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THE FEASIBILITY OF ARTIFICIAL INSEMINATION OF
DAIRY CATTLE MANAGED BY FULANI TRIBESMEN
IN KADUNA STATE, NIGERIA

by

Christian Olafimihan Ojomo

A thesis submitted in partial fulfillment of
the requirements for the degree

of

MASTER OF SCIENCE

in

Agricultural Education

(International Extension and Management)

Approved:

Major Professor

Committee Member

Committee Member

Dean of Graduate Studies

UTAH STATE UNIVERSITY
Logan, Utah

1987

ABSTRACT

The Feasibility of Artificial Insemination of
Dairy Cattle Managed by Fulani Tribesmen
in Kaduna State, Nigeria

by

Christian Olafimihan Ojomo, Master of Science
Utah State University, 1987

Major Professor: Dr. Pat Pruitt
Department: Agricultural Education

This study sought to determine: (a) the essential elements of a viable artificial insemination program for the Fulani Tribesmen in Kaduna State, Nigeria, and (b) to determine if the essential elements of a viable artificial insemination program exist in Kaduna State, Nigeria.

This study was conducted from April 15 to May 15, 1985, in the Artificial Insemination (AI) Subcenters of Zaria, Katsina, Kabomo, Kaduna, Ikara, Zonkwa, Kurmin-Biri, and Kauranjuli.

The data presented in this study were collected by personal interviews with Fulani Tribesmen. The population of this study was from a partial list of Fulani Tribesmen

who have had AI performed on their dairy cattle by the cooperative inseminators in the subcenters. The statistical analysis showed an overview of herdsmen reactions to each question. The use of additional statistical tests to determine the degree of significance was not appropriate because the respondents were not randomly selected. The writer did not know in advance the number of Fulani Tribesmen that constituted the total population of the AI system in the subcenters.

Noneconomic analysis of this research study includes five linked essential elements of a viable AI program. These elements are: (1) high performance bulls with quality semen, (2) skilled dependable AI technicians, (3) healthy cows, (4) functional communication and transportation resources, and (5) cooperative and informed farmers.

This study concluded that four of the five essential elements for a viable AI program currently do not exist for the Fulani Tribesmen in Kaduna State, Nigeria. As a result of this study, it was determined a viable AI program for the Fulani Tribesmen in Kaduna State, Nigeria, is not feasible under the present situation.

DEDICATION

I dedicate this work to my deceased father and brother, Adesanmi Ojomo and Taiwo Ojomo, respectively.

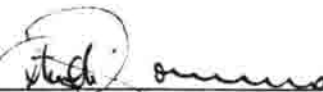
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I express my heart-felt gratitude to my parents, my government, my family and my committee members for giving me an opportunity to obtain a Masters degree in Agricultural Education. I thank all of them for their suggestions, encouragement and patience.

My deep appreciation goes to Drs. Pat Pruitt, Jay Call, and William Farnsworth respectively, who worked closely with me and knowing full-well my committments and sacrifices towards obtaining this diploma. I thank these men for their reviews of the manuscript and useful suggestions.

I also appreciate and thank my best friend and wife, Mojisola, and my children, Diana, Brenda, Leslie, and Christian Jr., for their love, understanding, patience, suffering and sleepless nights for obtaining this golden gift. I owe Mojisola and my children a great debt.

Thanks so much to Dr. William Farnsworth, who gave me all the kindness, generosity, guidance, concern, and moral support to feel at home in Logan, Utah, while my family was in Sacramento, California caring for my disabled child (Leslie), twin sister to Brenda.



Christian Olafimihan Ojomo

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CHAPTER I

INTRODUCTION

An artificial insemination (AI) Center using imported frozen semen was started by the National Animal Production Research Institute (NAPRI), Ahmadu Bello University, Shika, Zaria, in 1976. The functions of the institute are:

1. To cooperate with other organizations in the dissemination of knowledge concerning animal reproduction;
2. To arrange for conferences of governmental officials and livestock extension personnel, including dairymen to promote artificial insemination;
3. To provide semen from high quality bulls for distribution to inseminators and to farmers with AI skills;
4. To inseminate cows on private and institutional farms;
5. To collaborate with the Agricultural Extension and Research Liaison Services of Ahmadu Bello University, Zaria, in the planning and conducting of training programs for livestock extension personnel who are responsible for field AI activities.

The use of artificial insemination on dairy cattle in Nigeria could improve genetic capacity, thus enhancing milk production of dairy cattle. The genetic capacity for milk production by indigenous dairy cattle can be improved by selecting and using semen from bulls with desired genetic characteristics for high milk production. Improved nutrition, disease control and other management practices also influence milk production.

The main source of livelihood of Fulani Tribesmen of the Kaduna State in Nigeria is livestock production. Their average herd size is between 40 to 50 cattle. They are incessant wanderers in search of grass and water for their cattle. They are bound by tradition, unwilling to sell their cattle, difficult to administer and are a problematic group of people who, some feel, need to be settled or semi-settled. They usually occupy permanent homesteads on a season basis. They migrate to wet season grazing areas. In areas where there is enough fodder, water and a healthy environment, the Fulani Tribesmen often remain stationary. If there is an outbreak of disease, if there is a lack of feed, if the temperature becomes too hot, or a lack of water occurs, they move to other areas.

The Fulani herds are grazed on uncropped or harvested

crop lands. They travel from the Northeast to the Abuja area in the early dry season (November) above the confluence of the Niger and Benue Rivers. In the wet season (May), they travel south in search of grazing, water, and a healthy environment. The influx of the Fulani during the dry season (November) brings about competition for grazing resources as well as for sales of milk, manure, and animals.

Some settled Fulani Tribesmen do some farming but their main source of livelihood is livestock production. The Fulani cattle and sheep are sold to traders and butchers who organize the driving of animals to markets near larger population centers. The Fulani women process and sell dairy products such as sour milk and butter to the local markets or directly to farm families. Their earnings are used to purchase foodstuffs and manufactured goods. Farm boys are hired for herding. They receive food and lodging and a bull per year or a heifer every two years for their pay.

The Fulani Tribesmen hire farmers occasionally for diking irrigated farmland and weeding crops. The rural farmers are also hired as builders, especially when the Fulani want mud-brick dwellings instead of their

traditional grass huts. The exchange of labor, meat and dairy products and land sharing between the Fulani and farmers does not occur without conflicts. Ethnic and religious differences generally create a social distance between the two groups. The greatest source of conflict is crop damage by the Fulani cattle.

The settled Fulani Tribesmen grow crops so that they will not have to purchase their staple foods. It has been shown that an average Fulani household farms only about one hectare (2.47 acres) less than half the area cultivated by a local farm family of similar size. They have adopted traditional techniques such as planting grain on dikes and transplanting millet from nurseries. Some settled Fulani grow sufficient grain crops to satisfy their food needs while some with large herds grow no crops at all. Their foodstuffs are purchased from farmers or traders. The major reason some farmers or traders allow Fulani Tribesmen to live on and farm the land rent free is to gain access to cattle manure. The major cash crop in the Abet area is ginger which is fertilized with cattle manure instead of commercial fertilizer. The Fulani Tribesmen are often paid by the farmers to hold cattle overnight in fields to be used for ginger production during the dry season.

Problem Statement

There has been relatively little work done to demonstrate the feasibility of artificial insemination in dairy cattle for the Fulani Tribesmen in Kaduna State, Nigeria. Very little attention has been given to artificial insemination of dairy cattle in Kaduna State. Fulani Tribesmen have chosen to remain in the northern part of Nigeria. They control about 90 percent of the entire cattle population of Nigeria. Their nomadic grazing tradition and practices, lack of communication, unsteady supply of electricity, transportation and cooperation and generally being unformed about modern technology present special problems for a successful AI program for their dairy cattle.

The biggest constraint for livestock production in Kaduna State has been the lack of settlement of the Fulani Tribesmen, illiteracy and land tenure system. With the population growth and increasing cultivation, fewer areas are available for nomadic grazing. According to Lamorde and Franti (1975), the Fulani Tribesmen complained about insufficient feed for their cattle, their cattle starved during the rainy and dry season because of restriction of grazing areas and some of the bushes burned. Therefore,

feed scarcity coupled with lack of water during the dry season was the major reason for nomadism.

Dairy cattle in Nigeria are dual purpose. They are used for meat and milk. These products are expensive and the supply is short. There are vast market potentials for animal products since there are approximately 100 million people in Nigeria.

Often the environment dictates the success or failure of all livestock production functions. Throughout history, man has tried to develop cattle that are the most productive for the environment in which he lives. His tools are heredity, crossbreeding, and performance/progeny testing. Artificial insemination subcenters have been established. The Federal Government AI program provides free insemination of all cows owned and managed by the Fulani Tribesmen. However, the system does not function well. Fulani Tribesmen in Kaduna State breed their cows naturally for milk and meat production. Fayinka (1982) reported cattle production in Nigeria is not market-oriented, rather milk production which fluctuates with seasons appears to be the primary reason for keeping cattle as daily needs of the Fulani are met from cheese, butter and milk sales. There is little interest in knowing about

artificial insemination as a viable alternative to natural breeding. Extension workers and artificial insemination technicians are located throughout the state to transfer the knowledge and perform artificial insemination of dairy cattle at no cost to the farmer or owner. The Fulani Tribesmen and their cattle are an extremely valuable resource of beef cattle production in Nigeria. There is no information on the relative milk production potential of their cattle, so it is a problem to judge where their cattle rank on such a scale.

