with the national level which stands at 49.4% . The district education directorate comprises four circuits: Osudoku, Ningo, Prampram and Shai . Each of the circuits has a chain of basic schools and one senior secondary school. There are seven vocational/ technical schools in the district.

The non formal education division of the Ministry of education is also contributing in educating some of the population.

3.1.8.Transport.

The district has about 252 kilometers of road net work. Out of this total, about 40% is surfaced, while the rest are earth roads. Tracts and foot paths also links the villages.

Public transport supply for goods and passenger movement is however inadequate.

There is an average passenger waiting time of about two hours on market days.

3.1.9. Communication System.

The only telephone facility in the district is located at Dodowa within the district administration. The Ghana telecommunication company has started installing relay stations in

two centers (Prampram and Afienya), to boost telecommunication in the district.

There is no radio station in the district.

3.1.10. Common Diseases in the district.

The first five common disease in the district are : Malaria, Diarrhea, Anaemia, Upper Respiratory tract infection and skin diseases.(District Director's report 1997)

3.2. HEALTH FACILITIES

The health delivery system is poorly developed. The district health post at Dodowa, the capital of the district, is in the process of being upgraded to a district Hospital.

There are also three health posts, 4 community clinics an 5 community based clinic/ MCH health posts in the district . There is only one medical officer and two nursing superintendents.(District Director's report 1997)

The District Health Management team consists of;

* The District Director Of Medical Services.
* The Principal Nursing Officer Public Health.
* The Principal Nursing Officer General.
* The District Environmental Officer.
* The Principal Medical Assistant Dodowa
* The Medical Assistant Ningo
* The Medical Assistant Osudoku
* Medical Assistant Prampram.
* Principal Technical Officer Nutrition.

* The Accountant.
* The District Pharmacist
* Technical Officer Nutrition.

3.4. VETERINARY SERVICES.

Veterinary services is very poor in the district. There is only one veterinary officer in the district, instead of a minimum of four to take care of the sub districts . There is a technical officer in each of the four sub districts, but there are no offices from where they can be located. This makes it difficult for the officer in charge to coordinate veterinary activity in the district. There is no means of transport for the officers in the district, this makes an out reach activities almost impossible. The officers are not provided with logistics .

The most common disease problems facing livestock owners are worms, tick infestation, brucellosis leading to abortions, and foot and mouth disease.

The four Sub- Districts controlled by technical officers are:

* Ningo sub district,
* Prampram sub district ,
* Dodowa sub district ,
* Osudoku sub district.

3..5. Study Population

One thousand two hundred cattle of both sexes and ages two years and above were screened These cattle were randomly selected from private individual farms .The breed were mainly zebus and their cross with the N'dama, west African shorthorn and white Fulani.

The animals are kept in open kraals and are sent out for grazing every morning from 7 am to 6 p.m.

None of the farmers practice zero grazing or supplement feeding, so the animals walk several kilometers during the dry season in search of food and water.

The herdsmen do not fully milk the cows. They take an average of about 1.5 liters from each cow and then allow the calf to drink directly from the mother.

Milk is usually collected once in a day and sent in a special containers to the Amranhia dairy farms. Here, it is mixed with milk collected from other districts and then sent to Accra for distribution. Some customers go to the farm to buy directly from there.

Almost all the cattle drink from stagnant waters in dams or ponds which can serve as source of tuberculosis infection.

3.6.SAMPLE SIZE:

A total of 1 200 out of the 34000 cattle in the District (cattle at Asutware area, even though are in Dangme west were not included because they form part of Akuse district in the Eastern Region according to veterinary demarcation.) were tested. A total of 1117 is suppose to be the sample size but was rounded up to 1200 . This sample size was arrived at using the formula: $N=[(Z^2 P q) / d^2]$ Where ;

N is the sample size, = ?

Z is the confidence limit, = 95% (1.96)

P is the assumed prevalence of T B in cattle in the district, = 3% (0.03), based on previous works. (Veterinary reports on tuberculosis (1997) Accra.

q = 1- p = 0.97

d is the acceptable deviation from the true value. =1% (0.01).

The power of the test was set at 80%. Also 95% confidence limits was set.

3.7. PREPARATION FOR FIELD WORK.

When the author went to the Dangme-West District to start this study, two principal technical officers were assigned to help in data collection. Before the fieldwork, the team went round to inform the cattle owners whose animals were to be screened to seek their concern. The principal technical officers have had three weeks training in the screening methods.

3.8. TYPE OF STUDY.

This study was exploratory and descriptive in content.

3.9. Tuberculin Testing.

The standard single intradermal comparative tuberculin test using purified protein derivative (PPD) Antigen(M bovis and M avium) as described by Blood , was used .

A dose of 10 000 tuberculin units (0.1 ml tuberculin containing 2 mg of bovine PPD) was used. This test is selected so that false positive reaction due to Johnes disease or avian tuberculosis can be differentiated from bovine tuberculosis (Blood 1981)

Before the injection , the injection sites were shaved, so that the sites could be seen after the 72 hours. After shaving, a measurement of the thickness of the skin was taken with calipers and the results recorded. Each animal was given an identification number using permanent paint. Avian and Bovine tuberculin were injected simultaneously into two separate sites on the same side of the neck , at least 12 cm apart and with the avian above the bovine , using the Mclintock tuberculin testing equipment. The test results was recorded 72 hours after the injection. Care was taken in placing the injection so that it goes intradermally as sensitivity varies from place to place in the skin.

The thickness of the skin was measured again after the 72 hours , and compared with the previous readings.

The greater of the two reactions indicates the organism responsible for the sensitization.

