

Benchmark study on husbandry factors affecting reproductive performance of smallholder dairy cows subjected to artificial insemination (AI) in Nyagatare, Gatsibo, and Kayonza districts of Rwanda

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Key words: Artificial insemination, Husbandry, Reproduction, Smallholder, Dairy, Rwanda.

Abstract

The objective of this study was to identify existing farmer practices that may influence reproductive performance of cows bred through artificial insemination. A random sample of 1080 households supplying milk to the milk-processing centre was drawn in Nyagatare, Gatsibo, and Kayonza districts of Rwanda between October and November 2007. Extensive grazing (71 %) was the predominant production system identified with only 10 % of the farmers supplementing veld pastures with barna grass during the dry season. Farmers use a variety of signs to detect estrus in cows. Among these, ‘standing to be mounted’ (6.83 %), was rated the least while mucus discharge (35.58%) was regarded as the most important sign of heat in cows. Further, only 11.54 % of the farmers invited inseminators after observing standing heat, while the majority (88.46 %), observe for signs such as decreased feed intake (26.51 %), ‘mounting of other cows’ (21.54 %), clear mucus discharge from vulva (15.38 %), swelling of vulva (13.85 %), and ‘being followed by a bull’ (11.54 %). Non-return to heat after service was the predominant method of pregnancy diagnosis used by about 86 % of the farmers. The major reproductive problems encountered included abortion (13 %), retained placenta (33 %), and dystocia (37 %), while tick borne diseases (27.6 %) and gastrointestinal parasites (18.4 %) were among the most prevalent general diseases reported. Very few farmers (1.1%) vaccinated their cattle against reproductive diseases such as brucellosis and more than 95 % do not keep records. None of the respondents completed the sections requiring disclosure of critical reproductive events such as dates of service and calving. Seventy-eight percent of the respondents were below primary school education. Poor heat detection, diseases, nutrition, and lack of record keeping were the major husbandry factors identified whose performance was below expected. The implications of these findings are discussed in the text.

Background and justification

Artificial insemination (AI) has become one of the most important biotechnologies ever devised for improvement of reproductive performance of farm animals. Todate, it is the main tool for dissemination of outstanding germplasm, control of venereal diseases and cost-effective dairy farming. The dairy industry plays an important role in the agrarian economy of Rwanda. Development of this sector is viewed as a means of reviving the

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rural economy, achieving national self-reliance and ensuring food security in milk and milk products. However, of the many constraints facing dairy development in Rwanda, low genetic merit of indigenous cattle is understood to be the most important. As a result,

since 1996, the government of Rwanda vigorously pursued genetic upgrading of indigenous stock through crossbreeding with exotic germplasm in order to enhance milk production. In order to rapidly achieve this objective, artificial insemination (AI) was accepted as the primary breeding method (19). The number of inseminations over the last two years has increased drastically from 10 000 in 2006 to 47 000 in 2007, and milk production improved from 55 500 tonnes in 1999 to 158 700 tonnes in 2007. Over the same period, milk powder imports dropped from 1280 tonnes to 500 tonnes (19). Although both number of inseminations and milk production has improved to some extent, the overall pregnancy rate following AI has been very low, around 50%. The precise cause of this failure of AI, however, is unknown. The resulting decrease in rates of reproduction has direct economic implications on the Rwandese dairy industry and warrants identification of the aetiological factors involved and formulation of appropriate interventions. Clearly, there is a need to undertake a comprehensive assessment of fertility and to identify various factors affecting the success of AI. With this in mind, a series of studies were designed to assess the performance of the AI service and identify its constraints, in order to develop and implement remedial measures. Initially, a field survey was carried out to identify prevailing animal husbandry practices among smallholder farmers. Part of the objectives of the initial survey was to identify problems that required further investigations so as to enable generation of tailor –made solutions. These field observations will be complemented with data on measurement of milk progesterone using radioimmunoassay (RIA) to monitor the success of AI. Monitoring the success of AI through conventional methods, such as rectal palpation of genitalia and non-return rate, has very limited value. On the contrary, measurements of progesterone profiles of cows by RIA has been used to assess the suitability of animals for AI, monitor stages of estrous cycle, perform early diagnosis of non-pregnancy (1), and diagnose factors limiting reproductive efficiency (7). This paper presents the results on the initial benchmark survey on prevailing husbandry practices that may negatively influence success of AI in Nyagatare, Gatsibo, and Kayonza districts. The overall aim of the project is to improve the productivity of smallholder dairy farms through improvement in the performance of AI services.