The Nigerian Third National Development Plan (1975-80), focused special attention on the settlement of the Fulani Tribesmen, the development of improved pastures (grass and legumes), and the re-establishment of better pasture in areas previously overgrazed.

Purpose and Objectives of the Study

The purpose of this study was to determine the feasibility of increasing the use of artificial insemination on dairy cattle managed by the Fulani Tribesmen, Kaduna State, Nigeria. The specific objectives of this study were:

1. To define the present situation of artificial insemination as used by the Fulani Tribesmen, Kaduna State, Nigeria.

2. To determine the essential elements of a viable artificial insemination system in the Kaduna State of Nigeria;
3. To determine if the essential elements of a viable artificial insemination system are functioning in Kaduna State;
4. To determine if artificial insemination of dairy cattle managed by Fulani Tribesmen in Kaduna State, Nigeria, is feasible.

Hypothesis

A null hypothesis was developed which was believed to have sufficient support from the literature and perceived conditions of the AI program currently existing in the Kaduna State of Nigeria.

There is no difference between the theoretical model of essential elements of a viable artificial insemination program and the actual condition for artificially inseminating of the dairy cattle managed by Fulani Tribesmen in Kaduna State, Nigeria.

Limitations of the Study

The study was intended to define the elements of a successful artificial insemination program for dairy cattle

in Kaduna State, Nigeria. It is not implied that the findings of this study should have general application to other parts of the world. However, farmers in areas having conditions similar to those found in Kaduna State, Nigeria, may benefit from the findings of this study as herdsmen strive to develop a functional and practical artificial insemination system of their own.

CHAPTER II
LITERATURE REVIEW

History of Artificial Insemination

The first scientific research in artificial insemination (AI) of domestic animals was conducted in 1780 by the Italian physiologist, L. Spallanzani, working with dogs. In 1780, Spallanzani's experiment was successfully repeated by P. Rossi and checked by Professor Branchi in 1782. These experiments proved the feasibility of inducing pregnancy by AI, with the resultant birth of normal offspring. Spallanzani's discoveries gave rise to intensive investigations in Europe and Russia. In 1922, E. I. Ivanoff, a leading Russian investigator and a pioneer in artificial insemination, was the first man to undertake successfully the AI of cattle and sheep. Ivanoff worked with stud farms. He obtained successful results with 10 cows. His experiments awakened much interest, and a physiological section was established in the veterinary laboratory of the Ministry of Agriculture with the objective of studying the physiology of fertilization and training veterinarians in the technique of AI. The section

was headed by Ivanoff. During the years prior to World War I between 300 and 400 men were trained and sent out as practitioners of AI. A considerable increase in the number of animals bred artificially resulted (Perry, 1960).

The first demonstration in the USA proving that large numbers of cattle could be bred successfully by AI was conducted at the North Central School of Agriculture and Experiment Station at Grand Rapids, Minnesota. This work started in 1937 and was completed in the spring of 1938. There were 98 cows successfully inseminated (Perry, 1960).

A new landmark was established in the field of AI in 1949 when C. Polge, A. U. Smith, and A. S. Parkes (Perry, 1960) discovered a practical method for long-time preservation of livestock semen by freezing to temperatures of -79°C . This was done by using dry ice (CO_2). This later was made practical by the American Breeders Service of Madison, Wisconsin.

Artificial Insemination in

Kaduna State

Waters-Bayer and Bayer (1984) observed that with rapidly growing populations, high income elasticities for livestock products outstripped local supply in many West

African countries. Promotion of livestock production has become increasingly prominent in development efforts which have concentrated on the modern sector: beef ranching, large-scale dairy farming, and feedlot fattening of livestock. Although some of these schemes have been technically successful, outputs do not generally justify the high input costs, and impacts on total national production have been minimal. In Nigeria, for example, over 90 percent of locally produced beef and milk still comes from the traditional sector. This sector is the focus of International Livestock Center for Africa (ILCA) research in the Subhumid Zone of West Africa. Indigenous livestock systems are being studied to identify major production constraints and to design innovations that can be adopted by traditional producers. The ILCA is located at Kaduna and the headquarters is located at Addis Ababa in Ethiopia.

The National Artificial Insemination Center is located at NAPRI, Shika, Zaria in Kaduna State. AI subcenters have been established as insemination points where frozen semen is distributed throughout the state. Artificial insemination is performed at NAPRI during the wet season (May to October). This is seasonal because there is low

feed production during the dry season (November to April) which is the dry season while there is much feed production during the wet season (May to October). Research carried out by NAPRI has shown that there are marked seasonal differences not only in the response of animals to synchronization and in the intensity of estrus signs, but more importantly in conception rates. The proportion of animals responding to synchronization agents and the proportion conceiving is much higher in the wet season than the dry season. It, therefore, appears reasonable to concentrate on NAPRI resources in terms of manpower during the wet season, so that maximum benefit can be obtained from the inputs. Schmidt-Dumont (1984) in a review, reported that the single factor most limiting AI in Southwest Africa is the annual rainfall. He remarked,

If it is insufficient and poorly distributed, drought conditions occur as has happened during the previous four seasons. This forces many farmers to stop doing AI either because their stock numbers have to be reduced substantially or the animals are moved to areas where there is grazing. (p. 381)

Kaduna State has fourteen artificial insemination subcenters. Each subcenter is headed by a village agent called the inseminator. The inseminator's sole responsibility is to identify the Fulani Tribesmen and

livestock farmers who are interested in AI and to obtain their participation in the AI program.

In the wet season, the young Fulani boys or men in Abet graze their herds in fallow fields and natural range in upland areas. The herd is corralled overnight beside the homestead inside a circular fence made of wire strands. Grazing time is short, about 5.5 hours/day. This is because of conflicting labor demands for herding and farming and the Fulani believed the animals could graze their fill in that time. In the dry season, the cattle graze on the remaining dry leaves and stems plus rice and bean residues and grasses in the low-lying areas. No fences are erected during the dry season. This is because the herd is shifted to distribute manure over fields of the Fulani and farming neighbors once a week. During the late dry season, the herders cut down branches from certain trees whose leaves are more nutritious than the mature grasses. But, at harvest time, 80 percent of the grazing time is spent on crop residues, where the cattle graze on green leaves and auxiliary heads of sorghum and millet. At night, the calves are separated from their dams and tied with rope beside the corral and the cattle are hobbled in pairs. Men and boys milk the cows in the morning and later

pick ticks by hand off all animals in the herd. Waters-Bayer and Bayer (1984) found that the average settled herd has more than 50 percent breeding females and roughly 20 percent adult males, mostly non-castrated. Milk production averages 0.71 ml/cow/day over the year and peaks twice: in the early wet season and during initial crop residue grazing. Calf mortality rate is considered high at 15 percent to 20 percent while in adult cattle it is about 5 percent. Observations of grazing behavior, chemical analysis of fodder types consumed, veterinary examination and condition scoring of cattle have revealed that the major mortality factor is inadequate nutrition which renders cattle susceptible to infectious diseases and parasites.

What Constitutes a Viable Effective
Artificial Insemination Program?

Hafez (1980) pointed out that artificial insemination is the most important single technique ever devised for the genetic improvement of animals. This is possible because, a few highly selected males produce enough spermatozoa to inseminate thousands of females per year, whereas only relatively few progeny per selected female can be produced

per year even by embryo transfer. The following are considered advantages of AI:

1. Genetic improvement of the cow population.
2. Control of venereal diseases.
3. Availability of accurate breeding records necessary for good herd management.
4. Economic service.
5. Safety through elimination of dangerous bulls on the farm.

A successful artificial insemination program requires techniques that are performed by a well trained inseminator, good herd management, suitable handling facilities and a well-trained, interested herdsman. AI is a technique that deposits semen into the cows' reproductive tract with an inseminating rod or instrument. The genetic potential, according to Moeller (1981), has been increased through the use of artificial insemination using production tested bulls. In Denmark and Japan, nearly all cattle are inseminated artificially. The proportion of cattle bred by AI is also high in most European countries but low in Africa, South America and parts of Asia. The longevity of dairy cattle is good and the average age in most herds is about six years. Dairy cattle are adaptable to many types of housing.

Anatomy and Physiology of Reproduction

The basic understanding of the anatomy and physiology of reproduction is an important first step in learning how to inseminate cattle. The cervix is an important organ. The inseminator's ability to manipulate and control the cervix ultimately determines his insemination success. The cervix is the neck of the uterus and it is a thick-walled tube with an irregular passageway that serves as a valve between delicate internal organs and tougher outer organs. The cervix is firm and dense to touch and feels like a chicken neck. American Breeders Service (ABS) (1983) reported that to achieve the highest possible fertility rate, semen should be deposited at the very front end of the cervix. This is the area called the target point. A bull ejaculates semen deeply into the cow's vagina in natural service. But in AI, the semen is deposited by the inseminator right at the end of the cervix where the sperm are carried through the uterus and up to the forward end of the oviducts where fertilization occurs.

High conception rates and reproductive efficiency are important to the success of a dairy farm.