3.10. HANDLING OF MILK; There was an interview of 30 herdsmen and 15 cattle owners to find out what they know about bovine tuberculosis and how to prevent themselves and others from getting infected . The process of milking and how milk is handled before it is taken to the market for sale was also ascertained.

LIMITATIONS;

False negative reactions may result from :

(a) Advanced cases of tuberculosis due to desensitization .

(b) Early cases until 6 weeks after infection due to low antibody levels.

(c) Cows which have calved within the preceding 6 weeks due to desensitization.

(d) Animals desensitized by tuberculin administration during the preceding 8-60 days

(e)) Old cattle.

ETHICAL CONSIDERATION.

After testing the animals, we had time to interview both the herdsmen and cattle owners who were around to know what they know about bovine tuberculosis.

Based on what they know, we explained to them the possibility of getting infected with tuberculosis from the cattle. We also told them how to prevent being infected and getting other people also infected. Consent was obtained from livestock owners and herdsmen and information was to be kept confidential.

RESULTS:

The prevalence of tuberculosis

A total of 1200 cattle were tested; 747 cows, 400 heifers and 53 bulls.

Out of the 1200 cattle tested, 166 tested bovine tuberculin positive.. This represent 13.8% prevalence of bovine tuberculosis in the district.

The distribution of the positive tuberculin reactors is shown on table 2.

Table 2. Distribution of Bovine Tuberculin Reactors in the different subdistricts of the Dangme West District of Ghana.

SUB- DISTRICT	NO OF ANIMALS TESTED	NO OF POSITIVE REACTORS	PREVALENCE %
Dodowa	450	66	14.7%
Prampram	300	34	11.3%
Osudoku	240	26	10.8%
Ningo	210	40	19.0 %
TOTAL District	1200	166	13.8%

Out of the 210 cattle tested at the Ningo sub district, 40 tested positive. This represent 19. 0% prevalence in the Ningo sub district. The prevalence at Prampram was 11.3%. 34 out of the 300 cattle tested, tested positive to bovine tuberculosis. At the Osudoku sub district, 240 cattle were tested with 26 testing positive to bovine tubercilosis. This represents 10. 8 % prevalence at the sub district. At the Dodowa sub district, 450 cattle were tested, with 66 testing positive. This represents 14.7% . The result shows a significantly high prevalence of bovine tuberculosis in all the sub- districts, two or more times what is considered as low (5%) ,(Blood 1981). The prevalence at Ningo was the highest, (19.0 %) followed by Dodowa sub- district, (14.7%)

In all 400 heifers were tested. Out of this , 39 tested positive. This represents 9.8 % .

Fifty three bulls were also tested and 2 tested positive. This represents 3.8% .

Out of 747 cows tested 125 were positive, representing 16.7 % (fig 2)

The prevalence of bovine tuberculosis was significantly higher in cows than in heifers and bulls. It was almost two times higher than in heifers,(16.7% and 9.8 %) and about four times higher than in bulls(16.7% and 3.8%). See table 3 . The prevalence was also higher in female cattle than in bulls (14.3% in females and 3.8% in bulls).

Table 3. Bovine tuberculin reactors by sex and age.

CATEGORY	AGE	NO TESTED	NO OF REACTORS	PREVALENCE %
Cows	>3 years	747	125	16.7%
Heifers	2>4 years	400	39	9.8%
Bulls	>2 years	53	2	3.8%
All females	> 2 years	1147	164	14.3%

Body Condition Of Cattle That Reacted Positive To Tuberculin Test

In all, only 12 out of the 125 cows tested positive showed some signs of weight lost, dehydration, and ill health. All the remaining 113 were in good condition showing no sign of ill health. Out of the 166 cattle that reacted positive, 91 were producing milk for human consumption, 15 were either pregnant or dry, 19 were reported to have stopped calving, even though they were still within their reproductive ages. The conditions of the bovine tuberculin reactors are shown on table 4.

Table 4. Bodily Conditions Of Bovine Tuberculin Test Positive Cows In The Dandgme-West District Of Ghana

	BODY CONDITION					
No of reactors	good	Bad	No coughing	no producing milk	No pregnant	No not calving
125	113	12	11	91	15	19

Good bodily condition: Ribs not shown, Poverty triangle not prominent. Eyes not sunk into its obit.
Bad bodily condition: When the above is present

Knowledge About Tuberculosis.
The knowledge of cattle Herdsmen can be assessed from table 5.

Out of the 30 Herdsmen interviewed, 28 said they do not know what is tuberculosis (the local name of the disease was always used). Only two Herdsmen said they have heard about it. One Herdsman knew the symptom. However, after describing the disease, seven people said they know of the disease and know that it is an ancestral disease. They said people who are cursed suffer from the disease.

All the 30 herdsmen interviewed said they do not know that tuberculosis can be transmitted from cattle to man. None of them knew that cattle can suffer from the disease. None of the 30 interviewed knew how the disease can be transmitted from cattle to man.

Out of the 30 herdsmen interviewed, 25 said they do not boil their milk before drinking, 5 of them said they boil the milk because they have been told to do so. One person said, if milk is not boiled and is given to children, they get stomach pains.

Out of the 30 herdsmen interviewed, 6 said they know that milk can give some disease to man if they allow the hair of the cow to fall into the milk. They said if milk is filtered to get rid of the hair, then the milk becomes safe for human consumption.

Out of the 30 herdsmen interviewed 19 said they have either drunk milk directly from the teat of the udder of a cow on the field when hungry or seen somebody do it.

Table 5. Knowledge Of Cattle Herdsmen At Dangme- West District Of Ghana About Tuberculosis.

