# IMPACT OF PRIVATIZATION OF ARTIFICIAL INSEMINATION DELIVERY SERVICES ON THE PRODUCTIVITY OF DAIRY CATTLE IN KENYA: A CASE OF SMALLHOLDER DAIRY FARMERS IN NYERI EAST DISTRICT

BY

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A RESEARCH PROJECT REPORT SUBMITTED IN PARTIAL FULFILLMENT FOR THE DEGREE OF MASTER OF ARTS IN PROJECT PLANNING AND MANAGEMENT OF THE UNIVERSITY OF NAIROBI

2010

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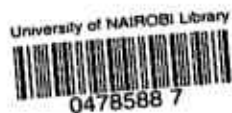
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DECLARATION

This research project report is my original work and has not been presented for a degree in any other university.
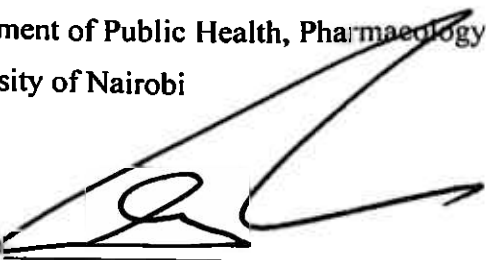
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ACKNOWLEDGEMENT

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ABBREVIATIONS AND ACRONYMS

AI   -   Artificial Insemination

ANOVA -   Analysis of Variance

CAIS   -   Central Artificial Insemination Station

DFID   -   Department of Foreign and international Development

DVO   -   District Veterinary Officer

DVS   -   District Veterinary Service

FAAB   -   Farming as a Business

GDP   -   Gross Domestic Product

KNAIS   -   Kenya National Artificial Insemination Service

KVAPS   -   Kenya Veterinary Association Privatization Scheme

KVB   -   Kenya Veterinary Board

SAPS   -   Structural Adjustment Programmes

SPSS   -   Statistical Packages for Social Scientist

VO   -   Veterinary Office

ABSTRACT

Artificial Insemination service in Kenya has undergone tremendous changes from time it was introduced by the colonial government. At that time it was only available to the to the white farmers who were practicing dairy farming in the white highlands. After independence the government continued offering the service through donor support. Artificial Insemination has been used in large and small dairy and beef herds and its development has contributed to new knowledge on reproduction and fertility level in these animals.

Artificial Insemination service has increased productivity in cattle thus providing livelihood to the growing human population. Increased demand of Artificial Insemination in the country made it difficult for the government to continue with its provision and by 1986 there was a policy change which recommended for cost sharing. This continued until 1991 when the service was privatized though the structural adjustment programme.

The main objective of this study was to investigate the impact of privatization of Artificial Insemination delivery service on the productivity of the dairy cattle of smallholder dairy farmers in Nyeri East district, Central Province. As a result of privatization of Artificial Insemination delivery service which occurred, there were changes in cost, accessibility, challenges of breeding diseases, quality of diary breeds and provision of extension services. This study examined how these changes affected productivity of dairy cattle in the district.

A representation sample dairy farmers in the six locations of the district was selected using stratified sampling technique. A sample of 120 households was obtained using proportionate random sampling from each of the stratum. The impact of privatization of Artificial Insemination delivery service was assessed using qualitative and quantitative research methods. The data which was obtained from the farmers using semi-structured questionnaires was coded and analyzed using descriptive statistics. Secondary data was obtained from the Ministry of Livestock Development monthly and annual reports, related literature review and relevant Journals. The results obtained in the study showed that the cost of Artificial Insemination delivery service increased after privatization and that farmers were willing to pay for the service despite the high cost. The productivity of dairy cattle increased as shown in the increased milk production, and improved calving intervals. Accessibility of the service improved after privatization while more farmers started taking dairy farming as a business enterprise. The findings obtained in the study are useful to the Ministry of Livestock Development and other stakeholders involved in the delivery of Artificial Insemination Service.

CHAPTER ONE

INTRODUCTION

1.1 Background of the study

Human being's dependency on animal products has created continuous demand for the selection of animals to ensure an available supply of meat, milk, eggs and fiber to meet the needs of an ever increasing human population. The selection for productivity through animal breeding is slowed because of the length of the gestation period, time required for animals to reach maturity and need to test for the desirable traits in the off springs.

According to Arthurs (1999) many approaches and techniques such as artificial insemination, estrus synchronization, super ovulation, embryo recovery, gene insertion, twinning and cloning, for enhancing the reproduction capacity and number of offspring have been developed for the last forty years.

In developing countries Artificial Insemination (AI) is widely used for cattle, mainly dairy cattle and to a lesser but increasing extent for other species such as sheep, goats and pigs. Although the immediate result is the impregnation of the females the real benefit of using AI is that it gives all farmers the possibility of gaining from genetic improvement created elsewhere privately or collectively.

In the industrialized world AI is usually implemented in combination with selection programmes including performance and progeny testing ending with the estimation of breeding values of the males which means discarding the less valuable ones and by publishing the indexes allowing the farmers to choose the breeding policy for their herds. Dairy cattle breeding are usually directed towards milk yield, milk composition, quality, longevity and some aspects of conformation. AI is also used to reduce and prevent transmission of breeding diseases which affect productivity of cattle. Some of these diseases include brucellosis which is zoonotic in nature, vibriosis, campylobacter, and trichomoniasis.

In many developing countries numerous projects have been introduced in order to establish AI services and to develop their activities. While establishing facilities for the production and storage of semen is reasonably feasible anywhere, it is far more difficult to implement and efficiently maintain AI field service activities. According to De Haans,C. and Bukere S (1991) most Sub-Saharan economies of Africa, structural reforms occasioned by fiscal crises in the 1980s and 1990s had devastating implications for the delivery of agricultural technologies. This was due to the fact that delivery of these services depended on Government budgeting allocations and so when structural adjustment programmes were introduced budgetary allocations for these services were cut resulting in stagnation or near

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collapse of the services. Animal health services delivery, which was predominantly a Public sector activity, was no exception (Otieno – Oruko et al 2000). With the scaling down of government budgetary allocations the private sectors were expected to take over those services that the government could not adequately provide. Studies have shown that there are strong reasons for privatization and some equally strong reasons against, concerns and fears. (Osborne and Geebler, 1992) showed that each sector (private or public) has relative strengths. Private sector delivery of services is not inherently better or worse than public service delivery.

In the 1970s and 1980s when government was offering AI service delivery system, productivity of dairy cattle was high with improved welfare and nutrition for the human population (Republic of Kenya, 1986). However according to Dickhaus and Dieltz,(2004) after privatization of AI delivery service, productivity of dairy cattle declined. This was attributed to the fact that when the government was offering AI service it had reliable transport and its personnel were well trained, equipped and the service was well programmed but after privatization the AI providers who took over were few, inadequately equipped and had poor financial and managerial skills. The result were changes in service delivery which had implications on the small holder dairy farmers.

1.2 Background to the Problem Statement

Kenya has one of the largest dairy industries in Sub- Saharan Africa with a well developed and processing milk industry, and according to Houlton (2004) the dairy industry is the single largest agricultural sub-sector in Kenya and constitutes some 14% of agricultural GDP and 3.5% of total GDP.

Small holder dairy farmers who are estimated at 1.5m households account for more than 85% of the annual total milk production and 80% of the annual marketed milk (S.J.Staal et al 2001)

Artificial insemination services were introduced in Kenya in 1940's and since 1963 the government provided subsidy to the services through donor support. However these services did not escape the general problems of high operational costs. Despite the support AI delivery service started to decline in 1979 which held the highest number of inseminations of 548,000 to a low of 60,000 inseminations by 1997, (Republic of Kenya,KNAIS annual Report, 1997).

1.3   Statement of the problem

In 1986 the government started cost sharing for the AI delivery service as a result of policy change contained in the sessional paper of 1986 on economic management for renewed growth. In 1991 as part of wider agricultural policy, AI services were privatized through the

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structural adjustment programmes (SAPS) which reduced the role of the government with subsequent impact on the small scale dairy farmer. This research seeks to investigate the impacts of privatization of delivery of AI service on productivity of the dairy cattle in Nyeri East district in central province

1.4   Justification of the study

According to Houlton (2004) the livestock sub-sector contributes to the livelihood of at least 70% of the world's poor. In Kenya, it contributes to 42% of the agricultural GDP and 10% of the total GDP. The sub-sector also employs over 50% of the agricultural labour force in the country.

