Capstone Practicum Report **(20%)**

INCREASING THE SUCCESS RATE OF CATTLE ARTIFICIAL INSEMINATION FOR GIRINKA BENEFICIARIES IN HUYE DISTRICT, RWANDA

By

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Submitted in Partial Fulfillment of the Requirements for the

Master of Science in Global Health Delivery

University of Global Health Equity

Capstone Practicum

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Date: May 16th 2018

DECLARATION

I, **Nancy SIBO**, hereby declare that the practicum capstone thesis has been written by me without any external unauthorized help, that it has been neither presented to any institution for evaluation nor previously published in its entirety or in parts. Any parts, words, or ideas in the thesis, however limited, that are quoted from or based on other sources, have been acknowledged as such without exception.

Signature: Nancy SIBO Date: May,16th ,2018

DEDICATION

This research project is affectionately dedicated to my beloved parents, brothers and sisters for their kind love and support, friends and colleagues.

ACKNOWLEDGEMENT

The achievement of this practicum emanates from the intervention of several people to whom I make a point of thanking.

My sincere thanks to my supervisor Sylvia T. Callender-Carter, for her guidance, advice and devotion during this research project.

Cordially, I am grateful to the University of Global Health Equity (UGHE) faculty members for their support, knowledge and the skills they provided me with.

I hold to express also my sincere gratitude to both the farmers and Huye District Veterinary Office for their good collaboration during my data collection period.

My gratitude is finally expressed to all whose names are not mentioned but whom, of near or by far, contributed to the realization of this research.

ABSTRACT

Background: Dairy farmers in Rwanda face numerous challenges in their production levels related to low Artificial Insemination success rate. Due to poor knowledge on heat period detection. It is apparent that those beneficiaries do not have the ability to track the estrous period of their cows to maximize their cows' potential. Their ability to detect exactly when their cows are on heat can help increase success of artificial insemination. If they miss out this period, they lose out on income from milk and the nearest family also miss out the calf.

This study aimed to increase the artificial insemination success rate among Girinka beneficiaries in Huye district from 40% to 60% by April 2018.

Method*:* A training was provided to 74 GIRNKA cattle farmers in in Huye district. The two-day training focused on heat period detection, estrus cycle and manifestation of cows in heat period.

Results: The overall average knowledge on cattle estrus cycle significantly increased from 37.16% pre-intervention to 92.34% post-intervention (P= 0.008 and CI= 0.50, 0.61). All six questions about the knowledge of participants showed significant increase statistically, with the knowledge of estrus cycle having the biggest increase in knowledge score from 31% pre-intervention to 95.9% post intervention, 65% improvement (P<0.001, CI= 0.53, 0.77). The smallest increase in knowledge score was related to knowledge on heat period of cows, increased from 55.4% pre-intervention to 98.65% post-intervention, 43% improvement (P <0.001 and CI= 0.31, 0.55). The AI success rate significantly increased from 44% pre-intervention to 58.7% post-intervention (P<0.001, CI = 12.20%, 16.77%).

***Conclusion**:* Training farmers on heat period detection, estrus cycle and manifestation of cows in heat period can increase the success rate of AI and is recommended to provide the same training to other GIRNKA beneficiaries.

Keywords: Artificial insemination (AI), estrus, cattle, heat detection.

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CHAPTER ONE: INTRODUCTION

1.1 Background

The economy of Rwanda is largely based on agriculture and farming; with 47% of the gross domestic product (GDP) coming from agriculture and 12% from livestock production (Kayigema, 2014). Apart from contributing to the country's GDP, livestock production also fuels the socio-economic well-being of the population (Rwanda Food Security, 2011). In Rwanda, 39.1% live below the poverty line and 16.3% live in extreme poverty (NISR, 2015). In Rwanda livestock production is a main source of income contributing to poverty reduction (Rwanda Food Security, 2011). In addition, milk and meat products from livestock are an important source of dietary protein as about 44% of Rwandan children suffer from stunting (Musaili et al., 2015; Rwanda Food Security, 2011).

A Government of Rwanda program, Girinka, was introduced in 2006, to reduce poverty and childhood malnutrition in rural areas by providing poor people with dairy cows (Musaili et al., 2015). Between 2006 and 2012, more than 198,000 households' beneficiaries have received cows from Girinka (Kayigema, 2014). These cows have contributed to an increase in milk production that has helped to reduce malnutrition and increase income (Mudingu,2017). However, the long-term success of these farmers is greatly determined by the rate of successful insemination of the cows since the estrus cycle of cows happens only once a month (John, 2009). Currently, the success rate of insemination of cows varies between 40% and 45% (Rwanda National Dairy Strategy, 2013).

1.2 Problem Statement

The success rate for artificial insemination of improved cattle breeds provided to families in the Girinka program in the Huye district is low.

1.3 SMART Practicum Objective

The overall objective of this study is to increase the artificial insemination success rate among Girinka beneficiaries in Huye district from 40% to 60% by April 2018.

1.4 Justification of the project

1.4.1 Setting

Huye district is home to the center of AI research and genetic improvement owned by the Rwanda Agriculture Board (RAB) (Mazimpaka, 2017). This center has the objective of training AI inseminators and to conduct research on how to improve genetic material of cattle breeds in Rwanda (RAB, 2016). Between 2006 and 2016, 9,698 cows were given through the Girinka program in Huye (RAB, 2016) and each sector of the district has one trained AI inseminator (MINAGRI, 2015). In 2016, the RAB reported the AI success rate in Huye district was estimated at 44%.

1.4.2 Beneficiaries

This project's results will have direct and indirect beneficiaries. The direct beneficiaries include the farmers who have received a cow from the Girinka program and also the other poor communities who will benefit from the calves that are born. These farmers will receive the training of this intervention to increase their knowledge capacity in the cattle estrus duration, cattle estrus signs and cattle estrus detection techniques. The knowledge and skills acquired will increase the success rate, therefore improving their economic livelihoods and providing

numerous other benefits such as reduced AI repetition and the neighboring family will benefit for the new born calf.

The indirect beneficiaries are the academic community, which will benefit from the research outcomes through online publication in scientific journals. Additionally, once published, information from this study can be used as teaching materials so that learners will benefit from the study findings.

The RAB will be informed through reports regarding the intervention and the proposed recommendations with the ability to increase the overall success of the Girinka program.

1.5 Description of each chapter in the report

This study is currently divided into six chapters.

Chapter one is composed of the background of Rwanda's livestock situation and Artificial Insemination (AI) success rate. It includes the problem statement, the project objectives, and justification of the project.

Chapter two is the project literature review of the AI, this part describes the historical background of the AI, the situation of success of AI Worldwide as well as of Rwanda. Furthermore, it talks about the factors affecting the success of AI in Rwanda which include factors associated with farmers knowledge, Inseminators associated factors.

Chapter three provide the description of the methodology used in the project which includes the project setting, project design, the sample population with the inclusion and exclusion of criteria and it explains the variables considered in the project. The procedures of data collection, data management, data analysis and ethical consideration of the project are also described in this chapter.

Chapter four gives an account of the project results by providing the descriptive statistics, the paired t-test with explicit tables.

Chapter five describes the discussion of the results obtained in the project. It compares the findings in other research projects with what was found in this project. It continues to talk about the project challenges during the project development, implementation and reporting.

Chapter six provides the conclusion of the project and recommendations of the project findings.