NO	STATEMENT	NO OF HERDSMEN INTERVIEWED	NO THAT KNOW	NO THAT DON'T KNOW
1	Know cause of TB	30	2	28
2	Know how TB is transmitted	30	1	29
3	Know that cattle can suffer from TB.	30	nil	30
4	Know that cattle can transmit TB to man	30	nil	30
5	Know how man gets TB from cattle	30	nil	30
6	Know that boiling milk prevent TB.	30	nil	30

Table 6 indicates the level of knowledge of cattle owners about tuberculosis.

Out of the 15 cattle owners interviewed, 10 said they know or have heard about tuberculosis, 6 knew the symptoms of the disease, and 8 said they know that tuberculosis can be transmitted from cattle to man. 4 said human being get infected by drinking cow milk which has not been treated, however, none of them boil milk before used. Also 2 of the owners said tuberculosis can be transmitted through milk and the consumption of infected meat.

Table 6. Knowledge of cattle owners in the Dangme- West District Of Ghana About Tuberculosis.

NO	STATEMENT	NO OF CATTLE OWNERS INTERVIEWED	NO THAT KNOW	NO THAT DON'T KNOW.
1	Know cause of T B	15	10	5
2	Know how T B is transmitted.	15	6	9
3	Know that cattle can transmit TB.	15	8	7
4	Know that cattle can transmit TB to man	15	7	8
5	Know how man gets TB from cattle.	15	4	11
6	Know that boiling milk prevent TB.	15	2	13

MILK HANDLING.

All the 30 herdsmen interviewed said they do not wash their hands or the teat of the udder before milking. All of them said they do not allow any day to pass after using acaricide on the animals before taking milk for human consumption. Out of the 30 interviewed, 9 said they have ever applied acaricide on the animals whilst milking. But they said they are always careful to prevent the poison from getting into the milk (table 7). During the interview, it was found that there were some abuse of the use of antibiotics by the herdsmen. (Animals were under dosed and the drugs were used for wrong conditions). All the 30 herdsmen said they do not wait for any day to pass after injecting their animals with antibiotics before taking milk for human consumption.

All the 30 herdsmen interviewed said they sell their milk either to the peri-urban milk collectors or to middlemen who go around to collect the milk and send it to the city for sale. Milking is done once a day. They all said yellow milk is given to dogs or thrown away.

None of them boils milk before drinking or selling.

Table 7. Handling of milk at the Dangme -West District of Ghana.

NO	STATEMENT.	NO OF HERDSMEN INTERVIEWED	YES	NO
1	Wash hands before milking cows.	30	nil	30
2	Wash teat of udder before milking.	30	nil	30
3	Ever applied acaricide while milking.	30	9	21
4	Obey withdrawal date on drugs.	30	nil	30
5	Boil milk before drinking.	30	5	25
6	Boil milk before selling.	30	nil	30

Tab. 8. Results Of Tuberculin Test At Dangme - West District.

LOCATION	SUB. DIST.	OWNER	NO TESTED	+REACTORS	FALSE +	REMARKS
Mataheko	Ningo	Mr. Kabute	60	4	-	
,,	,,	Mr. Kwabi	30	nil	nil	
,,	,,	Mr. Botchway	30	nil	1	
Dawa	,,	Mr Ntiamoah	30	15	nil	
,,	,,	Alfred Djagmah	30	16	nil	
,,	,,	Mr. Nartey	30	5	nil	
Asebi	Dodowa	A. Tettey	30	3	nil	
,,	,,	W. Teye	30	nil	nil	
,,	,,	Mr. Obeng	30	1	nil	
,,	,,	M. Mamudu	30	2	nil	
,,	,,	Col. Asase	30	1	nil	
Djopanya	,,	D. Hadjo	30	nil	1	
,,	,,	Mr. Donya	30	12	nil	
,,	,,	G. Adegbenu	30	12	nil	
,,	,,	S. Fulani	30	9	nil	
,,	,,	M Abuli	30	6	nil	
,,	,,	H. Tofa	30	nil	nil	
,,	,,	Mr. Akpali	30	6	nil	
,,	,,	K. Teye	30	3	nil	
Djopanya	,,	Mr. Koney	30	3	nil	
,,	,,	Osmanu Gali	30	6	nil	
Congo	Osudoku	Mr. Asubonteng	30	3	nil	
,,	,,	Imoro Sambo	30	12	nil	
,,	,,	Joseph Anumdjo	30	nil	nil	
,,	,,	Nartey Amoni	30	1	nil	
,,	,,	Atsu Sosi	30	nil	nil	
,,	,,	Tette Dadebo	30	1	nil	
,,	,,	Osmanu Gali	30	6	nil	
,,	,,	Nine Ayonu	30	3	nil	

LOCATION	SUB. DIST.	OWNER	NO TESTED	+REACTORS	FALSE +	REMARKS
Dawenya	Prampram	Mr. Botere	30	nil	nil	
Abbey	,,	Kwo Paddy	30	10	nil	
,,	,,	Malam Amadu	30	12	nil	
Prampram	,,	Lartioko Farms	30	2	nil	
,,	,,	Mensah Nyarko	30	nil	1	
,,	,,	Isaac Adoboli	30	7	nil	
,,	,,	Seth T. O	30	nil	nil	
Dawenya	,,	K Asem	30	2	nil	
,,	,,	Mr. Kwabi	30	1	nil	
,,	,,	Mr. Botchway	30	nil	nil	
TOTALS			1200	166	3	

Total number of cattle tested = 1200

Total number of cattle that reacted = 166

Prevalence of Tuberculosis = 13.8 %

Table 9. Bovine Tuberculosis Detected At Slaughter House/ Slabs In Southern Volta Region .(Veterinary reports 1997).

DISTRICT	SLAUGHTERED CATTLE	TUBRCULOSIS CASES	% OF TOTAL
Adidome	104	1	1.0
Juapong	537	10	0.2
Sogakope	47	0	0.0
Denu	587	10	0.2
Ho	1015	8	0.8
Totals			

DISCUSSION.