Heat detection. Heat or estrus, according to ABS (1983), is that short time when cows will stand to be

mounted, normally occurring every 18 to 24 days. Standing heat is the best indication of estrus. The female stands when mounted by a bull or other cows. One of the most effective instruments for detecting and marking cows in heat has been the chin-ball marker. Research studies show that standing to be mounted is the best heat detection signal. Reproductive problems in dairy herds are caused mainly by inefficient detection of estrus and by infertile services. Consequently, reproductive efficiency can be improved in most dairyherds by accurate estrus detection, insemination at the proper time in relation to estrus and ovulation, and use of semen from highly fertile bulls (Hafez, 1980).

Collecting, Processing and Freezing Semen

Semen is collected from healthy, fertile bulls. It is generally collected by using a mount animal and having the bull serve an artificial vagina. After the collection of the semen, the tube containing the ejaculate is sent immediately to the laboratory for analysis and examination. Sperm mobility is determined by using the microscope. If the quality is acceptable, the semen is place in the cold room (40°F). Antibiotics and an extender

are added to the collected semen according to quality and number of sperm. In the cold room, the semen is generally packaged and frozen in 0.5 milliliter plastic straws, each printed with the bull's name and registration number. With the ABS computer system for instance, orders are assembled in liquid nitrogen storage units for transport by ABS route service trucks. These trucks are an AI store on wheels. The trucks have the capacity to hold thousands of semen units plus liquid nitrogen refrigerators, inseminating supplies and other AI equipment. Liquid nitrogen should be kept in a clean, dry, well-ventilated area and the liquid nitrogen should be checked regularly.

Straw Insemination Procedure

Equipment and the step-by-step insemination procedure is the key to successful insemination of cows and heifers. The items of equipment needed for proper insemination are:

1. Insemination kit
2. Thawing device
3. Syringe and the sheaths Alcohol for disinfecting equipment
4. Scissors
5. Paper towels
6. Plastic shoulder-length gloves

7. Lubricant
8. Gloves
9. A pail, brush, and disinfectant handy to clean up after insemination.

Before thawing the semen, the inseminator should check the cows' identification. The inseminator will transfer a single straw from the refrigerator to warm thaw water as quickly as possible. The water temperature must be between 95 and 98°F. The straw should be in the thaw water for at least 30 seconds, then inseminate immediately.

Cattle identification and a good system of record keeping are necessary for a successful AI program. This is because after insemination, the following information should be recorded:

1. Date
2. Cow identification
3. Bull code number
4. Collection number

Moeller (1981) pointed out that identification of dairy animals is a requirement in the every day management of the herd. It is essential in the recording of parentage, in registration of offspring, for heat detection, milking, and feeding, for the health program,

and at sales and exhibits. An ideal identification program should be:

1. Permanent
2. Visible and readable at a distance
3. Visible in the milking parlour, particularly in the milking parlour pit
4. Acceptable to the dairyman
5. Reasonably priced

Fertility and Herd Reproductive Health

One of the major advantages of AI is control of venereal diseases. This problem can be eliminated when farmers inseminate their cows artificially with properly stored and thawed frozen semen and not allowing teaser bulls or steers to mount cows. Complete individual cow and heifer records are necessary. These records are essential to any successful herd reproduction management system. Effective management control will also help in herd fertility. Dairy cattlemen will realize the greatest efficiency in herd reproduction when they take advantage of and integrate the following:

1. The naturally high fertility level of cows when allowed to express it,

2. High quality and disease-free semen,
3. An insemination technician who uses proper and hygienic semen placement practices, and
4. A veterinarian who provides a scheduled, completed herd health care program (ABS, 1983).

There are four major infectious reproductive diseases that herdsmen should control.

1. Vibriosis--This disease is transmitted by the bulls through natural service. During sexual contact, organisms are transferred to the cow's genital tract. This disease can be prevented by using AI with vibriosis-free semen.
2. Trichomoniasis--This disease is similar to vibriosis except there is no specific treatment for infected females. The disease is self-eliminating after a few months. It can be prevented by using AI with trichomoniasis-free semen.
3. Leptospirosis--Semen is not a source of spreading the disease if the semen is not infected.
4. Brucellosis--There is no cure for this infectious disease. To prevent brucellosis from spreading, infected cows must be slaughtered. There are vaccinations to immunize calves against this

disease. Cleanliness during insemination is important. Technicians or inseminators should make sure syringes and sheaths are sterile before being used. Disinfecting reusable equipment reduces potential contamination problems.

During the insemination procedure, the cow vulva should be wiped clean with clean paper towels. Disinfectants and soaps must not be used on the cow's vulva because they are harmful to sperm if they come in contact with the semen. ABS (1983) reported that if cows are bred back too soon the fertility rate is lower. A 60-day rest following parturition before rebreeding is recommended.

To be able to find the inseminator's target, the inseminator will have to manipulate the cow cervix with one hand from inside the rectum. The syringe should be kept in a warm, clean place out of sunlight before inserting the loaded syringe into the vagina. Successful AI depends largely on the ability of the inseminator to pass an inseminating syringe through the cervix and deposit the semen in the uterus. The major steps to finding the target are as follows.

1. Keep fingernails short. Always wear protective gloves.
2. Develop positive attitude, relax and be gentle.
3. Assume a sideways stance.
4. Lubricate gloved arm.
5. Insert hand in anus in a coned position.
6. When wrist-deep in the rectum, start sweeping to find the cervix.
7. Wipe vulva with clean paper towel.
8. Enter vulva with syringe at 35° to 45° angle.
9. Level out syringe and pass to cervix.
10. Pick up cervix through rectum. Put it onto the syringe.
11. Manipulate cervix to pass the syringe through to the forward end.
12. Keep index finger at the cervix's front exit. Feel syringe tip as it emerges. This is the target. Deposit semen here.
13. If cow or heifer is suspected to be pregnant, only pass the syringe $2/3$ to $3/4$ of the way through the cervix before depositing the semen. Write this down on a chart or cow record card (ABS, 1983).

Finance

In the United States, AI organizations charge a fee for each dose of semen used, plus a service charge for the AI technician to inseminate the cow. In Kaduna State, the Federal Government AI program pays for each dose of semen used. The government also pays the inseminators' salary; there is no service charge to farmers for the AI service.

Nutrition

Nutrition is one of the essential factors for healthy cows. The literature (National Research Council publications) indicates that five classes of nutrients influence body reproductive functions. These are energy, protein, minerals, vitamins and water.

1. Energy is one of the most important nutrients affecting reproduction. The dairy cow needs to maintain high levels of reproduction and high levels of milk production. Nutrients required for reproduction are the same as those needed for high milk production. Keeping an adequate supply of energy in front of the milking cow is one of the surest ways to avoid reproduction problems (ABS, 1983).

2. Protein is an important nutrient affecting reproduction. It helps develop a cow's appetite and makes her consume more forage. This increases both energy and protein intake. Insufficient protein in the diet most often occurs when cattle are grazing mature, weathered pastures and corn stalks, or when low grade hay or straw is fed. This is especially true during the winter months and during drought periods (ABS, 1983).
3. Minerals are the third category of nutrients that influence body functions of cows. They are classified into major and minor elements. The two most important minerals to include in the dairy ration are calcium and phosphorus. Additionally, salt should be available at all times in either a block, supplement mix or in the ration.
4. The fourth category of nutrients is vitamins. Vitamin A is the most important. This is because it is needed for proper growth, sight, disease resistance and reproduction. Vitamin A can be obtained in adequate amounts by feeding good quality alfalfa hay or green chop. Neither alfalfa hay nor green chop is available to Fulani Tribesmen.

5. Water, the fifth class of nutrients, is not really a nutrient class. It is, however, important and necessary for proper utilization of the other nutrients. Water helps to control animals' temperatures, especially during the dry season.

Summary

The bull is an important element in all breeding programs. The selection of high performance bulls with quality semen in the United States of America (USA) is accomplished through all the production records kept by the Dairy Herd Improvement Association (DHIA), Program for Genetic Advancement (PGA), Select Mating Service (SMS), and US Department of Agriculture (USDA) sire summaries. They are independent from any AI organization. This is a major advantage that AI offers the dairy cattle producers.

Production records (performance and progeny testing) are used in the United States. Taiwo and Mofolorunsho (1984) indicated that bulls can be selected more intensely than cows. Although progeny testing is the most reliable method of selection of dairy bulls, this is not done because of the small number of dairy cows at present.

Correct collection, processing, and handling of semen

are essential for normal fertility response. Correct collection involves scheduling bulls for semen at optimal intervals, sexual preparation and correct semen collection techniques. Processing of semen is done in the laboratory by highly skilled, qualified persons who have been trained on how to collect, process, handle and ship frozen semen. Training in AI techniques can be obtained by attending a college, university, or on the job training.

Nutrition, heat detection, and a close working association with veterinarians is a must for a successful AI program. Dairy cows require five major classes of nutrients --energy, protein, minerals, vitamins, and water. All five are essential for normal health and productive purposes, but some, such as the minerals and vitamins, are needed only in very small amounts. The greatest requirement is energy. Without adequate energy, utilization of all other nutrients is impaired. Energy and protein are the limiting factors for high milk production in most dairy herds. Therefore, it is important to supply adequate energy if normal growth, high milk production and reproduction are to occur (Bath, Dickenson, Tucker, & Appleman, 1978). Consequently, reproductive efficiency can be improved in most dairy herds by accurate estrus

detection, insemination at the proper time in relation to estrus and ovulation, and use of semen from highly fertile bulls, (Hawk & Bellows, 1980).