CHAPTER TWO: LITERATURE REVIEW

2.1 Bovine Artificial Insemination

Artificial insemination (AI) was arguably the first great biotechnology innovation dealing with animal reproduction and animal breeding (Foote, 1999).

The first scientific research on the use of AI in domestic animals' dates back to 1780 by the Italian scientist Lazanno Spalbanzani (Salisbury et al., 1978; Parish, 2016). The development of AI raised knowledge level of the animal reproduction industry over the subsequent centuries (Foote, 2001; Verma et al., 2012) .

In the 1940s, there was a significant increase in the market of genetically sound animals in the US, which led to a phenomenal growth of the AI technology (Gordon, 2004). One of the procedures developed in US is bovine AI, and has been adopted worldwide (Salisbury et al., 1978; Foote, 2001;Dalton, 2011). AI in cattle (or Bovine AI) is a process by which ''sperm is placed into a female cattle's uterus or cervix at proper time using artificial means and with the intention of impregnating the female cattle with good genetics from the bull'' (Foote, 1992; Morrell, 2011). The application of bovine AI has brought enormous economic benefits because it contributes to the reduction of sexual transmissible diseases, improvement in milk production and reduction of recessive genes (Noguera et al., 2013).

The benefits of AI can be understood with a One Health perspective. "One Health is the integrative effort of multiple disciplines working locally, nationally, and globally to attain optimal health for people, animals, and the environment" (Musoke et al., 2016). AI helps to reduce the cost of maintenance of breeding bulls, to prevent the spread of infectious diseases like contagious abortion and vibriosis that can be transmitted from cattle to fish and to human,

and to minimize sterility due to genital diseases. It is also environmental friendly because it reduces the amount of grasses and forage needed to feed the bulls that would otherwise be used for insemination (CAB, 1999; Rensis et al., 2003; Hansen, 2013).

Moreover, AI can also enable the early detection of inferior or sterile males, thus, allow better breeding efficiency through regular quality checking after collection (Stevenson, 1997

; Rodriguez, 2012) .

2.2. Success of Artificial Insemination Worldwide

In the early nineties approximately 60% of dairy cows in the US were artificially inseminated, with a 84% success rate, and 90% were artificially inseminated in European countries such as Denmark, Holland and England, with a success rate of 92% (Magyar, 1991).

On the other hand, low income countries, AI success rate is still facing some challenges to be at the ideal rate of 75% as recommended by the FAO (FAO,2005). A study conducted over a period of two years in Bangladesh showed that AI was an important technique for economic growth of famers in both dairy and beef production industries (Shamsuddin et al., 1998; Uddin et al., 2014). However, only 40% of cows were artificially inseminated in Bangladesh and the success rate was only 53% (Shamsuddin et al.,1998; Gofur & Bhuyan, 2015). Studies suggested that constraints limiting the success of AI in Bangladesh were prolonged postpartum interval between calving, nutritional condition of the cow at calving and thereafter, weaning age of calves, frequency of suckling, cattle rearing system, accuracy of heat detection, interval between estrus, the estrus signs detection and semen quality (Shamsuddin et al.,1998; Uddin et al., 2010).AI was first introduced to Ethiopia in 1938 as a tool for genetic improvement; the application of AI to cattle was interrupted due to Second World War (Yemane et al., 1993;

Zewdie et al.,2006; Jemal, 2012). A 10-year retrospective study in Ethiopia showed the average AI success rate was about 56% (Ashebir, 2016), and the government of Ethiopia demonstrated improvement in dairy production and livestock management (Moard, 2007; Jemal &Lemma, 2015). The two main constraints faced by farmers in Ethiopia are the lack of laboratories to handle semen and failure to watch heat period on cows (Samre et al., 2015).

2.3 Artificial Insemination in Rwanda

In Rwanda, AI started in the 1990s (NISR, 2013).The service was interrupted during the 1994 Genocide and was resumed in 2001 when the country renovated its agriculture framework (MINAGRI, 2004; Chatikobo, 2009). At that time, 65% of bovines in Rwanda were of local race, and their milk production and nutritive value were low (MINAGRI, 2004).

In 2006, the president of Rwanda initiated the Girinka program to give one dairy cow to a poor family (Argent et al., 2013). The main objective of Girinka is to fight against malnutrition and it is an income generating opportunity (Mudingu, 2017). Any Rwandan family which is among the first category of Ubudehe as per Rwanda's economic classification and possesses a piece of land that can be used to cultivate grass is eligible to the program (Kayisanabo, 2014). So far, the Girinka has reached over 259,087 families while the target was 350,000 families by 2017 (Mudingu, 2017).

Through the bovine AI program, semen was imported from Holstein and Jersey varieties, with the goal of genetic improvement (MINAGRI, 2015 ; Argent et al., 2013). As farmers realized the improved breeds could bring in more revenue, the demand for AI increased (RAB, 2012). In 2007, a semen collection center (Masaka Bull Station) was set up in Rwanda to collect, store and distribute semen (MINAGRI, 2013). The AI industry in Rwanda is not market competitive, as

the government is providing mandatory training on the use of AI kits to AI providers with no cost (Klapwijk et al., 2014). Once these providers complete training, Rwanda Agriculture Board (RAB) integrates them into district or sector offices, making them government employees (RAB, 2012).

The prices farmers pay for AI services depend on the quality of the semen and the AI provider (Ilse et al., 2006; Oliveira et al.,2013). Semen can be divided into three general categories: ordinary, super and extra-super(FAO, 2005). Ordinary is the cheapest semen from local breeds, this type of semen is unproven and is not distributed in Rwanda; Super is genetically tested and proven semen; it is higher in quality and is being used in Rwanda and Extra-super is the sexed semen which gives 95% accuracy that the calf will be a female; the semen are imported from other countries to be distributed in Rwanda (Parker et al., 1999; DeForest, 2011;Hirwa et al., 2017).

2.4 Factors affecting the success of Artificial Insemination in Rwanda

The profitability of AI is dependent on the success rate of AI (Dahlen, 2015).There are many factors affecting the success of AI, in which the RAB and the Rwanda college of Agriculture in 2015 have identified the main factors associated with the low success rate of artificial insemination and were categorized into farmers associated factors and inseminator associated factors (RAB, 2015, Nishimwe et al., 2015).

2.4.1. Factors Associated with Farmers Knowledge

The farmers' ability to detect heat is crucial to the success of AI (Heres et al.,2011). Heat detection is the most limiting factor in an AI program (Nishimwe et al., 2015). Heat is the period when cows can conceive and thus is the best time for successful AI (Amann et al., 2000; Nebel, 2014). Farmers who fail to detect the heat will significantly reduce the success rate of AI (Chandel & Pushpa, 2014). A study in Rwanda showed heat detection is the primary factor affecting the success rate of AI; accurate detection of heat can increase AI success rate by 38% (Chatikobo et al., 2009). A similar study conducted in Tunisia showed that by improving farmer's knowledge on heat detection, the success rate of AI increased by 15%; and in turn contributed to significant increase in revenue due to calves and milk production (Salem & Khemiri, 2008; Nebel, 2014).

Due to such importance, farmers are advised to observe cows for heat signs at least three times a day (in the morning, afternoon and late evening) for a total of 20 minutes a day (Amann et al., 2000; Nilsson, 2010). In order to help manage heat/reproduction and reduce the economic loss due to missed heat, farmers are advised to learn to observe and record the pre-heat, standing heat and post-heat signs (Hansen, 2013; Hansen & Aréchiga, 1999; Noguera et al., 2013).