The prevalence of tuberculosis in cattle is said to be low when it is 5% or less and that is when the test and slaughter control method would be considered economical practice (Blood 1981).

The 13.8% prevalence of tuberculosis in cattle in the Dangme West as shown by the results of our study is therefore very significantly high. This calls for a nation wide survey to establish the general prevalence to help institute an appropriate control Programme.

In Africa very little is known about how much bovine tuberculosis exist (Crofton 1992) making it difficult to institute appropriate control measures.

In Cuba an island wide testing programme has shown a prevalence of 0.01%, while a 50% prevalence was reported in Aden in the gulf region . Environmental conditions and stagnant water as source of drinking water for the animals have been blamed for the high prevalence of tuberculosis . The disease is reported as wide spread in all species of animal in Nepal, Cameroon, and Guatemala. Bovine tuberculosis is said to be wide spread in cattle in Zaire, Angola , Malagasy republic, Agentine, Chile, Dominica, Hunduras, Mexico and Western Samoa (Hall 1977).

In Ghana this is the first of the prevalence of bovine tuberculosis. The high incidence, like in Aden, can be blamed on environmental factors, the most important of which are the stagnant water sources. There are only few dams and ponds in the district which serve as sources of drinking water for most of the animals in the district , and most of the animals graze at common grounds which are often over populated.

The very high prevalence at Ningo with some kraals having up to 50% prevalence , may

be due to the long period for which the people of Ningo have been in cattle keeping relative to the other districts. The Author was informed during the data collection period that the people of Prampram and Dodowa have all the time been crop farmers.

The other point that may explain the high prevalence is that, Ningo is on a low and wet land, and cattle that feeds on low and wet land are at higher risk of getting infected with bovine tuberculosis than those at higher lands (Hall 1977)

The prevalence, even though was highest at the Ningo sub district, it was significantly high in all the other sub districts. This general high prevalence may be due to the fact that most of the livestock keepers at the other sub districts got their initial stock from Ningo, some of which might have already been infected, and grazing on a common pasture and common source of water increased the rate of infection of other animals.

The body conditions of most reactors confirms the report of Clay, that the effect of bovine tuberculosis on Zebu cattle is less, relative to other breeds (Clay 1971). Most of the cattle screened were zebus or their cross breed.

The poor knowledge of cattle owners and herdsmen ,and the general public, about the disease and high prevalence indicated by the results show the risk involve in the consumption of milk from the district. If the reactors are suffering from the pulmonary tuberculosis , then the general public is at risk because the reactors can throw contaminated droplets of air into the atmosphere which can be a source of infection to the public, especially in Ghana, where the animals are kept very close to the people and in some cases in the same houses . Also since the people who are nearer to the infected animals know very little about the disease , they will do very little to prevent themselves from getting infected.

The collection of milk by the Ministry of Food and Agriculture for distribution to the public may also help spread the disease as they mix all milk collected from all localities before distribution. This leads to high volume of contaminated milk being distributed to the public. Unfortunately most of the milk distributed are not pasteurized before distribution. This is because the distributors claim that it will add cost to the milk.

Apart from the Public Health problems, bovine tuberculosis have economic consequences. Some of the affected animals lose body weight, (in our study 12 out of 166) and at times the whole carcass may be condemned at meat inspection. This cost the farmer money.

4.6 CONCLUSION

In conclusion, it can be stated that tuberculosis in cattle in the Dangme -West District is a serious problem as shown by our study and cattle owners , herdsmen as well as the general public are at risk from getting infected through consumption of milk. The study results have also shown that the inhabitants of the area know very little about bovine tuberculosis and the risk of drinking unpasterized milk. Based on what has been determined, there is the need to plan an educational Programme which will help strengthen the control measures as well as institution of new ones to control the disease. There is also the need to introduce practical training on dairy hygiene in order to make the peri-urban dairy programme a success.

RECOMMENDATIONS:

⇒ There is the need for an immediate tuberculosis control programme in the Ministry of

Food and Agriculture to control tuberculosis in cattle in the country. This will complement the efforts of the Ministry of Health in controlling tuberculosis in the country.

⇒ There is the need for an educational programme to educate cattle owners and herdsmen on the risk of taking unpasteurized milk . This can be done by the front line staff of the Ministry of Food and Agriculture whilst they are on their normal duties. However, the front line staff need to be educated first so that they know what to tell the people.

⇒ There is a need for tuberculosis typing in the country, so that a possible link between human infection and cattle could be established. This will give seriousness to the control of tuberculosis in cattle.

⇒ There is a need to train our meat inspectors so that they can recognize and report on tuberculosis in other organs in the body of the animal apart from lungs and liver.

REFERENCES:

1. Abram S, et al.(1995) Tuberculosis. Control of communicable diseases manual, sixteen edition Washington, 488-498

2. Bakulov I A, et al. (1987) Epidemiology and microbiology. Kalos 3, 142

3. Blood D C, et al. (1981) Veterinary medicine. E L B S, fifth edition. Macmillan New York. 19, 524- 530.

4. Crofton J, et al. . (1992) Clinical tuberculosis, Macmillan U. K. 10, 131- 134.

5. Crofton J, et al. (1997). Guidelines for the management of drug - resistant tuberculosis .W H O. Geneva.

6. Dangme -West Assembly, (1996) 5 year development plan 1996. Dodowa .

7. Forest C, et al. (1975) Principles of meat science. Freeman and Co USA

8. Hall H T B, et al. (197 8) Tuberculosis. Diseases and parasites of livestock in the tropics, Longman, london. 83 - 86

9. Horace T, et al. (1978) Textbook of meat hygiene, six edition. U. K252-272.

10. Konopatkin A A, et al. (1990) Tropical diseases of animals, Agropro, Moacow (1990) 4-214

11. Oxfam Practical Guide number 4. (1985). Guidelines for tuberculosis control programs in developing countries U K.

12 Savaiskova A. G. (1985) Pathological Physiology of farm animals ,Agropro, Moscow

13. Shull C R, (1997) Common medical problems in the tropics, Macmillan London.Urban 14.The Merck Veterinary Manual , . (1873)4th Edition , Merck and Co, U .S. A. 364- 367.