Materials and Methods

A random sample of 1080 smallholder households in the former Umutara Province (Nyagatare, Gatsibo, and Kayonza Districts) was carried out between October and November 2007. Twenty per cent of farmers delivering milk to each milk collection centre in the target area were randomly selected. Data collection was through household interviews conducted by trained enumerators using a pre-tested semi-structured questionnaire. The information gathered included level of education, record keeping, production system, heat detection, diseases and disease control measures. The number of questionnaires administered to farmers in each district were 761 (Nyagatare), 169 (Gatsibo), and 150 (Kayonza). The data collected was entered into SPSS Version 8 databases for descriptive statistical analyses.

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Results

Three production systems were identified with the extensive grazing system (71 %) being the most common followed by semi-zero or mixed grazing (15 %), and zero grazing (9 %). Only 10 % of the non-zero grazing farmers gave extra feed (supplementary feed) to their cows during the dry season. Communal dams or rivers were the major source of drinking water for their cows. Farmers use a variety of signs to detect estrus in cows. Among these, ‘standing to be mounted’ (6.83 %), was regarded as the least important sign while mucus

discharge (35.58%), was ranked the most important sign of heat in cows. Not surprisingly, the least (11.54 %) of the farmers invited inseminators after observing standing heat, while the majority (88.46 %), observe for a number of varied secondary signs of heat such as decreased feed intake (26.51 %), ‘mounting of other cows’ (21.54 %), clear mucus discharge from vulva (15.38 %), swelling of vulva (13.85 %), and ‘being followed by a bull’ (11.54 %) (Figure 1). None of the farmers had a heat detection programme, and estrus detection was carried out on an ad hoc basis. After mating, nonreturn to heat (85.6 %) was the predominant method of pregnancy diagnosis used, followed by rectal palpation (4.8 %), while 4.4 % did not utilize this management tool. General animal health problems identified by the farmers included dystocia (37 %), retained placenta (33 %), tick borne diseases (27.6 %), gastrointestinal parasites (18.4 %), abortion (13 %), Blackleg and Anthrax (9.0 %), Foot and Mouth Disease (8.3 %), Trypanosomiasis (8.2%), Lumpy Skin Disease (7.9%), and many others reported by less than 5% of the farmers. While vaccination was used to control general diseases such as Foot and Mouth Disease, Anthrax and Lumpy Skin Disease, very few (1.1 %) vaccinated their cows against specific reproductive diseases such as brucellosis. Seventy-eight percent (78 %) of the farmers had not attended school beyond the primary level, and 95 % did not keep records. None of the respondents completed sections requiring disclosure of critical reproductive events such as dates of service and calving.

Table 1. The distribution of signs of heat observed before inseminators are invited.

Sign of heat observed	Prevalence (%)
Decreased Feed intake	26.51
Mounting other herd mates	21.54
Mucus discharge	15.38
Swelling of vulva	13.85
Being followed by bull	11.54
Standing when mounted	4.8

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Discussion

Extensive grazing management systems where cows are given very little supplementary feeding may affect reproductive performance of cows subjected to artificial insemination. These systems do not generally guarantee enough feed for the cows unless a comprehensive supplementary programme supports it, and, the mixing of cows from different herds and different disease status promotes spreading of diseases. As reported by Obese (17), and Domecq et al (8), lack of supplementary feeding in extensively grazed dairy cows affect their reproductive performance. Frequently, extensively grazed cows are exposed to heat stress, which suppresses estrus activity in cows (13, 20, 25), making its detection difficult. In addition, exposure to heat stress 1-3 days after insemination induces embryonic death (9), leading to poor conception rate and repeat breeding.