The sub-sector contributes to household income through sale of livestock and livestock products while at the same time earning foreign exchange. There is therefore need to develop strategies that would lead to improvement of AI service so as to increase incomes from livestock. Dairy farming is important since its products improve the health status of consumers and the farmers besides improving soil fertility through usage of manure derived from cattle waste which boosts small holder crop yield on farms where chemical fertilizers are often unavailable and unaffordable.

Use of exotic cattle genes obtained through AI is a potentially sustainable path to higher productivity in the dairy cattle for the small holder farmers.

This study will investigate the impact of privatization of AI delivery service on the productivity of dairy cattle in Nyeri East district where more than 80% of the residents depend on dairy farming for their livelihoods.

1.5 Objective of the study

1.5.1 Broad Objective

The overall objective of this research was to establish the impact of privatization of artificial insemination delivery on the productivity of the dairy cattle among the small holder farmers in Nyeri East district.

1.5.2 Specific Objectives

The specific objectives of this research was to:-

 Establish the impact of cost on productivity of dairy cattle

Determine the impact of accessibility of AI services on productivity of dairy cattle.

Determine the impact of incidences of breeding diseases on productivity of dairy cattle.

Determine the impact of availability of extension services on productivity of dairy cattle.

1.6 Hypotheses

Ho1 There is no statistically significant difference between the cost of delivery of AI and productivity of dairy cattle

Ho2 Accessibility of AI has no statistical significant relationship with productivity in dairy cattle

Ho3 Breeding diseases in dairy cattle have no significant relationship with productivity.

Ho4 Smallholder dairy farmers' contact with extension service providers has no statistically significant influence on the productivity of dairy cattle

1.7 Significance of the study

This study will add value to the existing literature for researchers on the privatization of veterinary services and how they impact on the farmers. It will also increase the existing knowledge on the use of AI as a means of increasing productivity on the dairy cattle. The study will also provide information to researchers, policy makers, extension agents, dairy farmers and the general public on the performance of the provision of AI services as a private good. Study findings and recommendations will be published in refereed journals, presented in workshops and discussed with officials from the Ministry of Livestock Development.

1.8 Scope of the study

This research was to establish the impacts of privatization of AI service on productivity of the dairy cattle. It focused on impacts of cost, accessibility of the service, availability of extension service, and challenges of breeding diseases on the dairy cattle productivity, while at the sometime focusing on the gender bias for the control of proceeds from the dairy farming bearing in mind that there are other factors that directly or indirectly influence dairy cattle productivity.

The research was conducted in Nyeri East District in Central Province. This is one of the areas with a high concentration of small holder dairy farmers with an average farm size of two acres.

1.9 Delimitation of the study

The high literacy levels in the district is beneficial to the success of this research in that it will not require a lot of persuasion to the dairy farmers to agree to be interviewed and at the same time transport communication is good which makes access to farms fairly easy.

1.10 Limitations of the study

Study limitations are those aspects of a study which a researcher knows may negatively affect the result or generalization of the results but over which he or she has probably no control over. (Mugenda & Mugenda, 2003) The limitations in this study include insecurity in the district which has been going on for the last three months as it can hamper collection of data, poor record keeping by the farmers, and possibly withholding or giving incorrect data and information.

1.11 Assumptions of the study

The assumptions made in this study are that all respondents will understand and answer all questions truthfully, the sample size represents the population, and that data collection instruments are valid and will measure the desired constructs.

1.12 Definitions of Significant terms

Accessibility	That which is readily available reachable or obtainable
Artificial Insemination	Refers to reproductive technique of making a female animal pregnant by introduction of spermatozoa into the vagina or uterus by means other than sexual union.
Biotechnology	Refers to application of biological knowledge to practical needs
Breeds	Refers to a particular type of animal that has been developed by people in a controlled way especially a type of farm animal.
Breeding Diseases	Diseases that affect breeding
Calving Interval	Time between one calving and the next.
Cost of AI	Money paid to have a cow artificially inseminated
Embryo Transfer	Refers to a reproductive technique in which embryos from a donor female are transferred to a recipient female
Extension service	Informal education given to farmers in order to improve on their farming activities
Gender	Refers to either male or female.
Livelihood	A means of living, income i.e. occupation or employment
Livestock	Refers to animals kept on a farm for use or profit.
Policy	Refers to the course of action or plan of action, adopted or pursued by the government, business enterprise or individual.
Population	Refers to a group of intermating individuals
Privatization	Refers to the transfer of ownership of resources and responsibility of services from the public to the private sector.
Productivity	Refers to the capacity to produce or the rate of production.
Selection	Refers to the process that determines which individuals become parents, how many off springs they produce and how long they will remain in the breeding population
Service	Refers to the particular skills or help that a person is able to offer.
Smallholder farmer	Refers to a person who owns a small piece of land for farming
Subsidy	Refer to the money that is paid by a government or an organization to reduce the cost of services or of producing goods so that the prices can be kept low and affordable.

Veterinarian Refers to a person who has been trained in the science of animal medicine whose work is to treat animals that are sick or injured besides managing animals for higher productivity.

CHAPTER TWO

LITERATURE REVIEW

2.1   Introduction

This chapter presents literature review in relation to the objectives of the study. It comprises literature related to, the evolution of animal health care in Kenya, privatization and barriers to access of quality service, the effects of privatization of artificial insemination, the consequences of privatization of AI delivery service and conceptual framework.

2.2 Evolution of animal health in Kenya

During the colonial and immediate post-independence era (Period between 1945 and 1965) animal health services were provided by veterinary officers and veterinary scouts. The veterinary officers were mainly confined in the high potential areas referred to as white settler areas while the veterinary scouts were local livestock keepers who received informal training from local veterinary officers in farmer training centers. The veterinary scouts lived and provided animal health care services in the villages.

In Kenya the provisions of private animal health care services were and still are governed by the Veterinary Surgeons Act (Cap 366) and the Pharmacy and Poisons Act (Cap 244).The veterinary surgeons Act which controls the practice of veterinary medicine was borrowed mostly unchanged from the British Veterinary Surgeons Act. This Act broadly limits the practice of veterinary medicine and surgery to registered veterinary surgeons and staff under their direct supervision. However, in recognition of the fact that many of the commercial farmers of the time provided their own veterinary services there were two clauses allowing anyone to treat their own animals or those belonging to a neighbour provided that it is not for profit.

The Pharmacy and Poisons Act (Cap244) limits the sale of pharmaceuticals, including veterinary pharmaceuticals only to registered pharmacists, however Veterinarians are allowed to keep limited stock of drugs for their own use while treating animals but not for sale.

2.2.1. 1970 -1980: Free Services for All

Seasonal Paper No. 1 (1965) on African Socialism set the stage for massive increase in government livestock services which was free throughout the country and massive investment in veterinary services. Veterinary scouts at village levels were phased out and were replaced by veterinarians and animal health assistants who were based at divisions and locations respectively.

2.2.2. 1980 – 1992: Structural Adjustment Programme

The first signs of change in the livestock sector emerged through a series of research papers in the Ministry of Livestock development in 1982 and 1983 leading to a policy paper on privatization of animal health services. However, this policy was not implemented.

Sessional Paper No. 1 (1986) 'Economic management for renewed growth' set the stage for structural adjustment within government and gradual privatization of public services.

Budget restriction in the agricultural sector began to bite in the late 1980s and the government stopped automatic employment of all animal health professionals in 1989 and froze recruitment in all vacant posts. This period marked the start of privatization of AI through cost sharing method.

2.2.3 Policy Context

Traditionally the Director of veterinary services (DVS) has been the source of policy direction. The DVS gives policy directions in the form of circulars to the field staff that disseminates information to the livestock farmers and the public in general. Various attempts have been made to develop livestock health policies and strategies in the past with little success.

In the 1960s, the Ministry of Livestock enjoyed a high profile in terms of budgetary allocation and good performance but this trend has changed over the years.

The drastic budgetary reduction between 1980 and mid 1990s led to inability of the ministry to implement organizational reform and thus resources were shared across a largely unchanged organization. Budgetary cuts were made in the operational budgets and by late 1980s field services were mostly affected. The Sessional Paper No. 1(1986) 'Economic Management for Renewed Growth' set the stage for structural adjustment, streamlining of government services and privatization.

Although the ministry of livestock had considered some of the issues in a series of research and policy paper in early 1980s (initiated by David Leonard who was an advisor in the ministry) they were not implemented. However structural reforms were pursued in the 1990s under the Agricultural Investment Sector Programme but they had limited success.