Pre-heat signs are when the cow presented restlessness, separation from herd, ear movements, attempts to mount others, clear mucus, reduced milk production and bellowing (Jalil et al., 2015). Standing heat signs included the cow stand still when mounted, clear and copious mucus, vulva enlarged, rests head on back of other cows and tail head roughened (Hiremath et al., 2009).The post-heat signs happen usually 2-3 days after the start of heat and include cows move away when mounted, tired and lying while others graze and clear or bloody mucus on tail

or legs (Hansen, 2013; Hansen & Aréchiga, 1999; Noguera et al., 2013). Farmers who can successfully detect these heat signs can enhance the timing, and success, of AI (Nebel, 2014).

2.4.2. Inseminator Associated Factors

Other than farmers' ability to detect heat, there are factors related to inseminators that affect the success of AI.

2.4.2.1. Semen Source, Semen Handling and Insemination Techniques

Proper handling of high-quality semen is another factor to promote successful AI (Gebre et al., 2007). The quality of semen can be compromised during collection, handling, freezing, storing, thawing or insemination (Lamb, 2007;Murage & Ilatsia, 2011). Certified Semen Services (CSS) labs have strict quality-control standards for semen processing and monitoring, therefore are usually more reliable source of semen (Salamon and Maxwell, 1995b; Joost et.al, 2010). Studies have shown semen quality could be four times better when shipped from CSS companies compared to from other sources (Amann et al., 2000; Parker et al., 1999; Van & Webb, 2013).

2.4.2.2. Skills of the Inseminator

The experience and technique of inseminators play a role in the success of AI (Jane A Parish, 2010). Professional technicians are more successful at insemination than inexperienced owners or managers (Dejarnette, 2016; RAB, 2013). Although the insemination process is simple to understand, it does require considerable manipulative skills, and less experienced inseminators generally have lower conception rates (FAO, 2005).

During insemination, a portion of semen is retrieved from a tank, and the remaining semen in the tank can easily be damaged if not handled properly (Perry et al., 2011). Similarly, thawing the semen, loading the AI gun, and manipulating the gun through the cervix to deposit semen in

the uterine body could all be potential steps for inexperienced inseminators to cause damage to the semen (Cohlen & Ombelet, 2014).

2.4.2.3. Availability of Inseminator

Heat detection is important in AI as putting semen in a cow that is in heat with proper timing is critical (Boujenane & Boussaq, 2014). Frozen-thawed sperm can survive approximately 20 to 24 hours in the female reproductive tract, thus it is important to make sure AI was conducted at the right time to ensure the fertile life of sperm and egg overlap (Ilatsia, 2011). As the heat only lasts for 48 hours, the availability of inseminator is critical to ensure proper timing of AI (Foote, 2001;Vickers, 2014).

The following figure shows the ideal timing of insemination during the heat (Foote, 2001a). Even if the farmer can correctly identify heat, if inseminator is not available during the best time to inseminate, the success rate may be reduced (Ombelet & Robays, 2015).

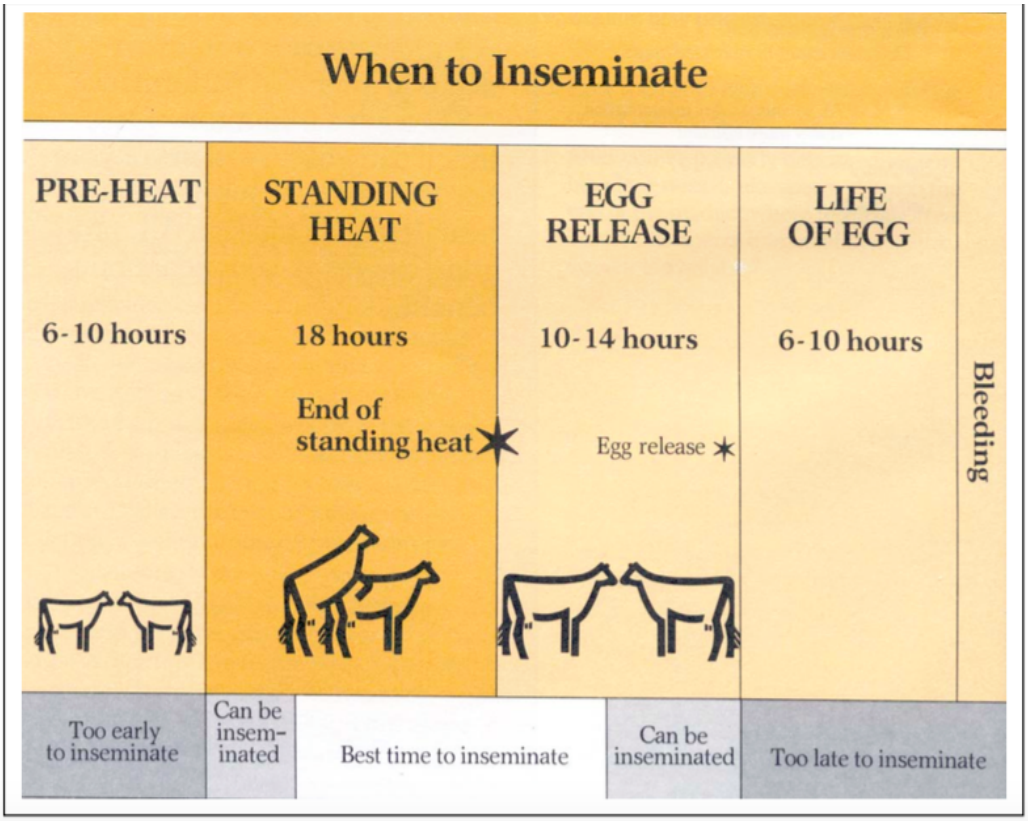

Figure1 : Schematic Illustration of the timeline of best time to inseminate (Huyin, 2008)

In summary, bovine AI plays an important role in improving cattle breeds genetically, reducing sexually transmissible diseases, and enhancing cost effectiveness. The cost of raising a bull can be reduced by up to 60% if using AI (Eklundh, 2013).

In Rwanda's Huye district, the average success rate of AI is 44%, lower than the FAO recommended 75% (Chandel & Pushpa, 2014). Very few studies were conducted in Rwanda to investigate the farmer's knowledge of heat detection. Accordingly, this project proposes to study if providing training to cattle Girinka farmers in Rwanda on heat detection could increase the AI success rate.

CHAPTER THREE: METHODOLOGY

3.1 Setting

Huye district is one of eight districts in the Southern province in Rwanda. There are two main inseminator centers in the district: one in Songa and one in Rubona. There is also a district veterinary laboratory to help with semen storage and the diagnosis of animal diseases; it serves as a capacity-strengthening hub for farmers (RAB, 2016). Approximately 69% of households in Huye raise some type of livestock, with 48% raising cattle (NISR, 2013).

Among all the cattle, 20% were provided by the Girinka program (RAB, 2013),about 67% of cattle farms utilized AI in 2014 and 2015, with AI success rate of 44% (Makuza, et al, 2016).