In Nigeria, improved communication, a steady electricity supply, and functional transportation systems are extremely limited. Nigeria is deficient of communication resources, especially for private use. Telephone service is available only among a limited number of towns and cities and not available in villages. Telephone calls may require a day to complete, and connections are poor. The most widely available and effective communication medium that has a major impact in reaching rural residents is the radio. Battery powered transistor radios are widely owned. Unimproved roads are the principal means of transport; the local access roads are the most poorly maintained. These roads cannot be travelled during the rainy season because landslides and flooding are very common.

Farmers should be willing to learn and understand about artificial insemination and reproductive technology of a cow. The farmers' cooperation and willingness to learn and understand how to breed cows are very essential for a successful AI program. The farmer must know how to

detect heat in cows, how to maintain a cow identification system. The farmer must be willing to communicate with the AI technician or inseminator about what information is needed (when, how, and where). The farmer must cooperate with the AI technician and the cow should be available at the time of insemination. The farmer must have the capability to restrain the cow during the insemination process. The AI technician and the farmer must be patient and understand each other's work schedule.

The discussion of AI in this chapter is summarized in Figure 1. Five essential elements of a viable AI program are identified.

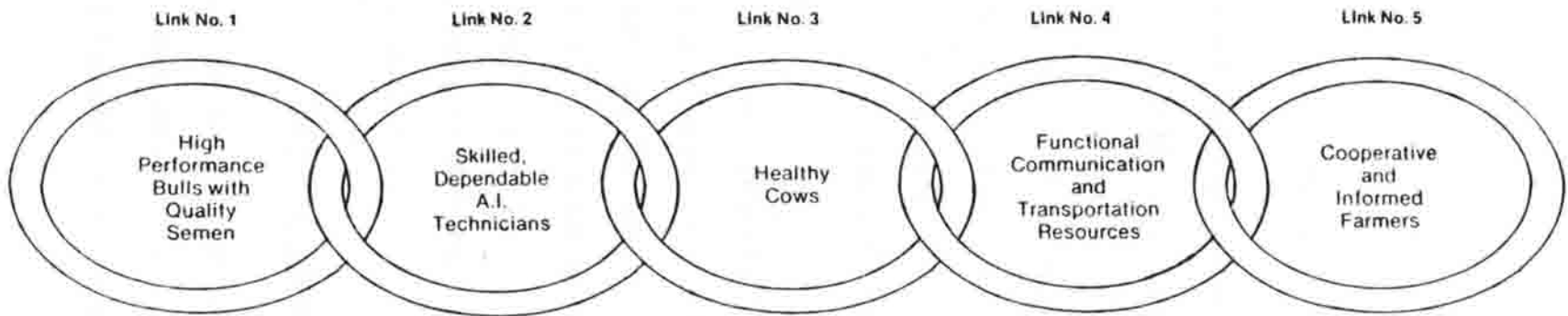


Figure 1. The linked essential elements of a viable artificial insemination program.

CHAPTER III

METHODOLOGY

The purpose of this study was to determine the feasibility of increasing the use of artificial insemination (AI) on dairy cattle managed by the Fulani Tribesmen, Kaduna State, Nigeria.

The specific objectives of this study were:

1. To define the present situation of artificial insemination as used by the Fulani Tribesmen, Kaduna State, Nigeria.
2. To determine the elements of a viable artificial insemination system in the Kaduna State of Nigeria.
3. To determine if the elements of a viable AI system are functioning in Kaduna State.
4. To determine if artificial insemination of dairy cattle managed by Fulani Tribesmen in Kaduna State, Nigeria is feasible.

Research Approach

The approach in this study was survey research. Survey research is a distinctive research methodology that owes much of its recent development to the field of

sociology (Borg & Gall, 1983). It is used as a method of systematic data collection. Survey research could be used to utilize a variety of instruments and methods to study the relationship, effect of treatments, longitudinal changes, and comparisons between groups.

Survey Methodology

The data presented in this study were collected by personal interviews with Fulani Tribesmen. The interviews were conducted by the writer and two of the AI staff of the National Animal Production Research Institute (NAPRI) in the AI subcenters of Zaria, Katsina, Kabomo, Kaduna, Ikara, Zonkwa, Kurmin-Biri and Kauranjuli (during the time period of April 15 to May 15, 1985). A detailed questionnaire was used (Appendix A) with a cover letter explaining the importance of the study.

Three months before the questionnaire was prepared, a letter was sent to the Head of the Department of the NAPRI to gain his permission and support to conduct the survey.

The Fulani Tribesmen who were interviewed could not read, write, or speak English and the writer could not read, write, or speak their Hausa language; therefore, the questionnaires were completed by the writer with the AI

staff of NAPRI interpreting during the interviews. The population of this study was the list of Fulani Tribesmen who have had AI performed on their dairy cattle by the cooperative inseminators in the subcenters of Zaria, Katsina, Kabomo, Kaduna, Ikara, Zonkwa, Kurmin-Biri and Kauranjuli. The writer did not know the total numbers of AI cooperators in the subcenters. There were 90 Fulani Tribesmen available for interviews. The writer did not know the total numbers of Fulani tribesmen who have used AI on their dairy cows.

Instrumentation

The survey instrument, a questionnaire entitled "Dairy Producers and Herdsmen Application Survey" (see Appendix A) was designed by the writer with the assistance from his graduate committee. The rationale for the questionnaire began with an overall goal to determine the feasibility of using AI on dairy cattle managed by the Fulani Tribesmen, Kaduna State, Nigeria. The questionnaire/individual interview methodology are common instruments for data collection in survey research (Borg & Gall, 1983).

Data Collection

Multiple-choice and "Yes" or "No" questions were used in the questionnaire. All questionnaires were completed by the three interviewers while on the farm and during each interview to assume accuracy with farmers' responses.

Design and Statistical Data Analysis

Statistical analysis was performed using the statistical package for the social sciences (SPSS). The statistical procedure used was descriptive statistics. In this study, the statistical analysis consisted of a tabulation of total responses to each question including percentages of the total responses. This was to give an overview of herdsmen reactions to each question.

The use of additional statistical tests to determine the degree of significance was not appropriate because the respondents were not randomly selected and the writer did not know the number of Fulani Tribesmen that constituted the total population of the AI system in the communities of Zaria, Katsina, Kabomo, Kauranjuli, Kaduna, Ikara, Zonkwa and Kurmin-Buri.

CHAPTER IV

PRESENTATION AND ANALYSIS OF DATA

The purpose of this study was to determine the feasibility of increasing the use of artificial insemination (AI) on dairy cattle managed by the Fulani Tribesmen, Kaduna State, Nigeria.

There has been relatively little work done to demonstrate the feasibility of artificial insemination in cattle for the Fulani Tribesmen in Kaduna State, Nigeria. Very little attention has been given to artificial insemination of cattle in Kaduna State. Fulani Tribesmen have chosen to remain in the northern part of Nigeria. They control about 90 percent of the entire cattle population of Nigeria. Their nomadic grazing tradition and practices, lack of communication, transportation and cooperation and generally being uninformed about modern technology present special problems for a successful artificial insemination program for their cattle.

Dairy cattle in Nigeria are dual purpose. They are used for meat and milk. These products are expensive and the supply is short. There are vast market potentials for

these products since there are approximately 100 million people in Nigeria.

Artificial insemination subcenters have been established. The Federal Government AI program provides free insemination of all cows owned and managed by the Fulani Tribesmen. However, the system does not function well. Fulani Tribesmen in Kaduna State breed their cows naturally for milk and meat production. There is little interest in knowing about artificial insemination as a viable alternative to natural breeding. Extension workers and artificial insemination technicians are located throughout the State to transfer the knowledge and perform artificial insemination of dairy cattle at no cost to the farmer or owner. The Fulani Tribesmen and their cattle are an extremely valuable resource of beef cattle production in Nigeria. There is no information on the relative milk production potential of their cattle, so it is a problem to judge where their cattle rank on such a scale.

The survey presentation and analysis of data (see Table 1) indicated 4 (4.4 percent) of the 90 respondents have irrigated farmland. Of the 90 respondents, 3 (3.3 percent) have non-irrigated farmland. Of the 90 respondents, 20 (22.2 percent) have land with small

Table 1.

Number of Fulani Tribesmen with Land Used to Support Dairy Cattle.

Type of Farmland	Total Number Interviewed	Number of Respondents Using	Percentage of Respondents
Irrigated land	90	4	4.4
Non-irrigated land	90	3	3.3
Land in small grains	90	20	22.2
Silage & Hay	90	0	0
Native pasture	90	7	7.7

grains. Of the 90 respondents, none (0 percent) grew silage or hay. Of the 90 respondents, the survey results indicated 7 (7.7 percent) possessed native pasture.

High Performance Bulls
Available for Semen Source

Survey responses provided the following results presentation and analysis of data.

The NAPRI organization purchased bull semen from Select Sires, Inc., United States of America (USA). The semen was from the Holstein Friesian, Brown Swiss, Jersey, Ayrshire and Guernsey breeds. They do not have semen available from the White Fulani breed. The survey results indicated that 85 of the 90 respondents have only White Fulani cattle. There was no indication in the interviews conducted that a breed preference existed among the Fulani Tribesmen as Fulani Tribesmen knew nothing about cross breeding. Breed preference ought not to be expected until the tribesmen know the potential production abilities of other dairy breeds in comparison with the White Fulani.