According to De Haans C.and Bukere (1991) there was pressure for privatization of animal health service from the World Bank and European Union in the mid 1980s which finally resulted in a project KVAPS (Kenya Veterinary Association Privatization Scheme) which started in 1994. This scheme provided soft loans to veterinarians to help them set up private animal health and improvement practices.

2.3 Effects of privatization

Privatization is encouraged since it assists in re-inventing government, but according to Osborne and Gaebler(1992) privatization is part of the answer because services can be privatized but governance cannot. Government is responsible for ensuring that public services are effective whether or not the services are public or private delivered. Public decision makers are supposed to look at the long term capacity of government agencies to monitor the costs of privatization of services.

Public services are symbolic of the democratic participation of all human beings in society's development. Unrestricted access to public services guarantees that basic rights are protected especially for those who would otherwise be excluded due to excessive cost or exclusive rights of use. Services that are delivered by public means take on dimensions of social equity and democratic control, universal availability, decision making and access to all.

Bakker,(2003) says that privatization of public services involves changes that are closely linked to questions of social equity, equal opportunities and democratic structural possibilities. Considering the nature of privatization its analysis from the perspective of social economic and political significance is important. The effects of privatization of AI were envisaged as a way of re-inventing service delivery by the government.

2.4 Privatization and barriers to access of quality services

Privatization is the incidence or process of transferring ownership of business or service from the public sector (government) to the private sector.

The advantages of privatization include:

Improvement of performance, promotion of competition, promotion of capital market, increase in process of industrialization, improvement of economic growth, increase of service motives and reduction of fiscal burden on government.

According to Parker, David Kirkpatrick, and Colin (2003) privatization is widely promoted as a means of improving economic performance in developing countries. However this policy remains controversial and relative roles of ownership and other structural changes such as competition and regulation in promoting economic efficiency remains uncertain.

If privatization is to improve performance over the long-term it needs to be complemented by policies that promote competition and effective state regulation. Privatization works best in developing countries when integrated into a broader process of structural reform and that's why there is need to make sure that privatization of AI falls under the wider and long term structural reforms.

2.5 Consequences of privatization

Privatization is a way of bringing the advantages of competition and flexibility to the delivery of public services. These advantages include greater efficiency, increased responsiveness to the needs of customers and encouraging innovation. These advantages are more difficult to achieve within a government due to structure on hiring public employments and budgetary issues related to capital expenditures.

While there is clear potential for improved efficiency, privatization also involves risks and requires careful management on the part of the public agency.

To achieve the potential benefits of privatization, public agencies will need to clearly specify the roles of private practitioners determine appropriate cost and develop performance criteria that are tailored to the client population being addressed.

Public agencies need to consider their long-term capacity to structure and monitor privatization initiatives in order to assure cost effectiveness and quality in the delivery of public funded services.

According to Dickhaus and Dietz (2004), privatization has led to a clear reduction in prices in a few of service sectors. This is especially in energy sector in Great Britain and Germany as well as local transport in Scandinavian countries.

However a more detailed analysis reveals the truth about who benefits from the price cuts and to what extent the long-term price reduction can be observed. It was established that while prices within the electric sector dipped by an average of 25%, households could only count on price reduction of about 9% until 2000 (Dickhaus and Dietz, 2004) which shows the low economical individual gain. In the case of privatization of AI the potential benefits would be expected to trickle down to the smallholder dairy farmers through improvement of productivity of their dairy cattle.

2.6 Conceptual framework

Conceptual framework is defined as a set of broad ideas and principles which are taken from relevant fields of enquiry and are used to structure a subsequent presentation. According to Mugenda and Mugenda (1999) conceptual framework refers to a situation where a researcher conceptualizes the relationship between variables in the study and shows the relationship graphically or diagrammatically. In this study the dependent variable will be productivity of the dairy cattle while the independent variables will be the cost, accessibility of AI service, incidences of breeding diseases, and availability of extension services.

Independent Variables		Dependent Variables
Privatization of AI 1. Cost of AI 2. Accessibility of AI 3. Incidences of breeding diseases 4. Availability of extension services	→	**Productivity of dairy cattle** 1. Milk production 2. Calving interval 3. Size of born calves 4. Number of breeding diseases 5 Number of inseminations before conception 6. Contact with extension service provider
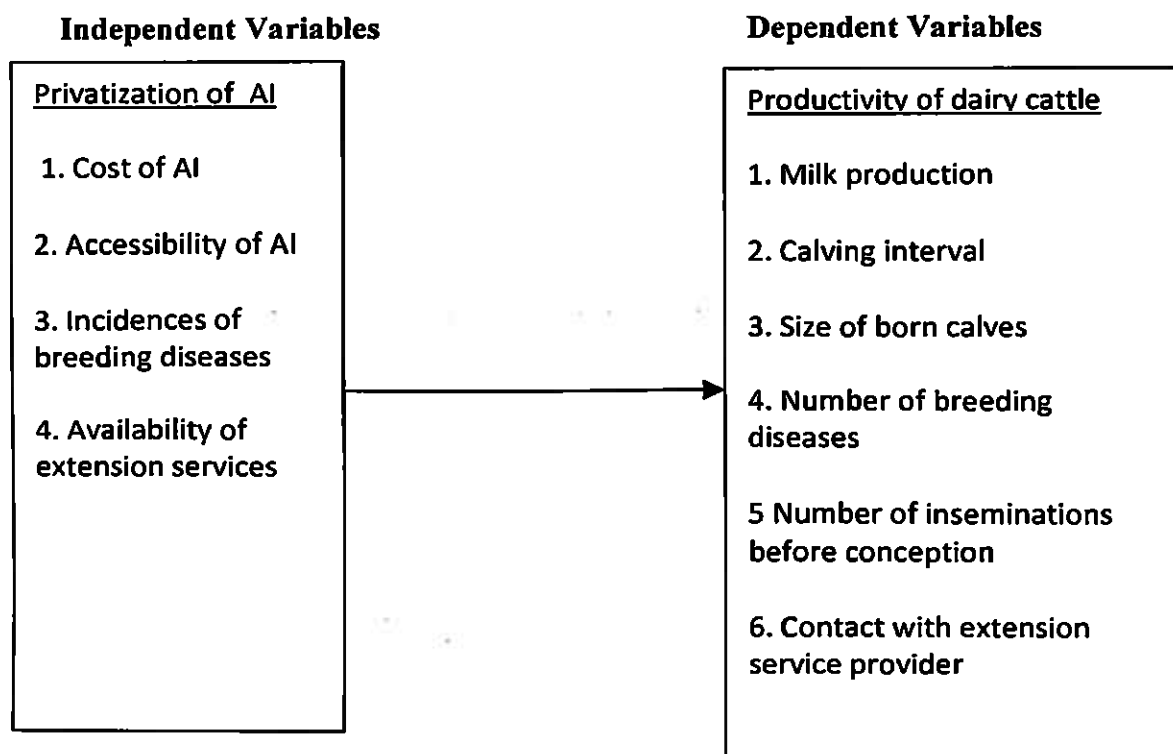
Figure 1.Conceptual Framework

The conceptual framework used in the study shows how the dependent variables are affected by the independent variables and there are multilinear correlations between the independent and dependent variables. The moderating variable is the government policy in place. All artificial inseminations carried out in the country are supposed to be recorded and reported to the Director of Veterinary Services.

The figure below shows the relationship between the independent and the dependent variables

Figure 2.Relationship between Independent and Dependent variable

Independent Variable	Indicators of dependent variable
Cost of AI	• Milk production • Calving interval • Breeding diseases
Accessibility of AI	• Calving interval • Incidences of breeding diseases • Availability of extension services
Incidences of breeding diseases	• Calving interval • Number of inseminations before conception
Availability of extension services	• Milk production • Calving interval • Size of calves • Number of inseminations before conception

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter deals with research design, study area, target population, sample size and sampling techniques, data collection methods and procedures, primary data, secondary data, validity, reliability and data analysis.

3.2 Research design

The research design for this study was an exploratory survey using qualitative and quantitative research methods to determine the impacts of privatization of artificial insemination delivery service in dairy cattle in Nyeri East district. An in depth inquiry was conducted using pre-tested questionnaires to probe for information and where possible got written records. Mugenda and Mugenda (1999) describe a survey as an attempt to collect data from the study population with a view to determining the current status of the population regarding certain variables.

This research methodology was used as it allowed gathering of information, which was thereafter summarized and interpreted for purposes of clarity, it also provided an opportunity to explore the various aspects of the research hypotheses.