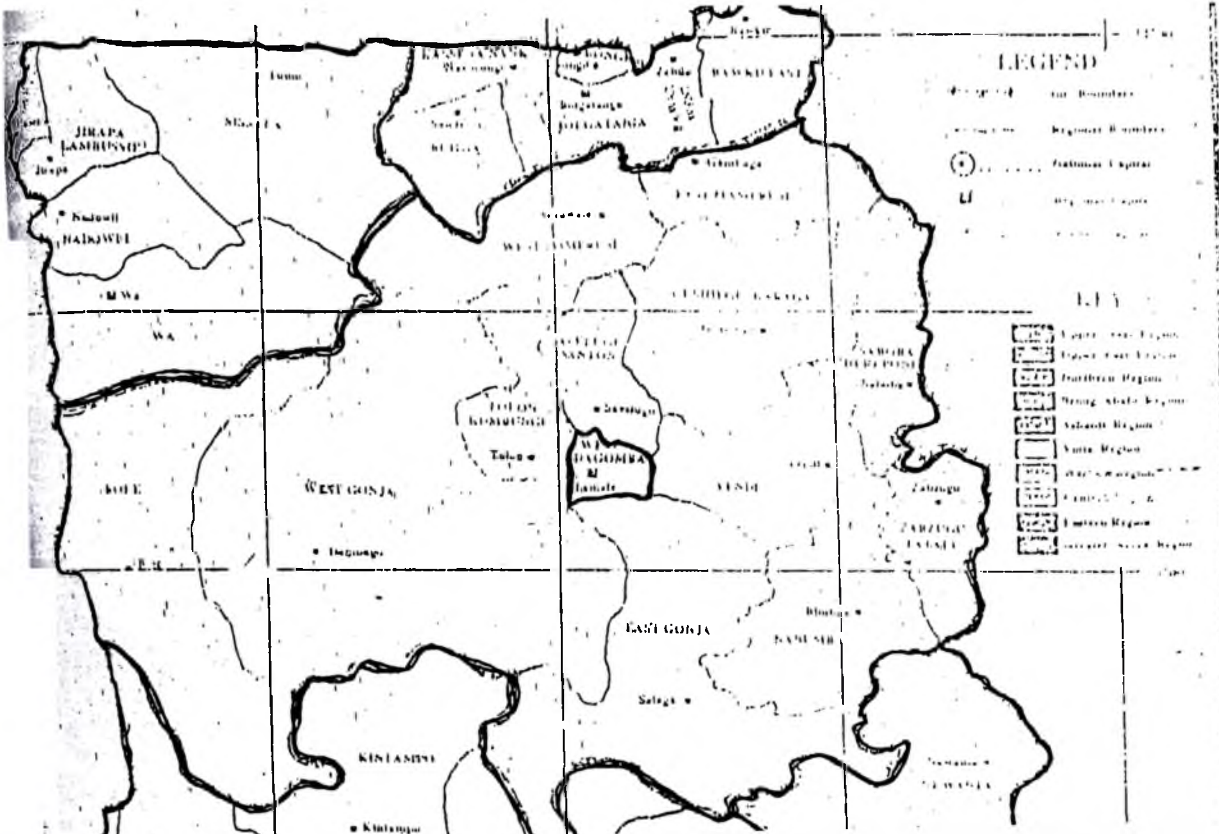
15 Warren E L, et al. (1994) Medical microbiology and immunology, third edition. Appleton and Lang Connecticut.. 21 , 114-119.