Availability of Skilled

AI Technicians

Of the 90 respondents in this survey, 56 of them (62.2 percent) have their cows inseminated by AI technicians. The writer did not find any conception rate records to imply how skilled the AI technicians were. However, the author did interview the veterinarian who had trained the AI technicians. In the veterinarian's opinion, the AI technicians were well trained and capable of performing their insemination skills in a professional manner. The survey also revealed that no one other than the AI technicians actually inseminated the cows.

Fifty percent of the respondents said they obtained their bull semen supplies, liquid nitrogen and other supplies from the NAPRI. The other 50 percent did not respond as there is no other known source and they felt it was unnecessary to respond.

Fifty percent of the respondents indicated there were facilities available for storage and shipment of semen. Twelve percent of the respondents did not know of the availability and storage of frozen bull semen. Thirty-eight percent did not respond. Forty-eight percent of respondents knew that bull semen in the tank was

arranged according to bull identity; 43 percent did not respond and 8.9 percent indicated they did not know.

Forty-four percent of the respondents knew they could remove semen from the tank without damage to the others. Fourteen percent did not know and 41.1 percent did not respond.

In terms of methodology to thaw frozen semen for use, only 12.2 percent knew the type of thawing method used, 87.8 percent did not respond to this question.

When semen tanks lose the supply of liquid nitrogen, 34.4 percent of the respondents said they discard the semen, 15.6 percent do not discard it, and 50.0 percent did not respond.

Based upon the above responses, one could conclude that some of the AI technicians should receive additional training.

Healthy Cows

Cows that are receiving adequate nutrition and are free of reproductive diseases are more likely to conceive by artificial insemination than cows with inadequate nutrition or that are infected with reproductive diseases.

Cow Nutrition

The survey questionnaire did not inquire into the specific content of nutrition for milking cows or dry cows. Such information was not available from the Fulani tribesmen as their cows survive on native pasture. However, the writer learned from visits with staff of the National Animal Production Research Institute (NAPRI) that the nutrition level of the White Fulani cows before and after calving was inadequate, and that throughout the climatic dry season (November through April) all animals suffer from a lack of feed. The common breeding season is from August to October when native pastures and water supply are plentiful.

The summary data revealed that 51 percent of the respondents graze their cows on pasture without any supplementation; 22 percent of the respondents utilize both dry-lot feeding and pasture on a daily basis; 4.4 percent feed their cows in dry-lot and used seasonal pastures; and 12.2 percent practice dry-lot feeding of their cows throughout the entire year.

The survey did not deal with pasture quality on a seasonal basis. However, visits with AI technician, NAPRI staff and Fulani Tribesmen confirm the following.

1. During the wet season (May through October), native pasture usually produces adequate pasture feed for dairy cattle.
2. During the dry season (November through April), all animals on native pastures receive inadequate nutrition and lose body weight, produce less milk, and conception is low. The data would indicate that cows on native pastures during the climatic dry season are not in good health for breeding purposes because of poor nutrition.

Reproductive Diseases

The survey inquired into farmers' vaccination program to safeguard the cows from reproduction diseases. Table 2 shows their responses. The survey revealed Fulani Tribesmen vaccinate their cows for rinderpest, anthrax, tripps, and contagious bovine pleura pneumonia (CBPP). No other vaccination program is practiced by Fulani Tribesmen. Other health problems impacting reproduction and AI were reflected in the survey.

1. Retained placenta
2. Difficulty calving
3. Cystic ovaries
4. Uterine infections

Table 2

Respondents' Report of Vaccination for Reproductive
Diseases

Diseases	Number of Fulani Tribesmen who vaccinate their cows to prevent each disease		
	Yes	No	Total
Infectious Bovine Rhinothacheitis (IBR)	0	90	90
Bovine Virus Diarrhea (BVD)	0	90	90
Para Influenza-3 (PI-3)	0	90	90
Leptospirosis	0	90	90
Brucellosis	0	90	90
Salmonella	0	90	90
Pasteurella	0	90	90
Rinderpest	62	28	90

5. Milk fever

6. Ketosis

The responses from the 90 Fulani Tribesmen revealed that they are not aware of any of these health problems in their dairy cows.

Cow First Aid

The questionnaire inquired into Fulani Tribesmen's practices of cow health care other than nutrition and/or vaccination. Four questions of this nature were asked each respondent. Table 3 contains data that indicates herdsmen responses. Eighty-four percent of the respondents indicated that they did apply medication to cuts and bruises compared to the 7 percent who did not. Fifty percent indicated that they did trim cow's hooves as compared to the 42.2 percent who did not. Ninety percent responded that they treated for internal and external parasites. Eighty-three percent responded that they frequently checked cows about to calve in their herd. Fourteen percent did dip the calf's navel cord at birth compared to the 73 percent who did not dip the calf's cord at birth. These data imply respondents care about the health of their dairy cows. The survey did not inquire about the respondents' knowledge and skills to do more to maintain satisfactory cow health.

Table 3

Respondents' Health Care Practices on their Dairy Cattle

Questions	Total Number	Yes		No		No Response	
		Number	%	Number	%	Number	%
Do you apply medication to cuts and bruises?	90	76	84.4	6	6.7	8	8.9
Do you routinely trim cow's hooves?	90	45	50.0	38	42.2	7	7.8
Do you treat for internal and external parasites?	90	81	90.0	4	4.4	5	5.6
Do you frequently check the cattle about to calve in your herd?	90	75	83.3	10	11.1	5	5.6
Do you dip the calf's navel cord at birth?	90	13	14.0	66	73.0	11	13.0

Calf Health Care

1. Eighty percent of the respondents gave fresh colostrum to the newborn calves. Eighteen percent did not indicate the colostrum was fed to new calves (Table 4).
2. From birth to one hour, of the 90 respondents in this survey, 28 of them (31.1 percent) gave colostrum to the calves (Table 5).
3. Twenty-three of them (25.6 percent) gave colostrum to calves for 1 day only, 15 (16.7 percent of them gave colostrum to calves for 2 days only, 22 of them (24.4 percent) gave colostrum to calves for 3 days only, and 12 of them (13.3 percent did not feed any colostrum to new calves (Table 6).
4. Of the 90 respondents, 68 (75.5 percent) did not feed powdered milk to the calves, 9 (10.0 percent) did feed powdered milk to the calves and 13 (14.4 percent) did not respond to the question (Table 7).
5. Of the 90 respondents, 40 (44.4 percent) treated calves with scours by injections only and 50 (55.6 percent) said no or did not respond to the question (Table 7).

Table 4

Respondents' Colostrum Source for Calves

	Total Number	Yes		No	
		Number	%	Number	%
Fresh	90	72	80.0	18	20.0
Frozen	90	9	10.0	81	90.0
Other	90	1	1.1	89	88.9

Table 5

How Soon after Birth Is Colostrum Fed to New-Born Calves?

	Total Number	Yes		No	
		Number	%	Number	%
From birth to 1 hour	90	28	31.1	--	--
From 1 hour to 4 hours	90	10	11.1	--	--
From 4 hours to 8 hours	90	3	3.3	--	--
After 8 hours	90	14	15.6	--	--
No response	90	--	--	10	11.1

Table 6

Number of Days Colostrum Is Fed to the New-Born Calves

	Total Number	Yes		No	
		Number	%	Number	%
For 1 day	90	23	25.6	--	--
For 2 days	90	15	16.7	--	--
For 3 days	90	22	24.4	--	--
For 7 days	90	18	20.0	--	--
No response	90	--	--	12	13.3

Table 7

New-Born Calf Management Practices to Control Scours

	Total Number	Yes		No		No Response	
		Number	%	Number	%	Number	%
Reduce milk volume	90	9	10.0	57	63.3	24	26.7
Stop milk diet/use electrolyte solutions frequently	90	6	6.7	60	66.7	24	26.7
Electrolytes plus antibiotic injections	90	11	12.2	55	61.1	24	26.7
Powdered Milk	90	9	10.0	81	90.0	--	--
Injections only	90	40	44.4	26	28.9	24	26.7
Remove to proper housing environment	90	24	26.7	42	46.7	24	26.7

Functional Communication and
Transportation Resources

Functional communication and transportation resources are essential to a successful AI program. The survey questionnaire did not inquire into how communication and transportation resources contribute to the success of artificial insemination in Kaduna State, Nigeria. However, the writer did interview the veterinarian who had trained the AI technicians and the Fulani Tribesmen. They confirmed the following:

1. The inseminators visit the herdsman everyday in all of the AI subcenters in Kaduna State;
2. The inseminators are required to live within ten miles radius to his area of work;
3. The inseminators are provided motorcycles by NAPRI on a loan basis. Loan payments eventually result in the inseminator owning the cycle;
4. The local access roads are poorly maintained. If the roads are deplorable, the inseminator may request a Land Rover vehicle from the institute;
5. There is no functional telephone service, especially in the village;

6. Radio is the most widely used communication system, but is not owned by the Fulani Tribesmen.

Conclusion

In Nigeria, functional communication and transportation resources are limited. Nigeria is deficient of telephone service, especially for private use. Telephone calls may require a day to complete, and connections are poor. Therefore, this makes it very difficult for the Fulani Tribesmen to call and make appointments with the AI technician. Without functional communication and transportation resources, the Fulani Tribesmen find it extremely difficult to inform the AI technicians when, how, and where to locate the farms and number of cows in heat. In addition, there is no vehicle capable of providing nitrogen service, semen and breeding supplies for AI operations.