3.3 Area of study

The research was conducted in Nyeri East District in Central Province which previously was Mathira division of Nyeri North district. The district is divided into six locations namely Konyu, Iriaini, Magutu, Kirimukuyu, Ruguru and Ngorano locations. It has 36 sub-locations. The district has an area of 257.5sqkm of which 31.5sqkm is arable land with a total of 38,662 households. The average household farm sizes is 0.8ha while the agricultural land per person is 0.21ha.The district has 8 Agro-ecological zones and a population of 150,998 persons with a density of 586persons per sqkm(Ministry of Agriculture, Farm Management Handbook of Kenya, voll 2 ,2007)

3.4 Target population

Population refers to an active group of individuals, events or objects having common observable characteristics, (Mugenda and Mugenda, 2003).The target population for this research were farmers engaged in dairy farming at the time of study. In the study area animals are culturally owned by household heads mostly men except where women are the bonavide household heads. The district has 34,700 heads of cattle (Mature cows

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20, 700, Heifers 3,500, Weaners 7,900, Female calves 3,230) Min of Livestock Development annual report 2007 Nyeri East district). Records from the District Livestock Production office indicated that 19,180 households own a farm which is 49.6% of the total households in the district. Out of this number 16,684 households own dairy cattle. Of these households 95% of them routinely use AI on their cattle. Therefore the target population for this study is 15,849 households.

3.5 Sample size and sampling technique
The research used stratified sampling technique to obtain the sample size for the respondents. The six locations in the district were used as the strata for the purposes of sampling. This was because the population was large and every member belonged to a group while at the same time it was not possible to have a sample frame as records of dairy farmers in the district were scanty. A sample of 120 households was obtained through proportional random sampling from each of the strata. This number of household was deemed adequate as Kathuri and Pals (1993) recommends a sample size of 100 for a survey research. Proportional sampling was done to obtain the 120 households in the ratio they were naturally present in each of the locations

TABLE 3.1: Number of households using AI per location.

Location	No of household using AI	Proportional Representation
Konyu	4,367	33
Iriaini	3,057	23
Magutu	2,619	20
Ruguru	1,790	14
Kirimukuyu	3,187	24
Ngorano	829	6
Total	15,849	120

Table 3.1 shows the number of households using AI service per location in the district and the sample proportional representation.

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3.6 Data collection methods and procedures

The researcher used a Letter of Authorization from the Director of veterinary Services in order to get assistance from Ministry of Livestock Development officers at the district level. Appointments were made with household owners during preliminary visits when the purpose of the study was explained and informed consent obtained. A face to face administration of the questionnaire was made and uniformity in the way of administration maintained.

3.6.1 Primary Data

The data was collected from the farmers, through personal interviews using pre-prepared semi-structured questionnaires.

The questionnaire for the farmers included:-

1. Farmer's bio-data (name, gender, age, level of education and acreage of individual farm sizes)

2. Farm management practices, challenges and constraints faced by the farmers.

3. Cost of artificial delivery service

4. Accessibility of artificial insemination service.

5. Incidences of breeding diseases in the dairy cattle.

6. Quality of dairy cattle and the herd sizes.

7. Availability of extension services to the dairy farmers

8. Milk production

9. Ownership of the income generated from the proceeds of the dairy cattle

10. Labour contribution to the dairy farming enterprise

3.6.2 Secondary Data

Secondary data was collected from the following sources:

1. Annual reports from the Division

2. Annual reports from the District.

3. Annual reports from CAIS (Central Artificial Insemination Station)

4. Annual reports from KNAIS (Kenya National Artificial Insemination Service)

5. Journals of similar research from local and international organizations.

6. Related literature

3.6.3 Validity

To ensure that the instruments accurately measured the variables of interest to the study, each of the items in the questionnaire was discussed with peers, research supervisors and other lectures of Project planning and management, giving attention to the specific study objectives.

3.6.4 Reliability

To ensure consistency of the questionnaires it was pre-tested using a purposive sample of 20 dairy farmers in Kirinyaga west district. The research chose this district as it neighbors Nyeri East district and it has similar agro-ecological conditions as the study area. The number 20 was taken for the pre-test as it is the smallest number that can yield meaningful results on data analysis in a survey research (Kathuri and Pals, 1993)

3.7 Data analysis

After collection of data it was coded and organized using thematic areas for purposes of data entry. This data was then analyzed using descriptive and analytical methods where tables, means, frequencies, standard deviations, pie charts, and percentages were generated for meaningful interpretation of study objectives. Further analysis using computer programmes (Microsoft excel and SPSS) were used. Each of the hypotheses was then restated followed by a presentation of the findings and on the basis of the tests the results were discussed with the hypotheses under test being accepted or rejected. The following were the thematic areas in which collected data was organized into:-

1. Farmers bio-data
2. Farm management practices
3. Challenges and constraints faced by the dairy farmers namely
    i) Cost of AI
    ii) Accessibility of AI
    iii) Incidences of breeding diseases
4. Production by the dairy cattle
    i) Milk production
    ii) Calving intervals
5. Economic status of the dairy farmer
    i) Labour contribution to the smallholder dairy farming
    ii) Gender control and ownership of proceeds from dairy farming

3.8 Operational Definition of Variables

The operationalization definition of variables is given in Table 3.2 below

Table 3.2 Operationalization of Variables

Objective	Variable	Indicators	Scale of Measurement	Type of Analysis
Establish impact of cost of AI	Cost of AI	• Milk production • Calving interval • Incidences of breeding diseases	Interval	Quantitative
Determine impact of accessibility of AI	Accessibility of AI	• Calving interval • Breeding diseases • Availability of extension services	Interval	Quantitative
Determine impact of incidences of breeding diseases	Incidences of breeding diseases	• Calving interval • Number of inseminations before conception	Interval	Quantitative
Determine impact of availability of extension services	Availability of Extension services	• Milk production • Calving interval • Size of calves • Number of insemination before conception	Interval	Quantitative

CHAPTER FOUR

DATA ANALYSIS, PRESENTATION AND INTERPRETATION

4.1 Introduction

This chapter presents the results of the findings based on the objectives stated in chapter one. The first section of this chapter gives description of the socio-economic and demographic characteristics of the smallholder dairy farmers in the area of study which followed by a focus on privatization of delivery of AI service as it affects the productivity of dairy cattle. The data was analyzed using descriptive and inferential statistics.

4.2 Social-economic and demographic characteristics of farmers in the study area

The following variables which included; distribution of the respondents, household characteristics, and land use practices with respect to dairy farming in the study area are presented in this section.

4.2.1 Distribution of respondents in the study area.

Table 4.1 Distribution of respondents

Location	Frequency	Percentage
Konyu	33	27.5
Kirimukuyu	24	20.0
Iria-ini	23	19.2
Magutu	20	16.7
Ruguru	14	11.6
Ngorano	6	5.0
Total	120	100

Table 4.1 shows the distribution of the respondents in the study area with Konyu location having the highest number of respondents at 27.5% while only 5% of the respondents came from Ngorano location.

4.2.2 Household characteristics

Table 4.2 Household characteristics

Gender of Household head	Frequency	Percentage
Male	98	81.7
Female	22	18.3
Total	120	100

Table 4.2 shows the gender of the respondents in the study and finding shows that 82% males participated in the study.

4.2.3 The respondents' age in the study area
Table 4.3 Respondent's Age

Age (Years)	Frequency	Percentage
25 and below	1	0.8
25-34	7	5.8
35-44	22	18.3
45-54	41	34.2
55 and above	49	40.0
Total	120	100

Table 4.3 shows that most of the respondents were 55 years and above with a percent of 40% and that the majority of them were 45 years and above forming 74% of those practicing dairy farming.

4.2.4 Size of the Farms in the study area

Table 4. 4 Sizes of Farms

Size of Farms (Acres)	Frequency	Percentage
Below 1	31	25.8
1-1.9	33	27.5
2-3.9	32	26.7
4-7.9	24	20.0
Total	120	100

Table 4. 4 shows the size of the farms in the study area with 4 Acres and above being 20%. 53.3% of the respondents own land below 2 Acres.

4.2.5 Number of Dairy cattle owned by the respondents

Table 4.5 Number of dairy cattle owned by the respondents

Number of cattle	Frequency	Percentage
1	17	14.2
2	35	29.2
3	30	25.0
4	19	15.8
5	11	9.2
6	2	1.7
7	1	0.8
8	2	1.7
9	2	1.7
10	1	0.8
Total	120	100

Table 4.5   shows the number of dairy cattle that the respondents own. It shows that 0.8% of the respondents own 10 cows while14.2% of the respondents own only one cow. The mean number of cattle owned by the respondents is 3.