The sector inseminators are responsible for the AI process in Huye. They were trained by the RAB and report to the district veterinary officer (RAB, 2016). Once farmers realize that their cows are in heat, they call the sector inseminator to come inseminate their cows (MINAGRI, 2015). The sector inseminator records the date of the AI to monitor and assess if the success of AI (MINAGRI, 2015; Nishimwe et al., 2015). In case the AI is not successful, farmers are advised to continue to check the next estrus cycle of their cows in order to repeat the AI (Argent et al., 2013).

3.2 Design

This project used a pre- and post-intervention study to investigate the effect of providing training to farmers on cattle estrus signs detection efficiency on the success rate of AI in Huye district.

Baseline AI success rate data was collected from the Rwanda Agriculture Board through the District Veterinary Office before the intervention and the post intervention data was collected

three weeks after the intervention for a period of two months, with two regular visits a week to AI success rate collect. This information was being collected in order to estimate the post-intervention AI success rate. Additionally, the intervention was provided in November of 2017 and that district has not yet delivered the results of AI success rate for that time frame, so that they can be accessed form the RAB database.

3.3 Sample

The study population included all farmers who received a cow from Girinka program and participate in AI in Huye area.

Inclusion criteria was that the participants had to:

- Be Rwandan by nationality
- Have received at least one cow from Girinka
- Be living in Huye district
- Provide informed consent
- Never received previous training on estrus detection

Sample size calculation

n =$\frac{N}{1 + N^* (e)2}$ (Yemane, 2004)

N= the population size (412 Girinka beneficiaries' farmers in Huye)

n=sample size

e=the acceptance sampling error (10%)

n =$\frac{412}{1 + 412 * (0.1)2}$= 80.4~80 Participants

Interval= $\frac{N}{n} = \frac{412}{80} = 5.15 \sim 5$

During the study, 74 participants were selected to receive the two-day training.

3.4 Measures

In this project data of the study population were provided from the RAB dataset of the Girinka beneficiaries through the Huye district officer. Within this data the following independent variables were extracted.

Table 1: Table explicating the study measures

Independent variables	**Explanation**
Farmers location	They were all living in rural, as of national demographic living classification (NISR, 2015)
Sex	The sex of farmers. They were either male or female.
Economic level	It is the economic status of the farmers. It is indicated by poor class, middle class and rich class. In the context of Girinka every beneficiary of the Girinka is classified in poor class.
Age	The age of the farmer.
Number of female cows possessed as per September 2017	The number of female cows possessed.
Number of cows inseminated per farmer	It corresponds to the total number of inseminated cows at every insemination date.
AI Success rate before the intervention	This is the percentage of the success of AI as per September 2017, before the intervention.

3.5 Data collection tools and method

3.5.1. Data collection tools

The RAB routinely measures the AI rate among the Girinka beneficiaries. This project's investigators obtained the pre-intervention success AI rates from the RAB through the District Veterinary Office. The information obtained included:

- Number of cows inseminated per farmer at every insemination date
- Number of successful inseminations

To assess the farmers' actual knowledge of heat detection techniques, pre-and post-training tests were given to all farmers' trainees (appendix 2. The tests were developed based on the materials developed for smallholder dairy farmers by the International Livestock Research Institute (ILRI). The questions were related to heat detection; the final score was presented as a percentage correct answers out of the total number.

3.5.2 Data collection method

A list of all Girinka beneficiaries (412 beneficiaries) was provided by the district veterinary office after investigators submitted a request. Beneficiaries who met the inclusion criteria were sampled from the list using segmented sampling. The pre- intervention data on AI success rates were collected only for those who attended the intervention training from the RAB through the DVO. The post-intervention data on AI success rate were collected 21 days after the training for a period of two months using the tool (see appendix 3).

Participants in this study were approached at their farms by the Principal Investigator (PI) through the Chief of village (umudugudu). The PI explained the intent of the study and asked participants for their voluntarily participation. They were informed that they would have the

right to leave the training and the study at any time they want. Participants were trained the same day that they would have attended the extension education at the sector level. The pre-intervention test was provided at the beginning of the training and the post intervention was given after the second day of the training.

3.5.3 Data collector(s)

Two volunteers, trained inseminators at Integrated Polytechnic Regional Center South (IPRC) and the Principal Investigator facilitated the two-day farmer-training program conducted on November 15-16th, 2017. The training consisted of the description of estrus detection techniques, including heat detection techniques in herds, heat detection times and how these techniques can be improved. The PI and two trained inseminators at Integrated Polytechnic Regional Center South (IPRC) conducted the training in Kinyarwanda at the district extension office.

3.5.4 Data management

Data collected during this study were entered and aggregated into an excel sheet and then checked for completeness and cleaned before analysis. Identifiers (names) of study participants were replaced by codes in order to protect participant identities. The codebook was stored kept in a separate document that could only be accessed by the primary investigator.

3.6 Intervention – the selection rationale of the intervention

The intervention in this project consisted of providing a training to GIRINKA beneficiaries farmers on the description of heat detection techniques in herds, which includes description of heat period of cattle, appropriate time to check for heat period, manifestation of cows in heat and cattle estrus signs and how these techniques can be improved. The training materials were

adopted from ILRI (International Livestock Research Institute) materials developed for smallholder dairy farmers (ILRI, 2016) and from Heat Detection Strategies for Dairy Cattle (Graves, 2012) (appendix 4).

3.7 Data Analysis

Data were analyzed using Excel 16 and STATA13. Descriptive statistics were also used to present the farmers demographic data.

The pre- and post-intervention AI success rates and farmers' knowledge scores were compared using paired t test with a p-value set at 0.05.

3.8 Ethical consideration

3.8.1 Vulnerable populations

This project had a population of adult farmers with age above 18. The study population had no vulnerable population.

3.8.2 Assessment of risks to participants

Risks that participants might face:

- During post intervention data collection, your identity mighty be shared among the research team

In order to minimize risks to participants:

- Identifiers (names) of study participants were replaced by codes so their identity is protected.
- We provided to participants all necessary protocols regarding the training.

3.8.3 Medical or psychosocial support

In this study, there was no need for participants to undertake medical or psychosocial support.

3.8.4 Information and consent process

Participants in this study were approached at their farms by the principal investigator and explained the intent of the study and asked to voluntarily participate. They were informed that they have the right to leave the training and to withdraw from the study.

After the explanation, participants were provided an informed consent form and asked to sign it. For illiterate participants, the trainers read it for them in presence of a witness person of their choice, and finger print the form if cannot sign.

3.8.5 Protection of privacy and confidentiality

In this study participants' confidentiality were protected by not collecting their names, instead an ID code were used. All the information will be used for academic purposes only.

3.8.6 De-identification of data

The codebook is kept in a securely locked drawer only accessible to the primary investigator.

3.8.7 Safekeeping of data

Only the PI had access to the Identity codes of the participants. Trainers are trained and experienced inseminators from IPRC South, and were clarified in their contracts that safekeeping participants' information and confidentiality are of a must. Only de-identified codes data were entered in Microsoft excel 2013, password protected.

In safe keeping raw data, informed consents are kept in closed envelopes and stored in a locked cupboard, only primary investigator has the key. All hard and soft copies of data will be destroyed after 10 years.

CHAPTER FOUR: RESULTS

A total of 74 farmers from Huye district participated in the training on 15th November 2017. Among all participants, 70.5% received their cows from the Girinka program and 29.5% received a cow from the first generation of the cows given from Girinka.

4.1 Participants Socio Demographics

Out of the 74 participants, 47 (63.5%) were female and 27 (36.5%) were male. Ages ranged from 30 to 80, with both the mean and median age being 50 years.