The Fulani Tribesmen are incessant wanderers in search of grass and water for their cattle during the dry and wet seasons. There is no adequate communication and transportation resources to serve the AI need for an effective program in Kaduna State, Nigeria.

Cooperative and
Informed Farmers

The survey inquired into the respondents' herd management practices on their cows. Table 8 shows their responses to herd management practices.

Of the 90 respondents, (see Table 9) 59 (65.5 percent) have dairy cattle herds for more than ten years; 13 (14.4 percent) of them owned a herd less than a year; 17 (7.9 percent) owned a herd between one year and five years; 7 (7.8 percent) between five years and ten years, and 4 (4.4 percent) did not indicate how long they had owned dairy cattle. Seventy-nine (87.8 percent) milked their cows by hand; 8 (8.9 percent) of them milked by machines, and 3 (3.3 percent) did not respond. Thirty-five of the respondents (38.9 percent) were familiar with AI techniques; 51 of them (56.7 percent) were not familiar with AI techniques, and 4 (4.4 percent) did not respond. Thirty-seven respondents (41.1 percent) have taught others how to use AI, and 2 (2.2 percent) did not respond. Of the 90 respondents, 38 (42.3 percent) weaned their calves at six months. Fifty-two of the respondents (57.7 percent) did not indicate at what age their calves are weaned. Sixty-nine (76.7 percent) of the respondents raised their

Table 8

Respondents' Dairy Herd Management Practices

Practices	Total	Yes response		No response	
		Number	%	Number	%
1. Fulani Tribesmen observe heat signs in their dairy cattle	90	57	63.3	33	26.7
2. Fulani Tribesmen use accessory aids for heat detection	90	59	65.6	31	34.5
3. Fulani Tribesmen monitor cow and heifers for time and length of heat periods	90	34	37.8	56	62.2
4. Veterinarians come to location upon request of Fulani Tribesmen	90	35	38.9	55	61.1
5. Fulani Tribesmen work with veterinarians in herd health programs	90	62	68.9	28	31.1
6. Fulani Tribesmen use reproductive records	90	21	23.3	69	76.7
7. This record is used by the Fulani Tribesmen to identify abnormal cycles in dairy cows	90	28	31.1	62	68.9
8. Fulani Tribesmen use crossbreeding in mating their cows	90	50	55.6	40	44.5
9. Is there any significant inbreeding occurring in their cows?	90	51	56.7	39	43.3
10. Fulani Tribesmen use birth date records for their calves	90	33	36.7	37	63.3
11. The method of animal identification used by the Fulani Tribesmen is calling by names	90	55	61.1	35	38.9
12. The Fulani children take major care of the calves	90	43	47.8	47	52.3

Table 9

Respondents' Ownership, Cow/Calf Management, and Practice of AI Techniques and Procedures

	Total	Yes response		No response	
		Number	%	Number	%
1. Number of herds owned for: more than 10 years	90	59	65.5	--	--
2. Less than 1 year	90	13	14.4	--	--
3. Between 1 and 5 years	90	17	7.9	--	--
4. Between 5 and 10 years	90	7	7.8	4	44.4
5. Hand milking	90	79	87.8	--	--
6. Machine milking	90	8	8.9	3	3.3
7. Fulani Tribesmen familiar with AI technique	90	35	38.9	--	--
8. Fulani Tribesmen not familiar with AI technique	90	51	56.7	--	--
9. Fulani Tribesmen taught other how to use AI procedures	90	37	41.1	2	2.2
10. Calves weaned at six months	90	38	42.3	52	57.7
11. Fulani Tribesmen who raised their bull calves	90	69	76.7	--	--
12. Fulani Tribesmen who did not raise their bull calves	90	21	23.3	--	--
13. Fulani Tribesmen who castrated their bull calves	90	39	43.3	--	--
14. Fulani Tribesmen who did not castrate their bull calves	90	51	56.7	--	--

bull calves and 21 (23.3 percent) did not raise their bull calves. Thirty-nine (43.3 percent) of the respondents castrated their bull calves and 51 (56.7 percent) of them did not.

Conclusion

These results infer that the Fulani Tribesmen were willing to learn and understand about artificial insemination, reproductive technology and management practices of a cow. Fulani Tribesmen cooperation and willingness to learn and understand how to breed cows are essential elements for a successful AI program. The Fulani Tribesmen must know how to detect heat in cows, under what circumstances they require veterinarian assistance, should keep reproductive records, should be able to identify their cows by names and also be willing to communicate with the AI technician about what information is needed, when, how, and where. Herdsmen should be willing to cooperate with the AI technician during and after insemination. Herdsmen should cooperate and be willing to attend training classes on different aspects of AI procedures and techniques. Nutrition, sanitary milking practices and close working association with good, well informed, progressive veterinarians is a must for a successful AI program in Kaduna State, Nigeria.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The purpose of this study was to determine the feasibility of increasing the use of artificial insemination (AI) on dairy cattle managed by the Fulani Tribesmen, Kaduna State, Nigeria.

The specific objectives of this study were:

1. To define the present situation of artificial insemination as used by the Fulani Tribesmen, Kaduna State, Nigeria.
2. To determine the elements of a successful artificial insemination system in Kaduna State of Nigeria.
3. To determine if the elements of a successful AI system are functioning in Kaduna State.
4. To determine if artificial insemination of dairy cattle managed by the Fulani Tribesmen in Kaduna State, Nigeria, is feasible.

Findings

Five vital links of an artificial insemination program have been identified (see Figure 1, page 31). There is a difference between the theoretical model of essential

elements of a viable AI program and the actual condition of the dairy cattle managed by Fulani Tribesmen in Kaduna State, Nigeria.

Summary, Conclusions

A viable AI program (for any AI program) includes: (1) high performance bulls with quality semen, (2) skilled, dependable AI technicians, (3) healthy cows, (4) functional communication and transportation resources, and (5) cooperative and informed farmers. If any of these linked essential elements are lacking, the entire AI program fails. The data obtained in this study failed to establish that the five essential elements are in operation for the Fulani Tribesmen in Kaduna State, Nigeria. The Fulani Tribesmen are nomadic and bound by tradition and culture. Therefore, they could not effectively carry on an AI program.

Link Number 1

High Performance Bulls with Quality Semen

The study revealed that there is no available supply of white Fulani semen for AI purposes. The semen used for breeding their cows was purchased by the Nigerian

government from Select Sires, Inc., USA. The purchased semen for dairy breeds does not include the White Fulani breed. There are no bull or cow performance records available on the White Fulani breed in Kaduna State. There are no breed registry associations, private herd records and dairy semen production organizations in Nigeria. The processing of dairy (White Fulani) semen is to be done in the NAPRI laboratory by qualified people who have been trained to collect, process, store, and ship frozen semen. However, due to technical difficulties not made know to the writer, the NAPRI Laboratory is not in operation. Therefore, the only dairy bull semen available is that which is purchased outside the borders of Nigeria. None of that semen includes White Fulani semen. One must therefore conclude that Link Number 1 of the AI Model for a feasible AI system in Kaduna State, Nigeria, needs to be implemented.

Link Number 2

Skilled, Dependable AI Technicians

Based upon the farmers' responses, the writer did not find any conception rate records to imply how skilled the AI technicians were. There was a total lack of record

keeping by the Fulani Tribesmen. The AI technicians were trained by veterinarians. The veterinarians reported to the writer that the AI technicians are well trained. Records are not kept for their actual work to indicate whether or not the AI technicians are doing their AI work properly. The writer is a certified trained inseminator and observed two AI technicians performing their work in a less than desirable manner. The writer, therefore, concludes that the AI technicians need additional training to upgrade their insemination skills. This is something that can be done. However, it is the opinion of the writer that as of the time the study was conducted, Link Number 2 is not in operation. But, it can be made functional if additional training is provided.

Link Number 3

Healthy Cows

As the Fulani Tribesmen are nomadic, the cattle are frequently moved in search of feed. There was little indication of serious health problems for White Fulani dairy cows. The writer observed and was informed that during the dry season, feed supplies are limited.

The questionnaire did not inquire into the specific

content of nutrition for milking cows and dry cows because such information was not available from the Fulani Tribesmen. Their cows survive on native pasture. The survey was designed to collect information on the types of feeding arrangements employed on Kaduna dairy farms. The survey did not deal with pasture quality on a seasonal basis. The survey revealed that cows on native pasture during the climatic dry and wet seasons are not in good nutritional health for breeding purposes. Other diseases such as Infectious Bovine Rhinotracheitis (IBR), Bovine Virus Diarrhea (BVD), Para Influenza-3 (PI-3), Leptospirosis, Brucellosis, Salmonella, and Pasteurella were not known to exist. However, the Fulani Tribesmen are aware of Rinderpest, Anthrax, Trichomoniasis, Tripps and Contagious Bovine Pleura Pneumonia (BPP).

The data revealed that Fulani Tribesmen are familiar with a vaccination program. They have veterinarians vaccinate their animals for Rinderpest, Anthrax, Tripps and CBPP. The writer concludes that Link Number 3 of the AI feasibility model is present in Kaduna State, Nigeria, but needs more inputs for a functional program.