4.2.6 Household respondent age and relation to farming practice.

Table 4. 6 Age of household head and farming practice

Age (years)	Dairy	Crops	Both	Total
25 and below	0	0	1	1
25-34	1	0	6	7
35-44	0	2	20	22
45-55	0	0	41	41
55 and above	0	0	49	49
Total	1	2	117	120

Table 4. 6 gives a summary of age of household head and the farming practice done by the different age groups. Despite the difference in age most of the farmers practice both dairy and crop farming.

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4.2.7 Education status of respondents in the study area

Table 4. 7 Education status of respondents

Education	Frequency	Percentage
Primary	33	27.5
Secondary	57	47.5
Post secondary	23	19.2
University	7	5.8
Total	120	100

Table 4.7 shows the educational status of the respondents .All the farmers had primary education and only 5.8% have university education. Majority of the farmers had secondary and above education at 72.5% implying that the literacy levels in the study area is quite high.

4.2.8 Education status of respondents by Gender basis in the study area

Table 4.8 Education status and gender of respondents

Education	Frequency		Frequency	
	Male	Percentage	Female	Percentage
Primary	23	19.2	10	8.3
Secondary	50	41.6	7	5.8
Post secondary	19	15.8	4	3.3
University	6	5	1	0.9
Total	98	81.7	22	18.7

Table 4.8 shows that 62.5% males have secondary and above education while 10.4% females had the same.

4.2.9 Experience in Dairy Farming by the respondents in the study area

Table 4.9 Farmers experience in dairy farming

Years	Frequency	Percentage
5 and below	11	9.2
6-10	23	19.2
11-15	13	10.8
16-20	13	10.8
Over 20	60	50
Total	120	100

Table 4. 9 shows that 50% of the farmers had a dairy farming experience of more than 20 years while only 9.2% had an experience of 5 or less years

4.2.10 Involvement in Dairy Farming by the respondents in the study area

Table 4. 10 Involvement of respondents in dairy farming

	Frequency	Percentage
Wife	11	9.2
Husband	10	8.3
Both	99	82.5
Total	120	100

Table 4.10 shows how the respondents shared out the work in the dairy work in the farm. It is clear that both the wife and the husband were involved in the management of the dairy work, implying that each of them was equally experienced.

4.3 EFFECTS OF PRIVITIZATION OF DELIVERY OF AI SERVICE

This section gives the effects of privatization on the delivery of AI service. The important factors which came into play included; cost of delivery of AI service, accessibility of AI service to the dairy farmers, provision of extension services to the dairy farmers, and incidences of breeding diseases in the dairy herd.

This purpose of this study was to look at how these factors affected the productivity of the dairy cattle.

4.3.1 Cost of AI before privatization as reported by the respondents in the study area
Table 4.11 Cost of AI before Privatization

	Cost (Ksh)	Frequency	Percentage
1.	10	6	5.0
2.	40	26	21.7
3.	50	83	69.2
4.	300	3	2.0
Total		118	98.3

Table 4.11 shows a summary of the charges of AI before privatization. It shows that the charges ranged from Ksh 10 to Ksh 300 with 90.9% of the respondents saying they paid either Ksh 40 or Ksh 50.

4.3.2 Cost of AI after privatization as reported by the respondents in the study area.
Table 4.12 Cost of AI after privatization

	Cost(Ksh)	Frequency	Percentage
1.	500	26	21.7
2.	600	44	36.7
3.	1000	25	20.8
4.	1200	2	1.7
5.	1500	13	10.8
6.	2000	10	8.3
Total		120	100

Table 4.12 gives a summary of the charges of AI service after privatization showing a range of ksh. 500 and Ksh. 2000. .Most of the respondents said that they paid between Ksh. 500 and Ksh1000

4.3.3 Rating of the cost of AI after privatization by the respondents in the study area

Table 4.13 Ratings of cost of AI after privatization

		Frequency	Percentage
1.	Expensive	56	46.7
2.	Very expensive	49	40.8
3.	Exorbitant	15	12.5
Total		120	100

Table 4.13 gives a summary of how the respondents rated the charges of AI after privatization. Most of the farmers rated the charges as either expensive or very expensive with a total percent of 87.5% while those who thought it was exorbitant were 12.5%.

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4.3.4 Accessibility of AI service by the respondents in the study area

Table 4.14 Comparison of Accessibility of AI

		Before		After	
		Frequency	Percentage	Frequency	Percentage
1.	Inaccessible	29	24.2	13	10.8
2.	Accessible	36	30	59	49.2
3.	Very accessible	54	45	47	39.2
Total		119	99.2	119	99.2

Table 4.14 shows how accessible AI was before and after its privatization in the study area. The respondents rated accessible and very accessible before privatization at 75% while after privatization it was rated at 88.4% for the same, showing a slight improvement.

4.3.5 Calving interval of the dairy cattle as reported by the respondents in the study area.

Table 4.15 Comparison of Calving intervals

Calving interval	Before		After	
(Years)	Frequency	Percentage	Frequency	Percentage
1	29	24.2	76	63.3
2	51	42.5	36	30.0
3	21	17.5	1	0.8
Over 3	15	12.5	3	2.5
Total	116	96.7	118	98.3

Table 4.15 shows the calving intervals before and after privatization .It shows that calving interval improved after privatization with only 3.3% reporting a calving interval of three and above years as compared to before privatization when it was 30% for the same number of years.

4.3.6 The breeding diseases in the dairy cattle in the study area
Table 4.16 Incidences of breeding diseases

	Before		After	
	Frequency	Percentage	Frequency	Percentage
Repeat breeders	80	66.7	102	85
Abortions	13	10.8	6.0	5.0
Difficult breeders	25	20.8	11	9.2
Total	118	98.3	119	99.2

Table 4.16 gives a summary of the nature of breeding diseases before and after privatization of AI. It shows that repeat breeders were more than either abortions or difficult breeders for the two periods. However there was an increase in the number of repeat breeders after privatization which was reported at 85% as compared to before at 66.7% while abortions and difficult breeders decreased.

4.3.7 Conception rates of the dairy cattle in the study area
Table 4.17 Conception rates

	Before		After	
	Frequency	Percentage	Frequency	Percentage
Once	27	22.5	56	46.7
Twice	35	29.2	26	21.7
Thrice	28	23.3	13	10.8
More than three times	28	23.3	24	20.0
Total	118	98.3	1 19	99.2

Table 4.17 gives a summary of the number of inseminations before and after privatization. It shows an increase in the number of cattle having a repeat insemination of only once at 46.7% after privatization as compared to repeats before privatization with a percent of 22.5%.

4.3.8 The types of extension service provided in the study area
Table 4.18 Types of extension services

	Before		After	
	Frequency	**Percentage**	**Frequency**	**Percentage**
Breeding/AI	74	61.7	43	35.8
Feeding	13	10.8	26	21.7
Housing	6.0	5.0	6.0	5.0
Pest and Disease control	23	19.2	24	20
FAAB	1	0.8	18	15
Total	117	97.5	117	97.5

Table 4.18 gives a summary of the characteristics of extension service before and after privatization. It shows that breeding/AI, feeding, housing, pest and disease control were the major extension areas both before and after privatization. However farming as a business (FAAB) picked up after privatization with 15% as compared to 0.8% before privatization. On the other hand there was a big drop in breeding/AI after privatization at 45% compared with 61.7% before privatization.

4.3.9 Sizes of Calves born by the dairy cattle in the study area is
Table 4.19 Sizes of calves

	Before		After	
	Frequency	**Percentage**	**Frequency**	**Percentage**
Large	28	23.3	108	90
Small	88	73.3	8	6.7
Total	116	96.7	116	96.7

Table 4.19 shows the sizes of calves born before and after privatization. It shows that there was an increase in the size of calves born upon privatization with 90% of the farmers reporting an increase in size of calves after privatization as compared with 23% before.

4.3.10 Milk Production by dairy cattle after privatization of AI
Table 4.20 Milk production

	Frequency	**Percent**
Increased	97	80.8
Decreased	11	9.2
No change	9	7.5
Total	117	97.5

Table 4.20 shows the trend of milk production after privatization of AI service. There was an increase in milk production after privatization with 80.8% of the respondents reporting an increment in milk production.