Three (4%) of the participants were in the age range of 30-40 years, 39 (52.7%) were in the range of 41-50 years, 26 (35.1%) in the range of 51-60, 5 (6.8%) in the range of 61-70 years and 1 (1.4%) above 70 years (Table 2).

Table 2: Illustration of participants' Socio-demographic characteristics

Sample		74
Sex	Female	47 (63.5%)
	Male	27 (36.5%)
Age (year)	Mean	50
	Range	30 -80
	30-40	3 (4%)
	41-50	39 (52.7%)
	51-60	26 (35.1%)
	61-70	5 (6.8%)
	71-80	1 (1.4%)

4.2 AI Success Rate

The AI success rate significantly increased from 44% pre-intervention to 58.7% post-intervention, with P<0.001(Table 3).

4.3 Knowledge of Participants

The overall average knowledge, which was measured based on the score obtained from the pre-intervention assessment (appendix 2) on cattle estrus cycle significantly increased from 37.16% pre-intervention to 92.34% post-intervention, with P-value= 0.008(Table 2). All six questions about the knowledge of participants showed statistically significant increases, with question 1 related to the knowledge of estrus cycle having the biggest increase in knowledge score from 31% pre-intervention to 95.9% post intervention, 65% improvement (P-value <0.001, CI= 0.53, 0.77). The smallest increase in knowledge score was question 2 related to knowledge on heat period of cows increased from 55.4% pre-intervention to 98.65% post-intervention, 43% improvement (P value<0.001 and CI= 0.31, 0.55) (Table 3).

Table 3: A summary of the pre-and post-intervention results

	Pre-intervention	Post-intervention	Change (95% CI)	P value (CI)
Sample	74	74	-	-
AI success rate	44%	58.7 %	14.70% (12.20, 16.77)	<0.001
Overall knowledge score from the knowledge assessment	37.16%	92.34%	55.18%(50, 61)	0.008
Question 1: Knowledge of estrus cycle	31.08%	95.95%	64.87%(53, 77)	<0.001
Question 2: Knowledge on the heat period of cows	55.41%	98.65%	43.24%(31, 55)	<0.001
Question 3: Cattle estrus duration	41.89%	97.30%	55.41%(43, 68)	<0.001
Question 4: Appropriate time to check for heat period	40.54%	93.24%	52.70% (39, 66)	<0.001
Question 5: Manifestations of cows in estrus	33.78%	86.49%	52.71%(36, 69)	<0.001
Question 6: Cattle estrus signs	20.27 %	82.43%	62.16%(49, 75)	<0.001

4.4 Hypothesis Testing

The objective of this study was to increase the AI success rate from 44%-60%, but it was increased to the 58.7%. Table 4 shows that there is no statistical difference between 58.7% and 60%.

Table 4: Hypothesis Testing

Variable	observation	Mean	Std Error	Std Dev	CI	P value
Success Rate	74	58.7	1.381199	11.88153	55.94998 61.45543	-0.9393

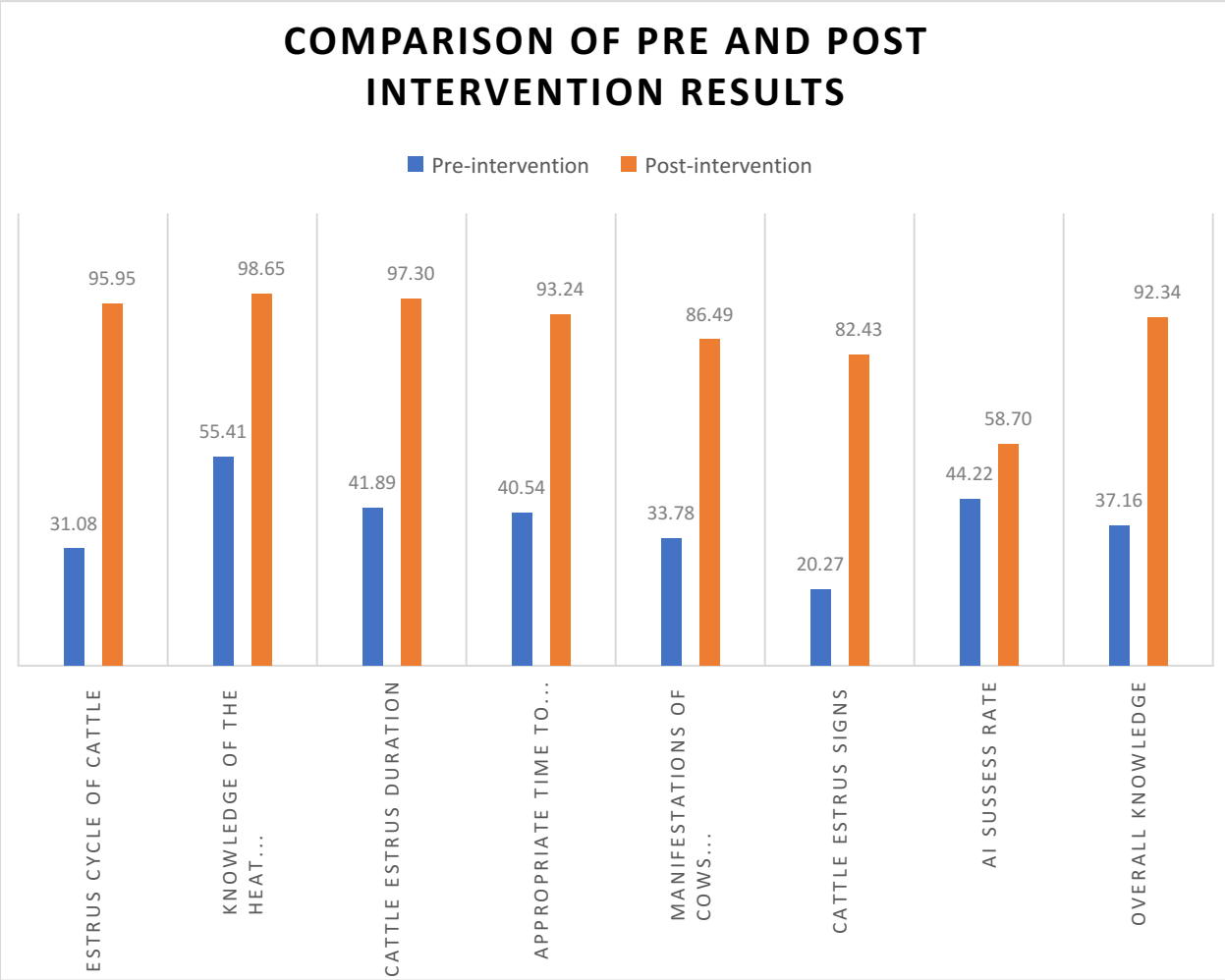

Figure 2: Illustration of the pre-and post -intervention data

CHAPTER FIVE: DISCUSSION

5.1. Discussion

This study showed that the training provided to the farmers increased the level knowledge of farmers on the estrus cycle of cows and was also associated with an increase in successful rate of AI. The results of our study are similar to many other previously published studies (Goncu et al.,2017; Rao et al.,2013;Sakatani et al.,2016;Sauls et al., 2017; Woldu et al., 2011; Mpofu, 2002) which showed that providing knowledge training to farmers on heat detection increases the success rate of AI in extensive, semi-intensive or intensive production systems.