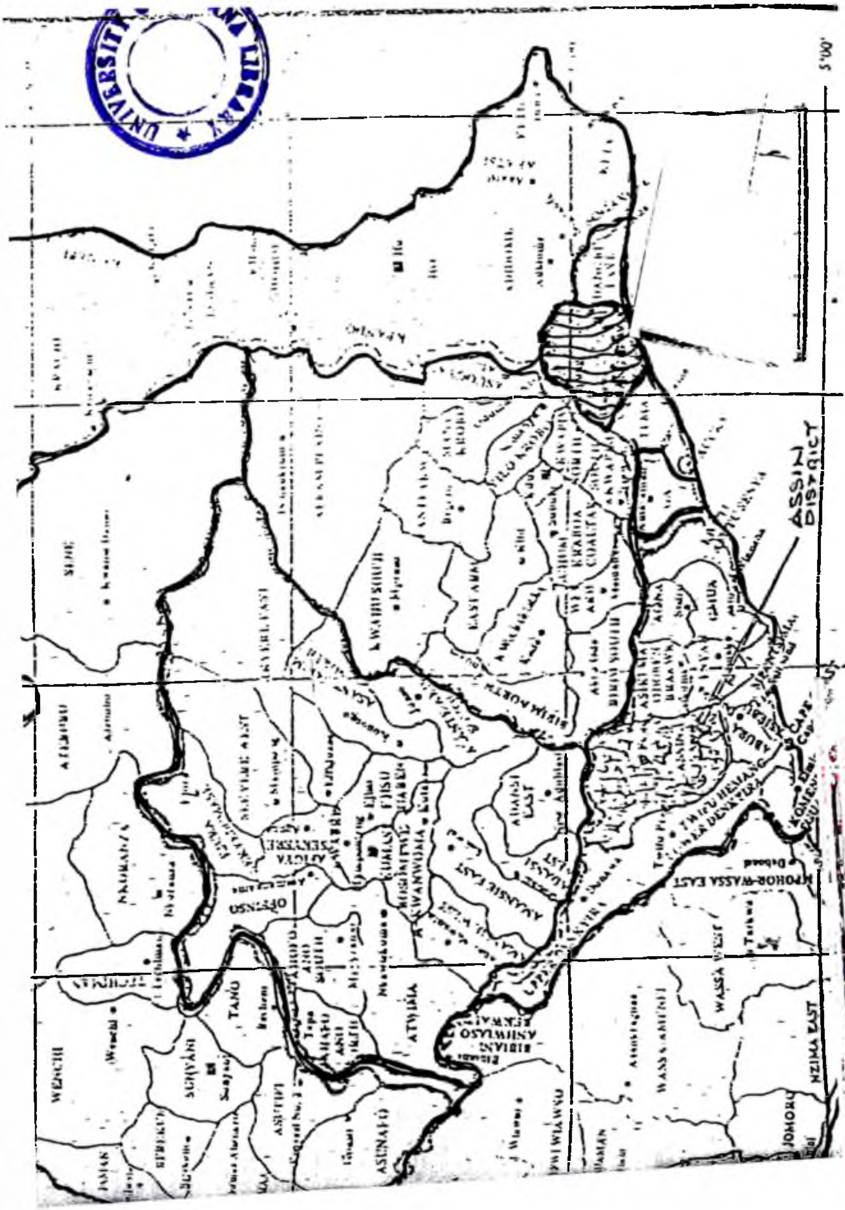
16. Williamson G, et al. (1978), Animal husbandry in the tropics, third edition longman London. 6, 429

17. Urban V P. (1987) Practical epidemiology and veterinary sanitation Agropro, Petrograd .

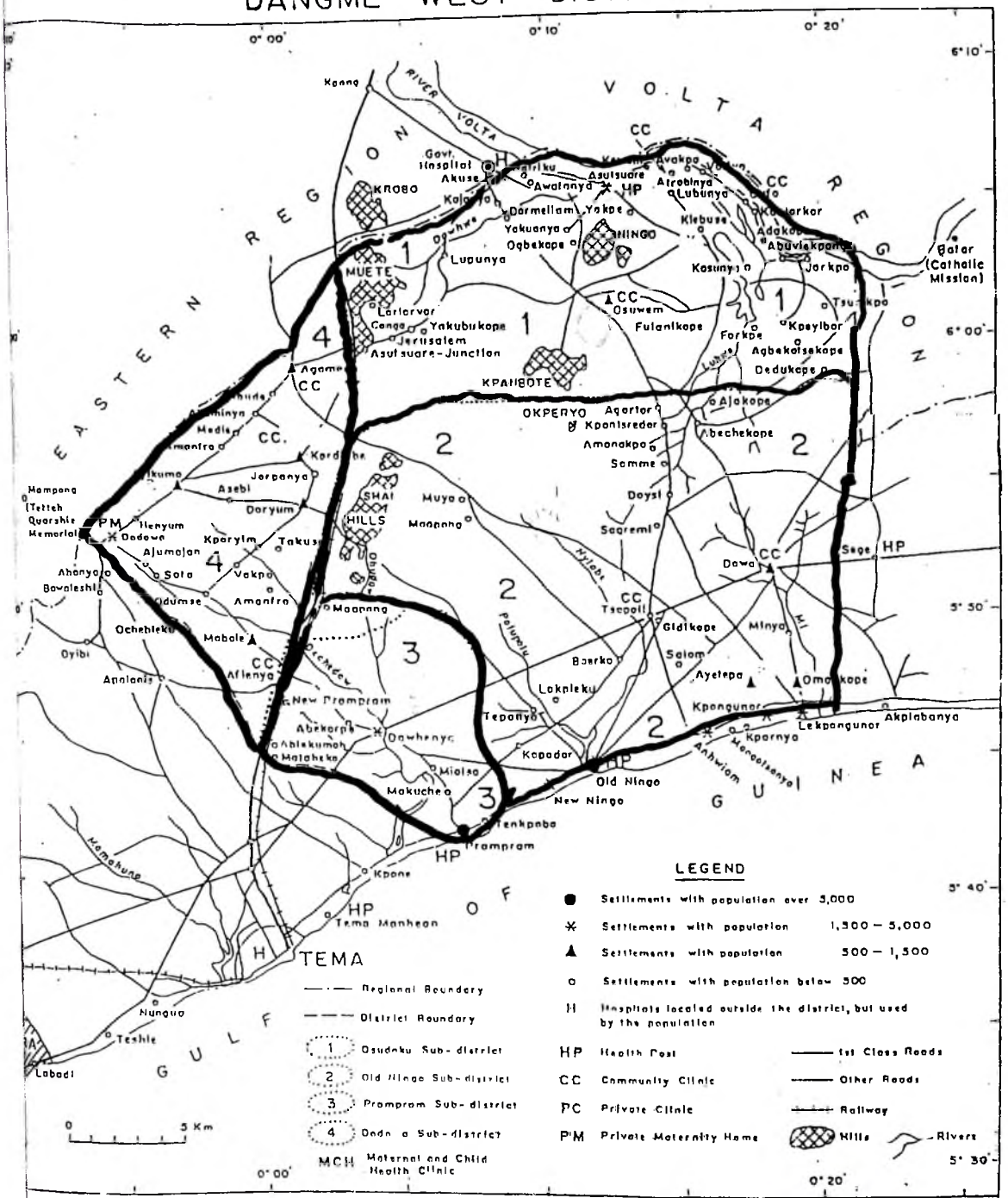
5. 155

18. Veterinary reports on tuberculosis, (1997) Accra,





DANGME WEST DISTRICT



APPENDIX 3

LIST OF QUESTIONS.