Almost eighty-nine percent (88.46 %) of farmers under study are inseminating cows while they are not in true estrus. Such a level of heat detection error is alarming, and well outside the 5 – 30 % range frequently observed on most farms (21). Estrous detection errors are brought about by identifying cows to be inseminated based on secondary signs of estrus. The problem with use of secondary signs is that they vary in duration and intensity, and may occur before, during, or after standing heat. As such, these signs cannot be used to correctly predict the time of ovulation. Therefore, inseminating cows based on secondary signs of heat will result in asynchrony of sperm-oocyte interactions leading to poor

conception (12, 11, 16), and wastage of semen and labor (18, 24). Perhaps, instead of using these signs for deciding when to inseminate, farmers should use these signs as clues or watch the specific cow more closely for standing behavior.

There are many possibilities as to why farmers in the study inseminate cows based on secondary signs of heat. Common practices resulting in high heat detection errors include inadequate animal identification, poor record keeping, lack of a specific heat detection programme, and lack of knowledge on significance of the various heat signs displayed by cows. All these negative practices are highly prevalent in the study area. Standing to be mounted' (6.8%), was ranked the least important sign of heat yet the converse is true. This shows that those responsible for checking for heat do not fully understand signs of heat. In the absence of a heat detection programme, people involved in heat detection will only be present with the cows at regular working hours. This can give rise to increased missed heats because the pattern of heat onset in cows is variable, with the greatest activity occurring early morning and late evening (2). According to Senger (23), the ideal goal for estrous detection error rate should be less than 2% in any herd. With 89 % of farmers failing to observe standing heat, it is clear poor heat detection is the major reproductive management problem in the study herds. The error margin as reported herein is a serious cause for concern. It should be noted, however, that estrous detection efficiency is under the total control of the management team and significant improvements in overall herd reproductive performance can be achieved if estrous detection is improved (15). Implementation of programs designed to focus exclusively on detection of estrus is highly recommended.

Farmers in the study use non-return to heat 18-24 days after service as a sign of pregnancy. However, while this is considered the easiest and cheapest method of pregnancy diagnosis, it requires keen and timely observation superimposed on heat detection skills for it to be accurate. As observed, farmers in the present study have a serious problem with heat detection, hence pregnancy diagnosis using non-return rate 355

could be inaccurate and misleading. As reported by Senger (22), the efficiency of nonreturn rate is further confounded by embryonic mortality, which results in lower calving rates. This method further suffers the disadvantage that farmers are generally not keen to follow up on heat detection on the same cow after insemination. In addition, cattle kept under zero grazing (though a small percentage in our study), exhibit a high degree of silent heats, which are difficult to detect. Because of these shortfalls, rectal palpation remains the most reliable, efficient method of pregnancy diagnosis. However, its requirement for skilled labour may explain why it is not a favorite with the farmers.

Farmers identified a number of systemic and reproductive diseases, which are a major cause for concern. Among the reproductive problems reported, dystocia was the major cause for concern. Dystocia means "difficult birth." The prevalence of dystocia (37 %) reported in this study is much higher than the 2-12% as reported from many field studies (23). Although it can occur due to other causes, the crossing of exotic, large framed breeds such as the Friesian Holstein with the short, framed local Ankole cows precipitate fetopelvic disproportions (calf too large for the birth canal) leading to dystocia(3). The problem with dystocia is that with few exceptions, cows that have 'difficult births' almost always have "downstream" reproductive problems inclusive of retained placenta, metritis, delayed uterine involution and poor cyclicity (23). Similar findings were reported by (15, 25). Further studies are needed to identify the true factors behind this unprecedented increase in prevalence of dystocia.

The causes of retained placenta are fully known (23). Nevertheless, the prevalence of

retained placenta (33 %) reported in this study is much higher than the literature values of between 4% and 10% (22, 23). Like dystocia, cows with retained placenta almost always experience infertility syndromes characterized by delayed return to estrus, increased services per conception, lengthened calving interval, higher culling rate, reduced milk production and increased days open (6, 10). These infertility syndromes are believed to be because of the subsequent endometritis and pyometra that develop following retained placenta (4, 5). The combined high prevalence's of abortion and retained placenta is highly suggestive of the presence of brucellosis infection among the cows (14). Because of zoonotic and reproductive effects, urgent longitudinal studies are needed to rule out the suspicion on brucellosis.