Participants' pre-intervention average score on the farmers' knowledge test questions related to the estrus cycle was only 37%. Estrus in cows is a lifetime event that occurs every 21 days (Selvam & Archunan, 2017), and knowing its signs and how cows manifest during this period is important to successful insemination (Hansen, 2013). Heat period is the duration that sexually mature female cattle are ready to conceive (Johnson, 2016). When farmers cannot understand the signs of heat period, resulting in missing the proper timing, insemination usually fails (Davis, 2015; Dahlen, 2015; Tonui, 2017). They are all important keys to the success of insemination (Sauls et al., 2017). The low level of knowledge of farmers on cattle heat detection affected the insemination success rate and could result in economic losses due to the fact that they have to pay for inseminators more than once (Mozūraitis et al.,2017; Anjana at al., 2016; Bassazin et al., 2017).

Our training program was designed based on our extensive literature review and following the recommended methodology by the ILRI. The curriculum and contents were created using

evidence to target the most important factors that could affect the AI success rate. The training was delivered in simple terminology using local language (Kinyarwanda) to ensure all farmers could understand the contents. The training was delivered by trainers who are very proficient in the topic. Trainers also used visual aides included graphs, pictures as well as videos to enrich farmers' understanding.

Our training increased the level knowledge of farmers on all aspects of the estrus cycle. The results are similar to some previous studies on behavioral signs of estrus and are associated with the increase of the AI success rate (Goncu et al.,2017). Some studies conducted in Ethiopia, Malawi and China had shown that by providing similar trainings on heat detection and appropriate time of insemination to farmers could increase the knowledge of farmers on estrus cycle, heat period of cows and cattle estrus duration, and in turn, positively influence the success of AI (Woldu et al., 2011; Mpofu, 2002; Yin,et al., 2013). In Malawi, the AI success rate increased from 56% to 78% after providing the trainings (Mpofu, 2002). The increased knowledge help prevent insemination too late or too early thus associated with the increased success rate of artificial insemination (Rao et al.,2013, Sakatani et al.,2016, Sauls et al., 2017; Sprott & Carpenter, 2016).

In the context of One Health, the increased AI success rate presents to the farmers the benefits of preventing infectious diseases that can be spread from cow to cow when natural mating is done and that can also affects human (Morrell, 2011). Increase AI success rate also helps to save the amount of money that could be spent on rearing bulls (Parish & Riley, 2011) and also save the environment by reducing the amount of emission of carbon in the environment and

also with the reduction of grasses and water they would consume.(Rathod et al. , 2017, Ybañez et al., 2017).

5.2 Success of the study

This project successfully increased the farmer's knowledge and contributed to the increase in AI success rate of their cows.

This project adopted the Strategic Problem Solving (SPS) approach from the design to evaluation of the intervention (Burns et al., 2012). They defined SPS as an 8-step problem solving methodology that provides step to step systematic process to address a health care issue. By creating a clear problem statement, the project was able to focus on a clear and defined problem that needed to be addressed. Having realistic objectives helped the project to set clear direction and deliverables.

We conducted a root cause analysis (RCA) by reviewing the literature and brainstorming with the DVOs in order to determine the cause of low insemination rate among GIRINKA farmers. The RCA helped to identify the real causes that were to be addressed, and in turn to identify the most appropriate intervention in order to be successfully create the intended results.

5.3 Challenges

The project successfully increased the knowledge level of farmers and the AI success rates. However, there were challenges in the project.

We experienced delay in the post-intervention data collection for the AI rate. That was due to RAB would not release their data until they have finished analyzing all data in the entire country. Such governmental process caused some delay in our project progress.

Although our intervention showed success in both knowledge and AI success rate, we cannot eliminate any confounding factors. The success of artificial insemination depends on a lot of factors, and we could not completely contribute the increase in AI success rate only to our intervention.

The confounding variables include firstly skilled inseminators as they receive regular training and mentorship by the RAB, so this can be also associated with the increase in AI success rate. Secondly, the follow-up time was short; farmers could still remember the training contents and apply it. The long-term effect of the intervention is unknown. Thirdly farmers were informed that they would be visited on a regular basis for a period of two months, which may have alerted them to keep monitoring and applying the knowledge acquired from the training during the mentioned period. There is need for follow up to test if the knowledge level changes over time.

The study sample size was relatively small compared to the farmer population in Huye. Thus, the results may not be generalizable to the entire farmer population.

Some feedback provided by the farmers mentioned that sometimes they have to leave their farms for other work, they could not detect the heat period while they were away. They suggested that having other materials that could help them in the identification of the heat period, they could be connected to farmers' mobile phone and help in giving signals to the alert the farmers. It helps farmers not only to be aware that their cows are in heat to be inseminated but also that they can do other activities out of their farms.

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CHAPTER SIX: CONCLUSION

6.1. Conclusion

This project utilized a pre- and post-intervention study design to assess the effect of providing training on estrus cycle to farmers on the success rate of AI. The results showed our intervention significantly increased the knowledge score of farmers from 37.16% to 92.34% and also, the AI success rate from 44.22% to 58.7%. Indicating that providing training to farmers, as a way of enhancing skills and building their capacity on heat detection, could increase the AI success rate. Cattle farming is a major contributor to the financial wellness of farmers in Rwanda, the success of AI is an important issue to address.

Our evidence-based training targeted the needs of the farmers and provided them the knowledge and skills to accurately detect the signs and timing of estrus cycles, thus improved the success rate of AI. Longer term follow-up on the effect of the intervention is needed.

6.2 Recommendation

Based on the study findings, in order to continuously improve farmers health status through improved economic livelihoods by eradicating poverty, we recommend the following:

For the Rwanda Agriculture Board (RAB) and for the District Veterinary Officer (DVO)

- We recommend to provide farmers trainings on heat period detection during orientation before receiving a cow and quarterly refreshers to equip them with sufficient knowledge and skills to daily management of their farm including heat detection techniques and estrus signs.

- We suggest RAB in collaboration with the other districts to conduct similar trainings to farmers in their respective districts to ensure increase in the AI success rate.
- We recommend the RAB and the DVO to provide sensory detecting devises to assist farmers in identifying cows in estrus even if their away from their herds, by using.

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APPENDICES

APPENDIX 1: PRACTICUM PROJECT INFORMATION AND CONSENT FORM

Project Title: INCREASING THE SUCCESS RATE OF CATTLE ARTIFICIAL INSEMINATION (AI) FOR GIRINKA BENEFICIARIES IN HUYE DISTRICT, RWANDA
27/8/2017

Main researcher: Nancy SIBO

Master of Science in Global Health Delivery candidate, University of Global Health Equity

Dear participant,

You are being invited to participate in a research project because you are a beneficiary of Girinka program and a resident of Huye District. Before accepting to join this project, you must understand and take into consideration the contents of this form, since it contains important information to assist you in deciding whether to participate or not.

This project is being conducted as part of a core requirement for the Master of Science in Global Health Delivery at the University of Global Health Equity. The project has received required ethical approval from UGHE and complies with international ethical standards for research to be carried out in Rwanda. Permissions have also been obtained from the district Veterinary officer.

The purpose of this project

The purpose of this project is to increase of the success rate of AI.

The procedure for participation in this project

You will be provided with training on estrus detection and will be followed for a period of two month with 2 visits a week. At each visit, the PI will direct some questions about the successful AI to you. If you chose to participate, you will be requested to sign this consent form.