4.4 Hypothesis Testing

The rest of this chapter presents the test results at confidence interval of 95% and a p-value of less than 0.05 for each of the null hypothesis of the study. It's then followed by a discussion and an explanation for the findings. Statistical Package for Social Sciences (SPSS) for windows, version 15 was used to test each of the hypotheses as per the specific study objectives.

4.4.1 Effect of cost of AI on the productivity of dairy cattle.

It was noted that the cost of AI increased after privatization and therefore it is important to establish if there was any influence that cost had on productivity of the dairy cattle.

This study undertook to establish the effects of cost of delivery of AI and its influence on the productivity of dairy cattle in the study area in line with first objective. Productivity of the dairy cattle was measured in terms of milk production, calving intervals and incidences of breeding diseases. The hypothesis under test was that:-

Ho1: There is no statistically significant difference between the cost of delivery of AI service and productivity of dairy cattle in Nyeri East district. To test this hypothesis an analysis of variance (ANOVA) at 95% confidence interval and p-value of 0.005 was done to see if there was any relationship between the mean cost before and after privatization of AI and:-

1. Milk production

2. Calving intervals

3. Incidences of breeding diseases.

The following results were obtained.

Table 4. 21 Effects of cost of AI on milk production

	Mean cost Before (sd)	mean cost After)(sd)	p-value
Milk production			
Increase	55.5 (11.9)	872.2 (468)	0.001
Decrease	52.9 (4.5)	1000 (173.2)	
No change	42.9 (2.9)	900 (135.4)	

Table 4.21 shows the effects of cost of delivery of AI on milk production. It shows that there was a significant association between cost and milk production with a p-value of 0.001.As the cost of AI rose so did the production from the dairy cattle.

Table 4. 22 Effects of cost of AI on calving interval

	Mean cost Before(sd)	Mean cost After(sd)	p-value
Calving interval			
1 year	53.8 (9.0)	852.6 (51.9)	
2 years	49.4 (5.2)	930.6 (80.6)	0.001
3 years	59.5 (12.1)	2000 (_)	
Over 3years	48.7 (0.9)	733.3 (133.3)	

Table 4. 22 shows the effects of cost of delivery of AI on calving intervals. It shows that cost had a significant association on the calving interval with a p-value of 0.001.It implies that farmers were more keen to make sure that they got back better returns from the investments that they had done. The calving intervals improved significantly to between one and two years with the rise in cost of AI service. The implication of this is that the farmers were becoming keener in the dairy farming. This leads to improved productivity by the dairy cattle .The impact of this to the farmer is more calves and more milk leading to improved livelihood.

Table 4. 23 Effects of cost on breeding diseases

	Mean cost(Before)	sd	Mean cost(After)	sd	p-value
Incidences of breeding diseases	54.5	5.5	887.3	46.3	0.025
Repeat breeders					
Abortions	47.7	1.2	950.0	261.7	
Difficult breeders	46	1.7	827.0	100.0	

Table 4.23 shows the effects of cost of delivery of AI on the incidences of breeding diseases. It shows that there was no association between costs the incidences of breeding diseases with a p-value of 0.025.

4.4.2 Effect of accessibility of delivery of AI service on productivity of dairy cattle.

The study undertook to evaluate the relationship between accessibility of delivery of AI and productivity of dairy cattle in the study area. This was in line with the second objective of the study, for which the null hypothesis under test was that:-

Ho2: Accessibility of AI service has no statistical significant relationship with productivity of dairy cattle.

A chi-test at 95% confidence interval and a p-value of 0.005 was done to test if there was any association between accessibility of AI and:-

1. Calving interval
2. Breeding diseases
3. Extension services

Table 4.24 Association between Accessibility of AI and calving interval before and after privatization

	Accessibility of AI		p-value
Calving interval(Years)	Before	After	0.001
1 - 2	71	103	
≥ 3	18	0	
Total	89	103	

Table 4.24 shows association between accessibility of AI and calving interval. It shows that there is an association between accessibility of AI and the calving interval with a p-value of less than 0.001.As accessibility improved the calving interval improved to between one and two years. This means more calves were being born implying that productivity of the dairy cattle was improving.

Table 4.25 Association between Accessibility of AI and Breeding Diseases

Breeding Diseases	Before	After	p-value
Increased	26	20	0.104
Decreased	54	73	
Total	80	93	

Table 4.25 shows association between accessibility of AI and breeding diseases before and after privatization. The p-value is 0.104 which means there is no association between accessibility of AI and breeding diseases.

Table 4.26 Association between accessibility of AI and extension services before and after privatization

	Accessibility of AI		p-value
Extension services AI	Before	After	
Yes	60	40	<0.001
No	27	64	
Total	87	104	

Table 4.26 shows association between accessibility of AI and extension service.

There is association between accessibility of AI and extension service with a p-value of less than 0.001. As more farmers were able to access AI with the provision of more extension service. This means that more cattle got pregnant resulting in more calves and more milk which are factors of productivity in dairy cattle. Based on the findings of the study, the null hypothesis that there is no association between accessibility of AI and productivity of dairy cattle in Nyeri East district is rejected. This implies accessibility of AI has an association with productivity of dairy cattle in Nyeri East district.

4.4.3 Effect of breeding diseases on the productivity of dairy cattle

The study undertook to investigate the effects of breeding diseases on the productivity of dairy cattle in the study area. This was in line with third objective of the study, for which the null hypothesis under test was that:-

Ho3: Breeding diseases in dairy cattle has no significant relationship with their productivity.

A chi-test with 95% confidence interval and p-value of 0.005 was done to test if there was any relationship between breeding diseases and:-

1. Calving interval

2. Number of inseminations before conception.

The following results were obtained.

Table 4.27 Association between incidences of breeding diseases and calving intervals before and after privatization

	Incidences of Breeding Diseases(repeat breeders)		p-value
Calving interval	Before	After	
1 - 2	59	98	<0.001
≥3	20	1	
Total	79	99	

Table 4.27 shows association of incidences of breeding diseases and calving interval.

It shows that there is association between the incidences of breeding diseases and the calving interval with a p-value of less than 0.001. It was observed that calving interval increased to more than two years with an increase in the breeding diseases. This is as would be expected as breeding diseases affect conception.

Table 4.28 Association between Breeding diseases and number of Inseminations before conception before and after privatization

	Incidences of Breeding Diseases(repeat breeders)		p-value
Inseminations	Before	After	
Once	22	48	0.007
More than once	58	54	
Total	80	102	

Table 4.28 shows association between incidences of breeding diseases and number of inseminations before conception. The p-value of 0.007 was obtained meaning there is no association between the number of inseminations before conception and the incidences of breeding diseases.

4.4.4 Effect of extension service on productivity of dairy cattle

According to Balten and Staal (2000) farmers' use of AI service is explained by access to complimentary services like extension and veterinary services and also to market access of their products. Extension service acts as complimentary service to AI as it teaches the farmers how and when to detect heat so that insemination takes place at the right time.

The level of contact of the households had with extension services was evaluated against the productivity of the dairy cattle in the study area which was in line with the fourth objective of the study. The hypothesis under test was that:-

Ho4: Smallholder dairy farmers' contact with extension service providers has no statistically significant influence on the productivity of dairy cattle.

A chi-test at 95% confidence interval and p-value of 0.005 was performed to test if there was an association between contact of farmers with extension service and:-

1. Milk production

2. Calving interval

3. Sizes of calves born

4. Number of inseminations done before conception

The following results were obtained.

Table 4.29 Association between Extension services and Milk production before and after privatization

	Extension Services		p-value
Milk production	Before	After	
Increased	16	34	<0.001
Decreased	51	3	
Total	67	37	

Table 4.29 shows association between extension service and milk production. It shows that there is association between extension service and milk production with a p-value of less than 0.001.As farmers contact with extension service improved milk production increased. This implies that extension services messages especially FAAB and feeding assisted farmers to maximize on their investments thus leading to increased milk production.

Table 4.30 Association between Extension services and Calving interval before and after privatization

	Extension Services		p-value
Calving Interval	Before	After	
1 – 2	56	40	0.008
≥ 3	17	1	
Total	73	41	

Table 4. 30 shows association between extension service and calving interval

A p-value of 0.008 was obtained meaning there was no association between extension service and calving interval. This is reflected in the drop in the number of farmers receiving breeding /AI extension messages.