Link Number 4
Functional Communication and
Transportation Resources

The survey questionnaire did not inquire into how communication and transportation resources contribute to the success of AI in Kaduna State, Nigeria. However, the writer did interview the veterinarian who had trained the AI technicians. He indicated that there are no adequate functional communication and transportation resources to serve the AI program in Kaduna State, Nigeria. The writer found, by interview, that some AI technicians and veterinarians do not have vehicles to transport themselves to and from the AI subcenters. They also lack telephone services in their homes to communicate with the farmers. All communication is by personal contact. Data would indicate that functional communication and transportation resources are inadequate and totally absent in some cases. The writer concludes that Link Number 4 of the AI feasibility model is totally lacking in Kaduna State, Nigeria.

Link Number 5Cooperative and Informed Farmers

The survey questionnaire inquired into the respondents herd management practices on their cows. The survey results showed that the Fulani Tribesmen who are nomadic have not had an opportunity to learn and understand about AI reproduction technology and dairy herd management practices. Because they are nomadic and traditional, they could not cooperate in the program. They know little or nothing about AI performance-tested bulls, cow diseases, AI breeding and the role of nutrition in milk production. They are traditionally incessant wanderers in search of grass and water for their cattle. Given these conditions, the writer concludes that Link Number 5 of the AI feasibility model is not functionally present in Kaduna State, Nigeria.

In conclusion, this study has identified several hidden problem areas where further education and research are required. The null hypothesis in this study stipulated that there is no difference between the theoretical model of essential elements of a viable artificial insemination program and the actual condition of the dairy managed by Fulani Tribesmen in Kaduna State, Nigeria. On the basis of study conclusions, the writer found Links Number 1 and 2

are not present, that Link Number 3 was present but needs additional improvement, and Links Number 4 and 5 are totally lacking. The writer, therefore, concludes that there is a difference between the theoretical model of essential elements of a viable AI program and the actual condition of the dairy cattle managed by Fulani Tribesmen in Kaduna State, Nigeria.

Recommendations

Nigeria faces substantial obstacles in its efforts to become self-sufficient in the production of meat and milk products to bring improved welfare to its people. The AI agents are inadequately trained, the AI program lacks effective coordination, administration, and performance testing. Based on the writer's observations, the operating budgets are low, electricity supply is unsteady, travel is restricted because of inadequate supplies of gasoline and maintenance of vehicles.

An integrated approach must be used to solve these problems through information obtained from research and disseminated by extension agents to the settled farmers and Fulani Tribesmen. The application of the linked essential elements identified in the study is needed to make AI

successful in Kaduna State, Nigeria. Recommendations for implementation of the five essential elements follow.

Link Number 1
High Performance Bulls
with Quality Semen

Selected White Fulani bulls should be performance tested in order to verify their genetic abilities to increase milk and meat production. Additional studies should be conducted to verify the results of crossbreeding of White Fulani cows with Holstein, Jersey, or Brown Swiss bulls (exotic dairy breeds) for adaptation to the seasonal climatic conditions and nomadic herd life style. Such factors as heat tolerance, resistance to internal and external parasites, walking ability, water economy and ability to withstand periodic shortages of feed, all need study. If the AI program is to continue, there should be a reliable, adequate source of liquid nitrogen to support the AI program in Nigeria. At present, there is not a domestic reliable, adequate supply. All liquid nitrogen must be imported.

Link Number 2 Skilled,
Dependable AI Technician

Based upon the herdsmen's responses and the writer's observations, the following are recommended:

1. Additional technical AI training be given to the AI technicians to upgrade their insemination skills and knowledge.

2. Proper thawing method of semen, straw insemination procedure, and cattle identification should be intensified. Liquid nitrogen must be handled with care. Quality control and maintenance of supply is a problem area that needs improvement.

3. Breeding records should be kept so that AI technicians' skills and other factors may be properly evaluated.

Link Number 3 Healthy Cows

Feed supplies are limited at certain seasons, and seasonally do not always provide adequate nutrition for production and reproduction. The writer, based on this information recommends:

1. Feed reserves should be established or developed for use during seasonal short supply periods. This will also increase milk production.

2. The Fulani Tribesmen must become less nomadic if they are going to use and benefit from an AI program for their cattle.

3. Evaluation of feed materials and pasture

supplementation, to produce balanced rations for increased milk production and reproduction is recommended.

Link Number 4
Functional Communication and
Transportation Resources

Functional communication and transportation resources are lacking in Kaduna State, Nigeria. The following are recommended:

1. There should be a long-term national livestock development policy and major national commitments for increasing meat and dairy production.

2. Under the current situation, functional communication and transportation resources are non-existent with the nomadic Fulani Tribesmen. The Fulani Tribesmen need to become more settled herdsman with a known location in order to participate in a functional AI program.

3. Synchronization techniques and procedures should be practiced on cows to reduce communication and transportation problems.

Link Number 5 Cooperative
and Informed Farmers

1. A feasibility study on how the nomadic Fulani Tribesmen could be educated about AI is recommended. Only

then will they be in a position to cooperate and use an AI program beneficially.

2. The Fulani farmers should learn and understand the linked essential elements of a viable artificial insemination program for Kaduna State, Nigeria. Additional efforts and commitments needed from the herdsmen can develop if they change from being nomads.

3. The currently settled farmers should learn and understand about AI performance-tested bulls, cow diseases, record keeping systems, AI breeding and the role of nutrition in milk production and reproduction.

4. Farmers' cooperatives and cow testing programs be established to support farmers' goals and AI program needs.

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International Livestock Centre for Africa.

APPENDICES

Appendix A
Survey Questionnaire

UTAH STATE UNIVERSITY LOGAN, UTAH 84322
COLLEGE OF AGRICULTURE

DAIRY PRODUCERS AND HERDSMEN APPLICATION SURVEY

DEPARTMENT OF
ANIMAL DAIRY AND
VETERINARY SCIENCES

March 26, 1985

Dairy Producers and Herdsmen Application Survey

Dear Respondent,

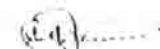
The potential benefits to all from a strong Nigerian dairy industry are tied to its ability to remove the obstacles which hamper its development and the use of modern techniques which create new opportunities for success.

Please take a few minutes and complete this questionnaire. Your contribution will ultimately benefit all Nigerian people through a nation wide ample supply of nutritious dairy products.

Thank you for your assistance in making this project a success. If you have any questions or comments concerning the study, please write to me at the following address:

Animal, Dairy and Veterinary Science Department
College of Agriculture
Utah State University - UMC 4B
Logan, UT 84322 - U.S.A.

Sincerely,


Christian Ojomo
Graduate Student


Ned L. Zaugg
Major Professor
Extension Dairy Specialist

kg

A. General Information

Please provide the following information:

Respondent

Name _____
Title _____
Address _____
Date _____

Farmland

Land measurement (a) Acres
(b) Hectares

Irrigated land _____
Dry land _____
Land in small grains _____
Silage _____
Hay _____
Pasture _____
List specific crops grown _____

B. Directions

Please respond to the following questions by placing a check mark (✓) against the one choice or more than one choice which you consider most applicable in your dairy business.

1. What breed(s) of cattle do you have? (Please indicate crosses)
a. Brown Swiss _____
b. Holstein Friesian _____
c. Jersey _____
d. White Fulant _____
e. Other _____
2. Please indicate the number of dairy cows in milk?
a. Less than 10 _____
b. Between 11 and 20 _____
c. Between 21 and 30 _____
d. Between 31 and 40 _____
e. Between 41 and 50 _____
f. Over 50 _____

Daily Production/cow _____

3. Please indicate the number of dry cows in your herd today.
- a. Less than 10
 b. Between 11 and 20
 c. Between 21 and 30
 d. Between 31 and 40
 e. Between 41 and 50
 f. Over 50
4. How long have you had a milk cow herd?
- a. Less than a year
 b. Between one year and five years
 c. Between five years and ten years
 d. Over ten years
5. What type of feeding arrangements do you have?
- a. Pasture
 b. Drylot plus pasture
 c. Drylot/pasture (seasonal)
 d. Drylot only
6. How do you milk your cows?
- a. Hand milking
 b. Machine milking
7. Milking equipment used
- a. Type _____
 b. Age _____
 c. Last check date _____
8. Do you draw milk samples for analysis on your cows?
- a. Yes
 b. No
9. How frequently is your milk marketed?
- a. Daily
 b. Every other day
 c. Other (please specify) _____
10. Please indicate the breeding method that you use.
- a. Artificial Insemination (A.I.)
 b. Natural
11. If A.I., who inseminates your cattle?
- a. Artificial Insemination Technician
 b. Herdsman
 c. Owner
 d. Other (specify) _____
12. Are you familiar with A.I. techniques?
- a. Yes
 b. No
13. Have you taught others how to use A.I.?
- a. Yes
 b. No
14. If you are now using A.I. what percent of your herd are bred using A.I.
- a. Cows _____ %
 b. Heifers _____ %
15. What signs do you watch for in detecting heat if the cows were not observed mounting or standing to be mounted?
- a. Clear mucus
 b. Swollen genitalia
 c. Ruffled tailhead
 d. Lowered milk production
 e. Other (specify) _____
16. What type of accessory aids if any do you use for heat detection?
- a. Pressure-sensitive device (KaMar, etc.)
 b. Chalk or paint sticks
 c. Chinball markers
 d. None
 e. Other (specify) _____
17. Do you monitor cows and heifers for time and length of heat periods?
- a. Time of day: morning _____ evening _____
 b. Duration of heat: hours _____
18. Against what disease(s) are your cows vaccinated?
- a. IBR
 b. BVD
 c. PI3
 d. Leptospirosis
 e. Brucellosis
 f. Salmonella
 g. Pasteurella
 h. Other (specify) _____
19. Please indicate the number of cows which had the following problems during the last year.
- | | |
|--|--------------|
| <input type="checkbox"/> a. Retained placenta | Number _____ |
| <input type="checkbox"/> b. Difficult calving | Number _____ |
| <input type="checkbox"/> c. Cystic ovaries | Number _____ |
| <input type="checkbox"/> d. Uterine infections | Number _____ |
| <input type="checkbox"/> e. Milk fever | Number _____ |
| <input type="checkbox"/> f. Ketosis | Number _____ |
20. Under what circumstances do you request veterinarian assistance?
- a. During calving
 b. Post calving check
 c. Pre-breeding
 d. Pregnancy check after breeding
 e. Other (specify) _____
21. Do you work with veterinarians and other specialists in developing a herd health program?
- a. Yes
 b. No