The possible benefits of taking part in this project

Your participation may potentially increase the artificial insemination success rate among your cattle.

Possible risks or discomforts related to taking part in this project

If you choose to participate, you will be required to provide information about the number of successful inseminated cows and the total number of artificial insemination you attempted. Your personal information will not be reported, as the final report will only present the aggregated summary.

If you choose to participate, your names will be replaced by codes in the data collection process, your identity will be protected. We will provide all necessary protocols regarding the training. You will also be provided a small transportation allowance in order to attend the training. .

Protection of your privacy

The collected data will be kept secretly and you will not be identified by names. Only the research team will have access to the information provided. The results will be used for research purposes and will be shared with RAB for policy improvement and not for any other interests, no name of you or your farm will be included in the report. All project data will be kept safe in locked storage and on password protected computer. All files will be destroyed after 10 years.

If I have any questions, concerns or complaints about this project, whom can I talk to?

When:

1) You have questions, concerns, or complaints,

2) You would like to talk to the project team,

3) You think the project has harmed you, or

4) You wish to withdraw from the study; please feel free to contact: Nancy SIBO on +250785552314 and n.sibo@ughe.org

Participation is voluntary

It is your right to decide to participate in this project or not. If you choose to participate, you may change your mind and leave the study at any time. Refusal to participate or stopping your participation will involve no penalty.

Statement of consent

Your signature (or finger print) below indicates you acknowledge that:

- You have understood the content of this form.
- You have had the opportunity to ask questions and received answers that were satisfactory.
- If needed, you took time to discuss this information with others to help you decide whether to participate.
- You will receive a dated and signed copy of the form.
- You agree to participate in this project.

Participant name	Signature/ finger print	Date
Researcher name/person requesting consent	Signature	Date

APPENDIX 2: INTERVENTION ASSESSMENT

FARM'S ID						

INSTRUCTIONS: Answer each question in the appropriate space provided.

Q1. Define the estrus cycle of cows?

……
……

Q2. What does heat in cows stand for?

……
……

Q3. How long is the estrus cycle of cows?

a) 15 days
b) 21 days
c) 24 days
d) 10 days
e) 30 days

Q4. What is the appropriate time to check for heat period?

a) One time/ day
b) Twice /day
c) Thrice /day
d) Never

Q5: What are the manifestations of cows in estrus?

a) Vulva discharge
b) Mounting
c) Frequent urination
d) Standing
e) Accept to be mounted
f) All the above
g) None of them
h) Others

Q6. What are the methods of estrus detection used at farm level?

a) Visual observation
b) Palpation
c) All the above

APPENDIX 5: AI SUCCESS RATE

	AI success rate in November 2017 before the intervention (RAB,2017)	AI success rate in January 2018 after the intervention
Farmer 1	39	45
Farmer 2	47	52
Farmer 3	50	55
Farmer 4	44	70
Farmer 5	43	65
Farmer 6	39	60
Farmer 7	47	76
Farmer 8	50	69
Farmer 9	42	67
Farmer 10	42	68
Farmer 11	43	70
Farmer 12	38	47
Farmer 13	56	59
Farmer 14	50	60
Farmer 15	42	50
Farmer 16	42	48
Farmer 17	43	47
Farmer 18	50	59
Farmer 19	42	50
Farmer 20	42	50
Farmer 21	43	57
Farmer 22	49	50
Farmer 23	49	51
Farmer 24	63	70
Farmer 25	34	40
Farmer 26	45	68
Farmer 27	38	55
Farmer 28	38	45
Farmer 29	50	56
Farmer 30	47	50
Farmer31	44	51
Farmer 32	45	70
Farmer 33	38	40
Farmer 34	38	46

Farmer 35	43	39
Farmer 36	38	45
Farmer 37	56	87
Farmer 38	50	56
Farmer 39	42	48
Farmer 40	42	59
Farmer 41	43	60
Farmer 42	50	75
Farmer 43	42	48
Farmer 44	44	75
Farmer 45	45	59
Farmer 46	57	78
Farmer 47	50	80
Farmer 48	51	75
Farmer 49	32	48
Farmer 50	31	47
Farmer 51	44	59
Farmer 52	45	75
Farmer 53	38	59
Farmer 54	38	60
Farmer 55	45	50
Farmer 56	38	48
Farmer 57	38	47
Farmer 58	44	59
Farmer 59	43	50
Farmer 60	39	50
Farmer 61	47	57
Farmer 62	50	77
Farmer 63	42	51
Farmer 64	42	70
Farmer 65	44	40
Farmer 66	45	59
Farmer 67	57	86
Farmer 68	50	77
Farmer 69	51	49
Farmer 70	44	75
Farmer 71	45	75
Farmer72	38	59
Farmer73	38	65
Farmer74	39	52

AI SUSSESS RATE	44.22	58.70

APPENDIX 3: DATA COLLECTION TOOL

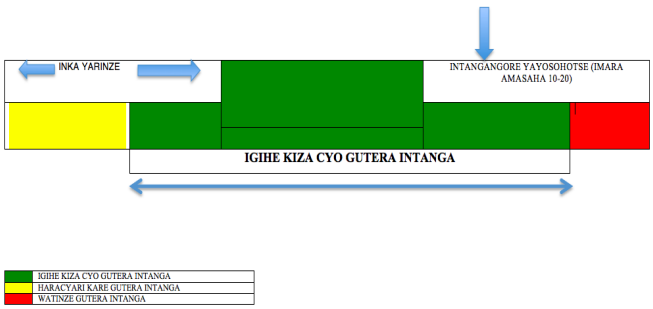
FARMER'S ID						

DATE OF VISIT	NO OF COWS	TOTAL COWS INSEMINATED	SUSSESS INSEMINATION	AVERAGE

APPENDIX 4: TRAINING MATERIALS

AMAHUGURWA Y'ABOROZI B'INKA KUBURYO BWO KUREBA INKA ZARINZE, MU KARERE KA HUYE.

UMUNSI WA MBERE			
ISOMO	**INTEGO**	**UBUSOBANURO**	**IGIHE**
I.GUSOBANUKIRWA ICYO KURINDA ARI CYO	**KUMENYA ICYO KURINDA KW'INKA ARI CYO**	**Kurinda kw'inka**: kurinda ni igihe inka iba yageze mu gihe cy'uburumbuke. Iki gihe iyo inka ihuye n'ikimasa cyangwa igaterwa intaga iba ishobora guhaka.	9:00 -9:45
	KUMENYA INKA ZISHOBORA KURINDA	Inka ishobora kurinda ni inka: • Inka igejeje nibura amezi 12 • Idafite uburwayi mu myamya myororokere	9:45-10:45
	AKARUHUKO (IMINOTA 15)		
	KUMENYA IGIHE KURINDA BIMARA	• Inka irinda kukigereranyo cy'iminsi 21, (18-24) • Igihe cyo kurinda ku nka kimara amasaha ari hagati ya 12-30.	11:00-12:00
IKIRUHUKO (IMINOTA 60)			
II. IBIMENYETSO BY'INKA YARINZE	**KUMENYA IBINYETSO BIGARAGAZWA N'INKA YARINZE**	Iyo inka yarinze igaragaza ibimenyetso bikurikira: • Yemera kurirwa nizindi nka • Itangira kurira izindi • Igira impagarara kandi ikabira mu ijwi rinini • Imirire yayo iragabanuka (ibiryo irya ku munsi) • Mugihe ikamwa,umukamo uragabanuka • Inka izana ururenda rwinshi ruva mu nda y'amaganga • Inda y'amaganga iratukura ikanabyimba • Gusohora amaganaga bya buri kanya • Iyo inka yarinze irenga imwe , zose ziregerana kandi zikirundira mu inguni.	13:00-14:00
III. IGIHE KIBONEYE CYO KUREBA KO INKA YARINZE	**KUMENYA IGIHE KIZA CYO KUREBA KO INKA**	Inka uyireba gatatu ku munsi mu gihe cy'iminota makumyabili:	14:00-15:00