Table 4.31 Association between Extension services and Calf Sizes before and after privatization

	Extension Services		p-value
Calf Sizes	Before	After	
Large	22	38	<0.001
Small	41	3	
Total	63	41	

Table 4. 31 shows association between extension service and calf sizes.

It shows that there is a strong association between extension service and calves born with a p-value of less than 0.001.This means that farmers were getting extension messages especially feeding thus better nutrition for the cattle. Better health for the pregnant cattle means larger calves born.

Table 4.32 Association between Extension services and number of Inseminations before conception before and after privatization

	Extension Services		p-value
No. of Inseminations	Before	After	
1 – 2	40	28	0.865
≥ 3	23	15	
Total	63	43	

Table 4.32 shows association between extension service and number of inseminations before conception. A p-value of 0.865 was obtained implying there is no association between the number of inseminations before conception and extension service. This implies that the extension messages provided were not geared towards breeding/AI which is reflected in the drop in number of farmers getting breeding /AI extension messages.

Based on the findings of the study the null hypothesis that smallholder dairy farmer's contact with extension service providers has no influence on productivity of dairy cattle in Nyeri East district is accepted.

CHAPTER FIVE

SUMMARY OF FINDINGS, DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This study examined the factors affecting productivity of dairy cattle in Nyeri East district with a view to finding possible explanations for the observed changes in their productivity since privatization of AI service was introduced in 1991.

This chapter highlights the major findings based on the objectives of the study, conclusions drawn from the findings, followed by recommendations to policy makers, extension service providers, implementers of the privatization programme, dairy farmers and researchers.

5.2 SUMMARY OF MAJOR FINDINGS

A summary of the major findings based on the objectives of the study is given below.

Table 5.1 Summary of major findings.

Objective.	Main Findings
Objective 1 To establish the impact of cost of AI on productivity of dairy cattle	• .There is a significant association between cost of AI and milk production. As the cost of AI went up milk production from the dairy cattle increased. • Cost had a significant association on the calving interval. The calving intervals improved significantly to between one and two years with the rise in cost of AI service
Objective 2 To determine the impact of accessibility of AI services on productivity of dairy cattle	• There is an association between accessibility of AI and calving interval. As accessibility improved the calving interval decreased to between one and two years. • There is an association between accessibility of AI and extension service. More farmers were able to access AI with increased contact with

	extension service providers.
Objective 3 To determine the impact of incidences of breeding diseases on productivity of dairy cattle	• There is an association between incidences of breeding diseases and the calving interval. The calving interval increased with increase in breeding diseases.
Objective 4 To determine the impact of availability of extension services on productivity of dairy cattle	• There is an association between extension service and milk production. Milk production increased as contact with extension service providers improved. • There is an association between extension service and size of calves born. The size of calves born increased as contact with extension service providers improved.

5.3 DISCUSSION

The study showed that the land size of most of the respondents was below two acres and they practice mixed farming with an average of three cows per household. This therefore means that there is intensive farming in the study area. A study done by Chupin and Schuh (1992) found that livestock are an important source of nutrients for crop production in all mixed farming system. Increased integration between crops and livestock in smallholder mixed systems is one of the major pathways out of poverty. Improved livestock husbandry and manure management practices can improve land productivity leading to more nutrition for the dairy cows. This is another economic benefit linked to crop and livestock integration in a homestead and reduction in transaction costs for each enterprise.

According to Balten et al (2004), high levels of education are correlated with high returns from dairy farming among smallholder dairy farmers in Kenya. With education comes high chances of the farmer getting access to information regarding how best to increase on dairy productivity. The study showed that majority of the respondents (72%) in the district had secondary and above education implying that literacy levels in the study area are high. The success of privatization of AI service could hence be attributed to the high literacy levels in this study area.

The study showed that both the wife and the husband are involved in the management of the dairy cattle implying that each of them is equally experienced. In a rural setting like in the study area, it is not easy to decide on the owner of the livestock production system. Ownership is not a simple or indivisible concept but a bundle of characteristics. The head of the family and others have to be involved in decision making regarding the livestock. This means that even if the house head owns the dairy cattle, other family members are directly involved in the dairy enterprise. A study by Hefferman et al (2000) shows that government often supported by the donor community handled the totality of livestock from disease control, AI, clinical service and diagnostic service. However in recent years and after introduction of structural adjustment programmes, government veterinary services have been forced to respond to a variety of changes. At the farm level production has shifted away from subsistence to a more commercial orientation. Consequently services have had to change from the herd to the individual animal. Equally and perhaps more fundamental is that there has been a trend towards the privatization of veterinary services over the past decade. This implies that every member of the family has to be involved in the dairy enterprise.

The reason for using AI service in a dairy industry is maintaining or upgrading breeding stock for optimal milk production as milk is the main source of income. While the main cost of animal production is dependent on female production, reproduction and growth of the young, and according to Joel Ira Weller (1998) the success of Artificial Insemination within a breeding programme depends upon several factors some of which include:- Accuracy of estrus detection, semen quality, fertility of sires and dam, and the expertise of AI technician .Estrus detection is one of the major factors controlling conception rates with AI. For dairy cows the goals are to achieve an estrus detection rate of 85% within a 24hour day period of observation. The only acceptable way to assess estrus is to note when the cow stands to be mounted and generally this period ranges from 10-24hours after the cow begins to stand. The length of estrus averages 17.8hours in dairy cows and 15.3 hours in dairy heifers. AI is most successful when performed from mid-estrus up to a few hours after end of estrus. (Mc Donalds, Veterinary Endocrinology and Reproduction)

To achieve optimal milk production therefore means reducing the calving intervals, and repeat breeders while controlling breeding diseases so as maximize on the conception rates. The study showed that despite the cost of AI service increasing, milk production went up but at the same time there was an increase in the incidences of breeding diseases and repeat breeders. It therefore means that the increase in milk production could be as a result of intensification of the dairy farming as there was an increase in the number of respondents taking dairy farming as a business enterprise.

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5.4 CONCLUSIONS

This study showed that privatization of Artificial Insemination in Nyeri East district led to increased cost in service delivery, and increased milk production from the dairy cattle. Accessibility of the Artificial Insemination service to the dairy farmers improved and the calving interval decreased to less than three years. The number of farmers taking dairy farming as a business enterprise also went up significantly which meant that the farmers realized that there are benefits of doing dairy farming as a business enterprise.

5.5 RECOMMENDATIONS

The following recommendations were made from the study in order to improve on the gains made on the privatization of Artificial Insemination delivery service:-

1. A review of the policy for privatization of AI services should be done in order to maximize on the benefits that accrue from it usage.

2. Extension services should be improved and emphasis placed on farming as a business as it was established that the services assisted the dairy farmers in improving the productivity of the animals.

5.6 SUGGESTIONS FOR FURTHER STUDIES

The suggestions for further studies are given below:

1. Further studies should be done in high potential areas in the country in order to triangulate the results of this study.

2. Studies on the impact of privatized Veterinary Clinical Services should be done as it also affects productivity of dairy cattle.

3. Studies on other complimentary factors which support the dairy sector eg marketing of milk or control of tick borne diseases should be done in order to establish how these factors affect productivity of dairy cattle.

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APPENDICIES

Appendix 1: LETTER OF INTRODUCTION

<div align="right">
Paul Marigi Waichinga

Private Bag, Kabete

00625 Kangemi

Nairobi
</div>

Dear Respondent

Re: **Research on Impact of Privatization of Delivery of Artificial Insemination on Productivity of dairy cattle in Kenya: A case of Smallholder Dairy Farmers in Nyeri East District.**

I am a student of University of Nairobi, School of Continuing and Distance Education undertaking a MA degree course in Project Planning and Management. I am doing a research on the above subject which is in partial fulfillment for my degree course.

I have selected you as a respondent in my research with the aim of getting your opinions about the impact that privatization of artificial insemination has on the productivity of dairy cattle in Nyeri East district.

The information that you provide will treated confidentially and for academic purposes only. Kindly respond to all the questions as honestly as possible and seek clarification where any question might not be clear.

Thank you for your cooperation

Yours faithfully,

Paul Marigi Waichinga.

Appendix 2: QUESTIONNAIRE FOR SMALLHOLDER DAIRY FARMERS.

Your household is among several dairy farms randomly selected in Nyeri East district for a study of impact of privatization of delivery of AI services on the productivity of dairy cattle. The study aims at finding out your opinion about the impact that privatization of AI services has on productivity of your dairy cattle. I would be glad to get your responses, please do not hesitate to ask clarification on any questions that may not be clear to you.