Regardless of when and how pregnancy diagnosis is carried out, the identified reproductive problems affects performance of AI through poor conception, embryo mortality, and abortion, hence farmers might be justified in their complaints on poor pregnancy rate in dairy cows subjected to artificial insemination. However, it must be noted that problems such as dystocia, retained placenta, and abortion, are under the direct influence of the reproductive system of the cow. For that reason, these factors are somewhat difficult to manage and control because the cow's reproductive system is the primary component influencing the outcome. Nevertheless, reduction in incidence of dystocia can almost always occur when sires used in AI are selected for a high degree of calving ease especially in heifers. Further, calvings should be accompanied by attendants with the appropriate obstetrical skills. Thus, management can exert a strong preventive influence by keeping records and selecting calving-ease bulls for use in heifers and employing proper heifer management and maternity pen care. Further, a good reproductive health program, which provides for checking normal uterine involution and return of ovarian cyclicity, is required.

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Apart from specific reproductive disorders, a high prevalence of general systemic diseases such as East Coast fever (ECF), black leg, anthrax, and lumpy skin (to mention but a few), were observed. These diseases result in sickness and or death of cows. In particular, East Coast Fever can have severe impacts on exotic cattle. Diseases, whether associated with the reproductive system or other systems of the body, have deleterious effects on fertility of dairy cows (15). The high prevalence of diseases for which disease control technology such as effective vaccines, and acaricides is available maybe taken to reflect failure of veterinary extension. Further studies are needed to determine the effectiveness of veterinary extension in the country.

More than 95 % of the farmers in the study did not keep records, while the few records being kept were incomplete, inaccurate or not updated. Poor record keeping affect performance of artificial insemination in several ways. Any attempt to improve the efficiency of AI has to be based on an understanding of the most important causes for failure under each specific production system. Traditionally, methods used to gain this understanding rely on accurate recording and analysis of reproductive events such as estrus, services, pregnancies and calvings. However, farmers in the study area rarely kept records, and even when available, they do not allow an assessment of the importance of factors such as efficiency and precision of estrus detection by the farmers or incorrect timing of insemination. Without proper records, elements used when reproductive performance is evaluated such as conception rate, numbers of services per conception, pregnancy rate, day's open, calving interval and many others cannot be measured. Simple, complete and accurate records about the entire reproductive life of the dairy cow are required to monitor components contributing to reproductive management. This aspect of

management needs to be improved. Poor record keeping has been reported to be one of the major management attribute affecting AI in dairy cows (1, 11).

The majority of farmers interviewed (77 %) were illiterate. This might possibly be a directly aftermath of the 1994 genocide which wiped out most of the skilled labour force of the country. While it is debatable, in our view, such a high illiteracy level among farmers is a potential in breeding of animals through AI because it creates imbalance balance between technical demands of the AI technology and the skills of the existing farm laborers. Further analyses are needed to determine the impacts of education level on reproductive performance.

Conclusion

Artificial insemination is a comparatively sophisticated method of animal breeding whose impact on cattle development is closely linked to the simultaneous introduction of reasonable standards of animal husbandry. In our study, the major basic animal husbandry practices are well below expected standards. Poor heat detection, diseases, nutrition, and lack of record keeping were the major husbandry factors identified that needed further investigation. Training is needed to uplift management capacity of most of the farmers because most if not all of the factors identified fall directly or indirectly under the control of the individuals performing the task or making a decision about the task. It is our conviction that fertility factors controlled by man, can be improved significantly with the appropriate management decisions and implementation of well-focused herd health,

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production and reproduction management programmes. For example, greatest improvement in reproductive performance can be made by improving estrous detection efficiency, estrous detection accuracy, nutritional management, and record keeping, among others. The probability of successfully implementing and controlling most of the factors identified in this study is much higher than attempting to control other factors, which cannot be totally controlled by the management team.

Recommendation

The nature of our study, do not allow us to determine any causal relationships. It is therefore imperative to carry out further studies to determine the effects of each of these factors on reproductive performance of artificially inseminate cows before any corrective measures can be taken.

Acknowledgement

Appreciation is extended to PDRCIU/ISAR/UP directorate for support during the study period.

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