	YARINZE	Mu gitondo Ku manywa Ku mugoroba ➢ Igihe hakonje ni byiza kureba ko inka yarinze: Ku manywa (ni cyo gihe kiza) ➢ Igihe hashyushye ni byiza kureba ko inka yarinze : Mu gitondo ndetse no kumugoroba (ni cyo gihe kiza) **ICYITONDERWA**: • inka zigaragaza ibimenyetso byo kurinda igihe ziri mu rwuli cyangwa ahantu hagutse. • Nubona iminsi 21 ishize uhereye igihe yaherukiraga kurinda , fata inka zawe uzisohore mu kiraro.	
AKARUHUKO (IMINOTA 15)			
		Uburyo bwo kureba inka yarinze bushobora kunozwa neza igihe : • Umworozi yongereye incuro areba ko inka ye ko yarinze ku munsi • Umworozi yitaye kubimenyetso n'imyitwarire bidasanzwe inka igaragaza.	15:15-15:45
	UBURYO BWO KUREBA KO INKA YARINZE	1. KUREBESHA AMASO 2. GUKORAKORA INKA	15:45-16:30
UMUNSI WA KABILI			
ISOMO	**INTEGO**	**UBUSOBANURO**	**IGIHE**
IV. IGIHE KIBONEYE CYO KUBANGURIRA INKA YARINZE	**KUMENYA IGIHE KIBONEYE CYO KUBANGURIRA**	Iyo umworozi yabonye kimwe mubimenyesto byavuzwe hejuru Igihe kiza cyo kubangurira ni hagati y'amasaha 4-14 nyuma yo kubina ikimenyetso cy'uko yarinze. Iyo umaze kubona ibimenyetso by'uko inka yarinze ukurikiza itegeko Igitondo –Umugoroba (AM-PM). Igihe inka irinze mugitondo yiteze intanga ku mugoroba Igihe inka irinze ni mugoroba yiteze intanga mu gitondo cy'umunsi ukurikira.  	9:00 -10:00

	AKAMARO K'UMUSHU MBA MU KUMENYA KO INKA YARINZE	Umushumba agira akamaro kanini mu kumenya ko inka yarinze. Ibi bishyingiye ku kuba umushumba ari we umara umwanya munini ari kumwe n'inka. Mufatanye kugira amakuru ahagije yerekeye ubumenyi bw'imyororkere yinka zanyu.	10:00-10:45
AKARUHUKO (IMINOTA 15)			
	INGAMBA ZIKWIYE GUFATWA N'UMWOR OZI	Mukwirinda gusimbuka ukwezi utabanguriye kubw'impanzu zatewe no kutamenya ko inka yarinze cyangwa se kubwo gukrerwa guzitera intanga. Umworozi agomba: 1. Kureba nibura gatatu (3) ku munsi ibimenyetso by'uko inka yarinze 2. Kubangurira inka zifite ubuzima bwiza, nyuma yiminsi 40-59 nyuma yo kubyara. 3. Kugira ifishi yaburi nka yerekana uko yagiye iyirinda mu gihe cyose inka igeze mu burumbuke (ku mezi 12).	11:00-12:00

Byakusanijwe bikuwe

1. Graves, W. M. (2012). Heat Detection Strategies for Dairy Cattle. Retrieved from https://secure.caes.uga.edu/extension/publications/files/pdf/B 1212_3.PDF

2.ILRI. (2016). Smallholder dairy farmer training manual. Retrieved from https://cgspace.cgiar.org/rest/bitstreams/82258/retrieve

Capstone practicum final report grading scheme

Area	Max score	Score
The Problem Statement Does the Problem Statement describe specifically what the problem is, which issues the capstone will explore, and why they need to be explored?	4	4
Objectives Is the overall objective of the project SMART and clearly stated, providing a clear indication of the expected contribution of the project to the specific organization/institute where the project is conducted? - If included, do specific/secondary objectives clearly outline the steps through which the overall objective will be achieved?	4	3.75
Background and Justification Does the Background to the Study provide a description of: (i) The significant and topical background issues (historical, current) pertaining to the study; (ii) why the project is being undertaken; and (iii) previous work related to the study? It is expected that the Justification of the project should provide a quick sketch of the proposed solution or study approach and briefly explain how it differs from other works – and within this context, it should make a strong case for why the project is needed, how the results of the study would fill this need and be beneficial; and why it is significant.	4	3.9
Layout of the Thesis Brief description of each of the chapters of the entire thesis	2	2
Literature review To what level and extent has the candidate reviewed, analyzed, and synthesized relevant previous works? Has the candidate: ● reviewed and documented the results of other studies that are closely related to the present study? ● demonstrated that s/he has a comprehensive understanding of the field of study and that he/she is aware of important recent substantive, methodological and theoretical developments in the field of study? ● identified the limitations of past/current research approaches and explained how s/he will build on the strengths of past studies while overcoming their limitations?	4 4 4	3.75 4 3.5

● identified potential outcomes of the study and discussed the importance of each?	4	3.75
Methodology **Project Design and Method** ● Does the candidate identify which study design had been adopted/used (if any), and then describe, discuss and justify the choice, relevance, and implementation of the intervention? **Measures** ● What type of data/Indicators has the project measured? **Implementation** ● Does the data collection method appear to be appropriate? ● Was the data collection tool clearly described? ● intervention appear to be addressing the root cause (if intervention is applicable)? **Data analysis** ● Appropriate analysis method(s), statistical or coding method(s) (if applicable) described with sufficient detail.	2 2 1 2 1 3	1.75 1.9 1 1.8 .75 2.25
Results ● Does the candidate present relevant results, without interpretation? ● Are the results obtained using the analysis methods described previously in the report? ● Does the candidate use appropriate tables/figures if applicable?	2 1 1	1.85 1 .75
Discussion ● Does the candidate interpret the results rather than simply restating them? ● Does candidate discuss the factors contributing to the results (success/failure of intervention, if applicable)? ● Does the candidate relate the results to the literature? ● Does the candidate discuss the challenges encountered and steps taken to overcome them? ● Does the candidate discuss the limitations of the project?	1 1 1 1 1	.9 .95 .95 1 .95
Conclusion Does the candidate provide a clear summary of the project, and does the candidate provide recommendations for follow up and future studies?	5	4.8

Adherence to the Guidelines for Writing Capstone Project Thesis The candidate strictly adheres to the guidelines provided for preparing the capstone document. Document is prepared with appropriate structure, format and layout (size 12 font, double-spaced, 1-inch margins); text is well developed and coherent; language and style are clear and appropriate; sources and citation style are correct; and references are high quality and relevant.	5	4.8
Total	60	56.05 (93.4%)