Kindly respond to all the questions as honestly as possible. The information obtained through this study is for academic purposes only and it will be treated with utmost confidentiality.

SECTION A: FARMERS BIO-DATA

1. Location...

2. Name ....

3.   Gender   Male   ☐   Female   ☐

4.   Age   below 25 years ☐   45 – 55 year   ☐

            25 – 35 years   ☐   above 55 years ☐

            35 – 45 years   ☐

5. Education   Primary Certificate   ☐   Post secondary   ☐

            Secondary   ☐   University   ☐

SECTION B: FARM MANAGEMENT PRACTICES

6.   Farm holdings in acres   below 1   ☐   2 – 4 ☐

                        1 – 2 ☐   4 -8   ☐

7.   What farming practice do you do?

      Dairy farming   ☐Crop farming   ☐ Both crops and dairy farming ☐

8   How many dairy cows do you have?

      Of these how many are:-

9.   Bulls...........................

10. In milk ....

11. Dry ....

12. Under one year old.................

13. Between one and three years old...............

14. Between three and six years old..............

15. Above six years old............................

16. For how long have you been a farmer?

0 – 5 years ☐　11– 15 years　☐　　16 – 20 years ☐

6 – 10 years ☐　20 and above　☐

17. Do you receive extension services?

Yes ☐　　　　　　　　No ☐

18. What extension services and farming messages were you receiving before privatization of AI service?

Breeding/A.I. ☐　Feeding ☐　Housing　☐

Pest and disease control ☐　Farming as a business ☐

19. What extension services and farming messages were you receiving after privatization of AI service?

Breeding/A.I. ☐　　Feeding ☐　　Housing ☐

Pest and disease control ☐　Farming as a business ☐

20. From whom were you receiving the extension messages from before privatization?

Government staff　　　☐

Private practitioners　　☐

Other farmers　　　　☐

Mass media　　　　　☐

21 From whom were you receiving the extension messages from after privatization?

Government staff　　☐

Private practitioners　☐

Other farmers　　　☐

Mass media　　　　☐

22. From who would prefer to get extension messages? Please state your preference.

....

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23 .Which area of extension service would you badly need.....................................

SECTION C: CHALLENGES AND CONSTRAINTS FACED BY SMALL HOLDER DAIRY FARMER: Cost:

24. What were the charges for AI service before privatization?

....

25. What were the charges for AI service after privatization?

....

26. How would you rate the cost of AI service after privatization?

    Expensive ☐   Very expensive ☐   Exorbitant ☐

27. How do you meet the cost of A.I.?

    Pay cash promptly   ☐

    Get credit from practioner/or self help group   ☐

    Postpone the insemination until when you get money   ☐

    Accessibility of AI:

28. How would you rate accessibility of AI service before and privatization

    Inaccessible   ☐

    Accessible   ☐

    Very accessible   ☐

29. How would you rate accessibility of AI service after privatization?

    Inaccessible   ☐

    Accessible   ☐

    Very accessible   ☐

30. Has accessibility of AI service providers affected productivity of your

    Dairy cattle?

    Yes ☐   No ☐

31. If yes, how has accessibility of AI service affected the productivity?

    More milk production ☐   Low milk production   ☐

    No change   ☐   Long calving intervals ☐

45

32. Are you aware of other breeding technologies?

Yes ☐ No ☐

33. If yes which are those technologies?

a) Embryo transfer ☐

b) Estrus synchronization ☐

c) Gene insertion ☐

d) Cloning ☐

e) Sexing ☐

34. Do you have a breeding goal?

Yes ☐ No ☐

35. Who selects bull semen for your cows?

No selection is done at all ☐

I select the bull semen on specific basis ☐

The inseminator does it for me ☐

36. Do you keep any breeding records?

Yes ☐

No ☐

37. If yes are your cows registered with the Kenya Stud Book

Yes ☐ No ☐

Incidences of breeding diseases:

38. Comparing the periods before and after privatization of AI service what
Were the incidences of breeding diseases which affected production of?
Your dairy cattle before privatization.

Repeat breeders ☐

Abortions ☐

Difficult breeders ☐

39. Comparing the periods before and after privatization of AI service what
Were the incidences of breeding diseases which affected production of?
Your dairy cattle after privatization.

Repeat breeders ☐

Abortions ☐

Difficult breeders ☐

40. Comparing periods before and after privatization how would you rate
The number of insemination before conception in your dairy cattle
before privatization?

Once ☐

Twice ☐

Thrice ☐

More than 3 times ☐

41. Comparing periods before and after privatization how would you rate the
Number of insemination before conception in your dairy cattle after
Privatization?

Once ☐

Twice ☐

Thrice ☐

More than 3 times ☐

42. Comparing the periods before and after privatization of AI service what has been the
incidences of breeding diseases in your dairy cattle after privitization?

Increased ☐   Remained the same ☐   Decreased ☐

43. What would you attribute this to?   Use of bulls   ☐

Irregular use of AI service   ☐

Quality of dairy breeds:

44. What type of breeds are you aware of?

a) Ayrshire ☐

b) Guernsey ☐

c) Friesian ☐

d) Jersey ☐

e) Cross-breed ☐

45. What breeds of dairy cattle were you keeping before privatization of AI?

Service?

....

46. What breeds of dairy cattle were you keeping after privatization of AI service?

....

47. Indicate the preferred breed before privatization of AI service.

....

48. Indicate the preferred breed after privatization of AI service.

....

49. Please state why you prefer that kind of breed

....

....

SECTION D: PRODUCTION OF THE DAIRY CATTLE

50. How would you rate the milk produced by your dairy cattle before

Privatization of AI service?

Increased   ☐

Decreased   ☐

Remained same   ☐

51 How would you rate the milk produced by your dairy cattle after

Privatization of AI service?

Increased   ☐

Decreased   ☐

Remained same   ☐

52. How much milk were your cattle producing per day before privatization?
Of AI in the first three months of lactation?

a) 5 liters and below ☐

b) 5-10 liters ☐

c) 11-15 liters ☐

d) 15 liters and above ☐

53. How much milk are your cattle producing after privatization of AI in the First three months of lactation?

a) 5 liters and below ☐

b) 5-10 liters ☐

c) 11-15 liters ☐

d) 15 liters and above ☐

54. What would you attribute the change in milk production to?

....

....

....

55. Comparing the period before and after privatization, what is the calving interval in your dairy cattle before privitization?

1 Year ☐

2 Years ☐

3 Years ☐

Over 3 Years ☐

56. Comparing the period before and after privatization, what is the calving interval in your dairy cattle after privatization?

1 Year ☐

2 Years ☐

3 Years ☐

Over 3 Years ☐

57. What would you attribute the calving interval in your dairy cattle to before privatization?

Irregular use of AI ☐

Availability of AI ☐

58. What would you attribute the calving interval in your dairy cattle to after privatization?

Irregular use of AI ☐
Availability of AI ☐

59. Comparing the period before and after privatization of AI service, how would you rate the size of calves born by your dairy cattle before privatization?

Large sizes ☐
Small sizes ☐
No charges ☐

60. Comparing the period before and after privatization of AI service, how would you rate the size of calves born by your dairy cattle after privatization?

Large sizes ☐
Small sizes ☐
No changes ☐

61. What would you attribute the change in size of the calves before privatization of AI service?

Availability of AI ☐
Non-availability of AI ☐
Irregular use of AI ☐

62. What would you attribute the change in size of the calves after privatization of AI service?

Availability of AI ☐
Non-availability of AI ☐
Irregular use of AI ☐

SECTION E: ECONOMIC STATUS OF THE DAIRY FARMER

63. Who is directly involved in the dairy farming?

    Wife   ☐   husband   ☐

64. Comparing the periods before and after privatization is there a change in

    The control in the dairy farming between the wife and the husband?

    Yes   ☐   No   ☐   Both ☐

65. If yes please state the changes that have occurred

    ....

66. Comparing the periods before and after privatization of AI service how would rate the control of proceeds from the dairy herd before?

    More by the husband   ☐

    More by wife   ☐

    No Changes   ☐

67. Comparing the periods before and after privatization of AI service how would rate the control of proceeds from the dairy herd after?

    More by the husband   ☐

    More by wife   ☐

    No Changes   ☐

68. What would you attribute the changes in the control of the proceeds

    From the dairy cattle to before?

    Increased returns   ☐

    Decreased returns   ☐

69. What would you attribute the changes in the control of the proceeds from the dairy cattle to ?

    Increased returns   ☐

    Decreased returns   ☐