1. When did you start cattle rearing?

2. Where is the source of your original stock ?

3. Do you milk your animals? If no why?

4. If you milk your animals, do you and your family drink some of the milk? If no why ?

5. If you drink some, what do you do with the remaining ?

6. If you drink some, do you boil it before you drink ? If yes why?

7. If you do not boil, is it safe to drink ? If not safe what makes it not safe?

8. What can you do to make it safe?

9. Have you drank milk directly from the teat of the udder of the cow before or seen somebody drinking directly from it ?

10. What do you know about tuberculosis?.

11. Do you know that cattle get tuberculosis ?

12. Do you know that human being can contract tuberculosis from cattle ?

13. If yes, can you tell me how human being can contract tuberculosis from cattle ?

14. Is there anybody in your family who have been coughing for two weeks or more?

15. Is there anybody in your family with stomach problem which keep on worrying him/her?

16. If yes, can you tell me how the person feels when the problem come?

17. Who has been treating your animals for you when they are sick?

18. Have you ever injected your animals yourself ?

19. If you have injected your animals before, tell me, how often do you do it?

20. If you have been injecting, can you show me the empty bottles of the drugs you have been using, and how you use them ?

21. If you treat your animals with drugs do you wait for some days to pass before you take milk from the treated animal?

22. Have you used tick medicine on the animals whilst you are also taking milk from them ?

23. Do you wait for some days to pass after you have done dipping of your animals?

24. What do you think veterinary services must do which they are not doing ?

25. Thank you very much for answering my questions, if you have some questions or something you do not understand you can say it.

APPENDIX 4

TABLE 9. Measurement of Skin Thickness of positive Tuberculin Reactors mm(Cattle).

ID NO	SEX	AGE	SKIN THICKNESS 1ST AND 2ND READINGS.				DIFF. 1ST &2ND READ		REMARKS
			BOVINE SITE		AVIAN SITE				
			1ST Read.	2nd Read.	1St Read.	2nd Read.	Bovine	Avian	
1	f	cow	6	14	6	6	8	0	+
2	f	cow	6	13	5.5	5.5	7	0	+
3	f	cow	5	14	5	5	9	0	+
4	f	cow	7	15	7.5	7.5	8	0	+
5	f	cow	5	15	6	6	10	0	+
6	f	heif.	4.5	15	6	6	10.5	0	+
7	f	cow	6	15	6.5	6.5	9	0	+
8	f	cow	7	13	6.5	6.5	6	0	+
9	f	cow	7	16	7	7	9	0	+
10	f	cow	5	12	5.5	5.5	7	0	+
11	f	cow	6	13	6	6	7	0	+
12	f	cow	6	12	5.5	5.5	6	0	+
13	f	cow	6	18	7	7	12	0	+
14	f	cow	16	25	18	18	9	0	+
15	f	cow	8	20	8	8	12	0	+
16	f	cow	6	16	6	6	10	0	+
17	f	cow.	5	13	5.5	10	8	4.5	+
18	f	cow	5	10	5.5	9	6	3.5	+
19	f	cow	6	12	6	6	6	0	+
20	f	cow	6	16	7	7	10	0	+
21	f	heif.	5	13	4.5	4.5	8	0	+
22	f	heif.	6	14	6	6	8	0	+
23	f	heif.	5	11	6	6	6	0	+
24	f	cow	7	23	6.5	6	16	0	+
25	f	cow	6	12	6	6	6	0	+
26	m	bull	15	23	17	17	8	0	+
27	f	cow	5	11	5	5	6	0	+
28	f	cow	6	12	6	6	6	0	+
29	f	cow	5	12	5	5	7	0	+
30	f	cow	9	17	10	10	8	0	+
31	f	cow	5	12	5	5	7	0	+
32	f	cow	6	15	7	9	9	2	+
33	f	cow	6	15	6.5	6.5	9	2.5	+
34	f.	Heif.	7	14	7	7	7	0	+
35	f	cow	5	17	5	5	12	0	+
36	f	cow	6	13	6	6	7	0	+
37	f	cow	5	14	6	6	9	0	+
38	f	cow	8	17	9	10	9	1	+
39	f	heif	5	13	5	5	7	0	+

APPENDIX 4 cont.