22. What form of reproductive records do you use?
 a. A.I. breeding sheets
 b. Calendar (regular 21 day cycle)
 c. Individual cow records
 d. Other (specify) _____
23. You routinely use these records to:
 a. Identify pregnancy check date
 b. Identify low fertility cows
 c. Identify abnormal cycles
 d. Predict due dates
 e. Predict when to dry off
 f. Other (specify) _____
24. What mating system do you use?
 a. Crossbreeding
 b. Linebreeding
 c. Outbreeding (unrelated individuals)
 d. Inbreeding (related individuals)
25. Is there any significant inbreeding occurring?
 a. Yes
 b. No
26. What are the sources of liquid nitrogen in your area?
 a. _____
 b. _____
27. Are these facilities available for storage and shipment of semen?
 a. Yes
 b. No
28. If you use A.I., are the semen doses arranged according to bull identity in the tank?
 a. Yes
 b. No
29. Can you remove a dose of semen from the tank without damage to the others?
 a. Yes
 b. No
30. What type of thawing method do you use?
- | | Thawing Time | |
|---|--------------|-----|
| | Min | Sec |
| <input type="checkbox"/> a. Warm water 95°F or 35°C | ___ | ___ |
| <input type="checkbox"/> b. Ice water | ___ | ___ |
| <input type="checkbox"/> c. Shirt pocket | ___ | ___ |
| <input type="checkbox"/> d. Air thaw (protected with covering? Yes or No) | ___ | ___ |
| <input type="checkbox"/> e. In the cow | ___ | ___ |

31. Has your tank ever run out of liquid nitrogen?
 a. Yes
 b. No
32. If yes, what was done with the semen in the tank? Explain.
33. Do you apply medication to cuts and bruises?
 a. Yes
 b. No
34. Do you routinely trim cow's hooves?
 a. Yes
 b. No
35. Do you treat for internal and external parasites?
 a. Yes
 b. No
36. Do you frequently check the cattle about to calve in your herd?
 a. Yes (how often)
 b. No
37. What type of records do you keep on your calves?
 a. Dam
 b. Sire
 c. Date of birth
 d. Health problems
 e. Veterinary treatments
 f. Other (specify) _____
38. What method of animal identification do you use?
 a. Ear tagging
 b. Tattoo
 c. Sketches or pictures
 d. Branding
 e. Other (specify) _____
39. Who takes major care of the calves?
 a. Owner
 b. Children
 c. Wife
 d. Hired labor
40. Do you dip the calf's navel cord at birth?
 a. Yes (please indicate method used)
 b. No

41. What is the colostrum source for the calves?
___ a. Fresh
___ b. Frozen
___ c. Other (specify) _____
42. How soon after birth is first milk (colostrum) fed to the calves?
___ a. From birth to 1 hr. after birth
___ b. From 1 hr. to 4 hrs. after birth
___ c. From 4 hrs. to 8 hrs. after birth
___ d. Beyond 8 hrs. of birth
___ e. Nurses cow only (length of time left with cow _____ hrs.)
43. Please state the number of days colostrum is fed to the new-born calves.
___ a. One day
___ b. Two days
___ c. Three days
___ d. Other (specify) _____
44. Do you feed powdered milk to the calves?
___ a. Yes (age when first fed powdered milk _____)
___ b. No
45. How do you treat calves with scours?
___ a. Reduce milk volume
___ b. Stop milk diet-use electrolyte solutions frequently
___ c. Electrolytes plus antibiotic injections
___ d. Injections only
___ e. Remove to proper housing environment (clean, dry, draft free, well ventilated individual pens)
46. At what age are calves weaned?
___ a. At two months
___ b. At three months
___ c. At four months
___ d. Beyond four months
___ e. Less than 8 weeks (_____ weeks)
47. Do you raise your bull calves?
___ a. Yes
___ b. No
48. Do you castrate the bull calves?
___ a. Yes
___ b. No

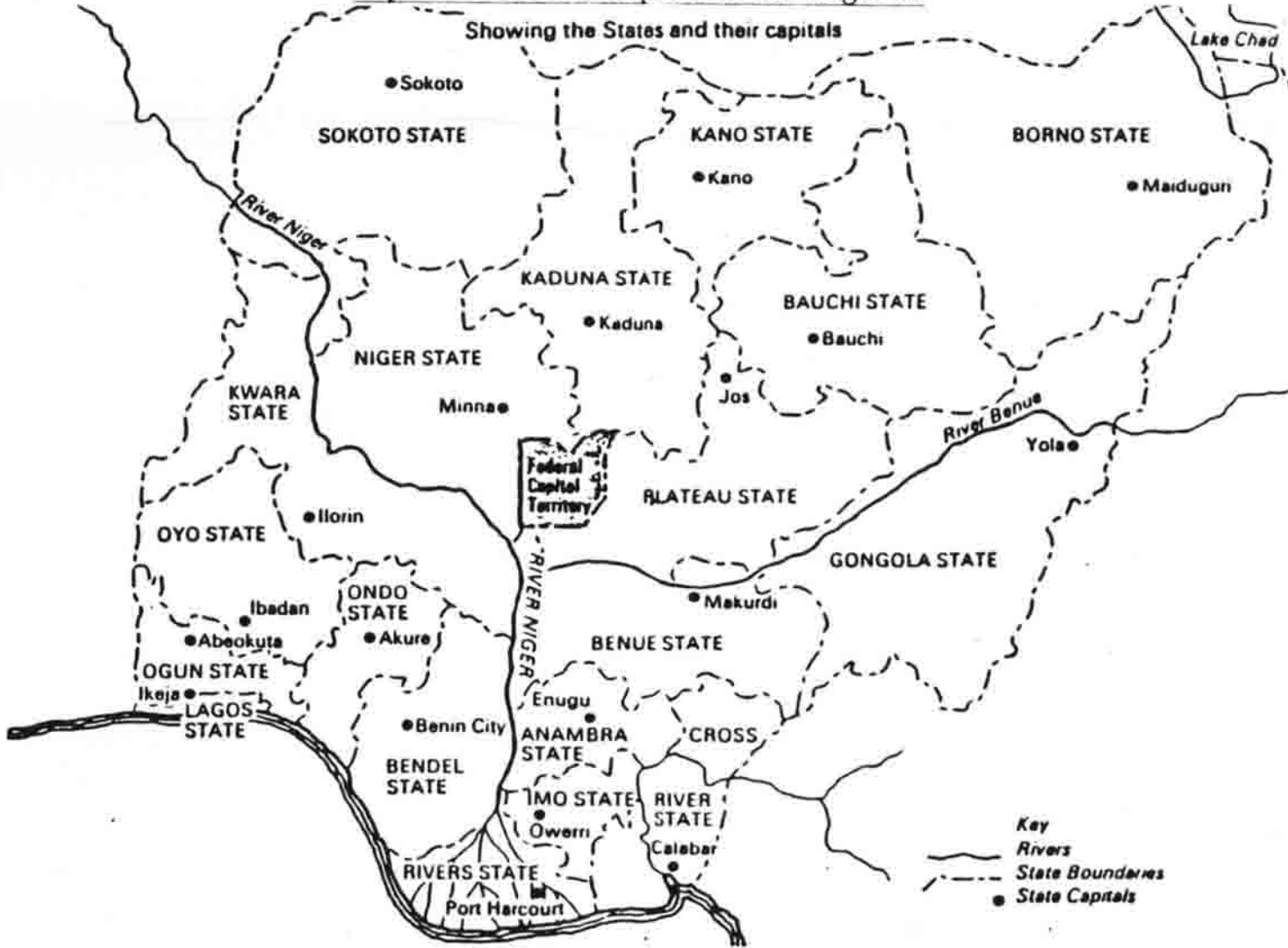
Appendix BList of Abbreviations

AI	Artificial Insemination
NAPRI	National Animal Production Research Institute
USA	United States of America
DHIA	Dairy Herd Improvement Association
PGA	Program for Genetic Advancement
SMS	Select Mating Service
USDA	United States Department of Agriculture
NAAB	National Association of Animal Breeders
CSS	Certified Semen Services
ILCA	International Livestock Center for Africa
ABS	American Breeders Service
IBR	Infectious Bovine Rhinotracheitis
BVD	Bovine Virus Diarrhea
PI-3	Para Influenza-3
CBPP	Contagious Bovine Pleura Pneumonia

Appendix C

Map of Federal Republic of Nigeria

Showing the States and their capitals



THESIS

1987

CHRISTIAN OLAFIMIHAN OJOMO

U.S.U.