40	f	heif	5	15	5	5	10	0	+
41	f	cow	6	17	6	12	11	6	+
42	f	cow	5.5	14	6	6	9.5	0	+
43	f	cow	6	14	6	6	8	0	+
45	f	heif.	4.5	15	4.5	4.5	8.5	0	+
46	f	cow	9	17	9	9	8	0	+
47	f	cow	6	18	6	6	12	0	+
48	f	cow	5	19	6	6	14	0	+
49	f	cow	6	15	6	6	9	0	+
50	f	cow	6	13	6	6	7	0	+
51	f	cow	7	16	8	8	9	0	+
52	f	heif.	5	12	5	6	7	1	+
53	f	heif.	5	13	6	6	8	0	+
54		cow	6	14	6	6	8	0	+
55	f	cow	6	18	6	6	12	0	+
56	f	cow	7	17	7	7	10	0	+
57	f	cow	7	18	7	7	11	0	+
58	f	heif.	5	10	6	6	5	0	+
59	f	heif.	5	12	6	6	7	0	+
60	f	heif	6	16	6	6	10	0	+
61	f	cow	6	11	6	6	5	0	+
62	f	cow	9	16	9	9	7	0	+
63	f	cow	8	15	8	8	7	0	+
64	f	cow	7	19	7	7	12	0	+
65	f	cow	6	12	6	6	6	0	+
66	f	cow	6	15	6	6	9	0	+
67	f	cow	7	15	7	7	8	0	+
68	f	cow	7	16	7	7	9	0	+
69	f	heif.	5	15	6	6	10	0	+
70	f	cow	6	15	6	6	9	0	+
71	f	cow	6	17	7	7	11	0	+
72	f	heif.	4	18	6	6	14	0	+
73	f	heif	4.5	19	6	6	14.5	0	+
74	f	heif.	3.5	15	6	6	11.5	0	+
75	f	heif	5	13	5	6	8	2	+
76	f	cow	6	16	6	6	10	0	+
77	f	cow	6	12	6	6	6	0	+
78	f	cow	7	13	7	7	6	0	+
79	f	cow	6	17	6	6	11	0	+
80	f	cow	6	19	7	7	13	0	+
81	f	heif.	5	16	7	7	11	0	+
82	f	heif.	5	11	6	6	6	0	+
83	f	cow	6	12	6	6	6	0	+
84	f	cow	6	15	6	6	9	0	+
85	f	cow	6	15	7	7	9	0	+
86	f	cow	6	13	6	6	7	0	+
87	f	heif.	6	16	7	7	10	0	+
88	f	cow	5	14	7	7	9	0	+

Appendix 4 cont.

90	F	Cow	6	13	6	6	7	0	+
91	f	cow	7	21	7	7	14	0	+
92	f	cow	5	15	6	6		0	+
93	f	cow	6	14	6	6	10	0	+
94	f	cow	7	20	7	7	13	0	+
95	f	cow	6	14	6	6	8	0	+
96	f	heif.	6	13	6	6	7	0	+
97	f	cow	8	18	8	8	10	0	+
98	f	cow	5	12	6	6	7	0	+
99	f	cow	6	11	6	6	5	0	+
100	f	heif.	5	10	6	6	5	0	+
101	f	cow	6	14	6	6	8	0	+
102	f	cow	6	16	6	6	10	0	+
103	f	cow	9	15	10	12	6	2	+
104	f	cow	5	15	6	6	10	0	+
105	f	cow	6	15	6	6	9	0	+
106	f	heif.	7	12	7	7	5	0	+
107	f	heif.	5	11	6	6	6	0	+
108	f	cow	6	20	6	6	14	0	+
109	f	cow	7	16	7	7	9	0	+
110	f	cow	6	19	6	6	13	0	+
111	f	cow	9	17	9	9	8	0	+
112	f	cow	6	18	6	6	12	0	+
113	f	heif.	5	13	5	6	8	1	+
114	f	cow	6	12	6	6	6	0	+
115	f	cow	7	16	7	7	9	0	+
116	f	cow	7	13	7	7	6	0	+
117	f	cow	6	15	6	6	9	0	+
118	f	cow	5	19	6	6	14	0	+
119	f	cow	6	18	6	6	12	0	+
120	f	heif.	5	17	5	5	12	0	+
121	f	cow	6	17	6	6	11	0	+
122	f	cow	6	15	6	6	9	0	+
123	f	heif.	5	16	5	5	11	0	+
124	f	heif.	3.5	15	6	6	11.5	0	+
125	f	heif.	3.5	12	5	6	8.5	1	+
126	f	heif.	3.5	19	5	6	15.5	1	+
127	f	heif.	4.5	12	6	6	7.5	0	+
128	f	heif.	5	11	6	6	6	0	+
129	f	cow	5.5	11	6	6	5.5	0	+
130	f	heif.	5	16	6	6	10	0	+
131	f	cow	5.5	12	6	6	6.5	0	+
132	f	cow	6	12	6	6	6	0	+
133	f	cow	6.5	17	7	7	10.5	0	+
134	f	cow	7	18	7	7	11	0	+
135	f	cow	9	17	9	9	8	0	+
136	f	cow	7	13	7	7	6	0	+
137	f	cow	6	12	7	7	6	0	+
138	f	cow	9	16	9	9	7	0	+
139	f	cow	4	15	5	6	11	1	+

Appendix 4 cont'

140	f	cow	5	13	5	5	8	0	+
141	f	cow	6	14	6	6	8	0	+
142	f	heif.	4.5	15	5	5	10.5	0	+
143	f	cow	9	15	9	9	6	0	+
144	f	cow	6	17	6	6	11	0	+
145	f	heif.	5	18	5	5	13	0	+
146	f	cow	6	19	6	6	13	0	+
147	f	cow	6	15	6	6	9	0	+
148	f	cow	7	13	7	7	6	0	+
149	f	cow	5	16	5	5	11	0	+
150	f	cow	5	12	6	6	8	0	+
151	f	cow	6	13	6	6	7	0	+
152	f	cow	6	18	6	6	12	0	+
153	f	cow	7	17	7	7	10	0	+
154	f	cow	7	20	7	7	13	0	+
155	f	heif.	5	12	6	6	7	0	+
156	f	cow	6	16	6	6	10	0	+
157	f	cow	6	12	6	6	6	0	+
158	m	bull	9	15	9	9	6	0	+
159	f	cow	6	19	6	6	13	0	+
160	f	cow	6	12	6	6	6	0	+
161	f	cow	7	15	7	7	8	0	+
162	f	heif.	5	15	6	6	10	0	+
163	f	cow	6	16	6	6	10	0	+
164	f	cow	6	15	6	6	9	0	+
165	f	heif.	7	15	7	7	8	0	+
166	f	cow	6	17	6	6	11	0	+

Key

f. - Female

m - Male

♦ Any difference more than two units was considered a positive case