Determination of Smallholder Farmers’ Knowledge, Attitudes and Practices regarding Fertility and Artificial Insemination Programmes: A case of Mpwapwa district of the Dodoma region in the central zone of Tanzania

ABSTRACT

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| --- |
| A survey was administered across 100 farmers in the Mpwapwa district in the central zone of Tanzania to determine their knowledge and practices in relation to fertility management and their interest in using AI. Very few of the farmers had used AI (18), although a majority had heard of it (52). Of the farmers who had heard of, but not used AI the main constraints identified were lack of access to AI (26/40) and cost (9/40). If effective AI provision could be made, 69 of the respondents 28 would be interested in using it (including 17/18 that had previously used it). This suggests that the reintroduction of AI services into the Mpwapwa district and similar regions in Tanzania could be successful. However, across the respondents there was little consistency in reproductive or routine management practices. Of particular concern was the lack of useable records on many farms. To ensure that the reintroduction of AI is effective, improvement is needed in smallholder farms management practices. Such changes would not only improve the impact of AI but also the productivity of beef cattle farming in the district. |

*Keywords:* *Fertility and Artificial Insemination Programmes, Mpwapwa cattle breed*

*On-farm baseline survey, Smallholder farmers, fertility management*

1. INTRODUCTION

Effective breeding practices can result in significant genetic gain and thereby improve livestock performance and productivity [1]. However, in Tanzania, the breeding practices of the smallholder farmers, who raise beef and dual-purpose cattle in many parts of the country, are often ineffective and result in negligible genetic gain [2; 3]. This can be observed in the central zone of Tanzania, a semi-arid agro-ecological zone, which has traditional pastoral and agro-pastoral communities [4].In these communities, traditional breeding with communal home-bred bulls is by far the most common breeding method [5; 6]. It is well-recognised that prolonged use of communal bulls increases the risk of spreading venereal diseases [7], significantly increases inbreeding, and reduces genetic diversity thereby severely limiting genetic gain [8; 9].

The only cattle breeding technology that is currently available in Tanzania on a commercial basis is artificial insemination (AI). The use of AI, even when used alongside natural mating, should result in improvements in genetic gain [10], so increased use of AI in smallholder communities could be significantly beneficial. However, the availability of AI services in Tanzania is limited by accessibility issues and the lack of trained AI technicians [4]. It is increasingly being recognised by the government and other funders that these issues are limiting the performance of Tanzania beef and dual-purpose cattle (i.e. those which are principally owned by smallholders: [2]) and that supporting the use of AI by increasing access and training additional technicians is necessary to meet country-level production goals ([2; 3]).

However, access to AI is not the only factor limiting its use by Tanzanian smallholders. Issues at farm level, including the generally poor fertility of smallholder cattle and, particularly, farmer awareness and understanding of the key issues around the use of AI [11; 10] also limit uptake, and would still be present if AI services became more available. Improving the productivity and performance of smallholder cattle requires a thorough understanding of farmers’ knowledge, attitudes, and practices concerning fertility programmes. This understanding is crucial for successful initiatives promoting artificial insemination.

The Tanzania Livestock Research Institute (TALIRI) central zonal office located in Mpwapwa district, has had a long-term programme of development of cattle that are suitable for smallholders and for the environmental conditions which predominate in Mpwapwa district. These projects have included an open nucleus breeding scheme for the development of the Mpwapwa breed of cattle [10]. TALIRI Mpwapwa has recently been funded by the Tanzanian government to develop AI services for cattle in that district. Implementing such a programme should lead to increased genetic gain and, hence, more efficient and effective beef cattle breeding. However, in order to target and strengthen the development of such services and to make them successful over the long term, we need to understand the beliefs and behaviours of smallholder farmers within Mpwapwa district in relation to the application and uptake of fertility programmes and AI technology. We thus undertook a survey of smallholders within Mpwapwa designed to assess their knowledge, attitudes and practices in relation to fertility and AI programmes.

2. material and methods

**Selection of participants**

The selection process started at the village level, with 14 villages in the Mpwapwa district being selected for the survey (Figure 1). These villages were a convenience selection, inasmuch as, all of the selected villages had previous involvement with the TALIRI Mpwapwa open nucleus breeding programme. Participants were recruited from within those villages. The selection of villagers was again a convenience selection made with the assistance of the ward livestock extension officer. A total of 100 farmers were selected over the 14 villages: Chipogoro (11), Wiyenzele (17), Chinoje (3), Winza (25), Kisokwe (1), Iyoma (11), Lupeta (1), Ilolo (4), Igovu (3), Ng’ambo (10), Mji Mpya (6), Muungano (4), Kileleni (3), Namba thelathini (1).

**Development of the questionnaire**

The questionnaire was designed to cover key factors such as farm details, breeding programme, management, nutrition, adaptation, production and growth performance [12; 13] and contain both structured and unstructured questions.

**Pre-testing of the survey questionnaire**

The survey questionnaire was piloted with 10 farms that had been identified as being suitable for the main study. The data obtained in the pilot study were not included in the main study, nor were the farmers resurveyed. This pilot process was designed to train the enumerators in the process and to identify the questions in the questionnaire that needed modification to improve farmers’ understanding of them.

**Data collection**

Data collection followed after the completion of the pretesting and piloting of the survey questionnaire. It involved the author and four enumerators who had received training on how to administer the questionnaire during the pilot stage. The survey was administered over two weeks starting in March 2022. Data were collected through individual face-to-face interviews with the farmers on each of the 100 farms.

**Statistical analysis**

Descriptive statistics for each survey question are collated and presented as proportions of respondents, or where suitable as medians (ranges). Most responses are presented at the univariate level, but where there was thought likely to be meaningful associations between responses they are analysed using relative risk (RR), or, for evaluating factors affecting intention to collaborate with TALIRI, logistic regression used.

3. results and discussion

**Respondents’ Demographic Characteristics**

Of the 100 respondents, 92 were males, 8 were females, 95 were married/widowed and 5 were single. The median age was 46.5 years (range: 20-76) and the median number of people in each household was 8 (1-20). The highest education level of the respondents is summarized in Figure1. Of the 100 respondents, 71 had primary education out of which 3 attended but didn’t complete,13 had secondary education, 7 had never attended formal education, 2 had attended adult education, 6 had attended college, and 1 had attended university.

**Cattle breeds**

*Mpwapwa Breed Cattle*

Thirty-two of the respondents kept Mpwapwa breed cattle. In those herd, the median number of Mpwapwa cattle was 7 (range: 1–150). Cattle had been sourced through purchase from TALIRI Mpwapwa farm, livestock markets, neighbours and through the on-farm open nucleus breeding scheme. All 32 respondents who kept Mpwapwa cattle reported that the performance was generally better (both cows and bulls) than for other local native breeds.

*Other Breeds of Cattle*

All 100 respondents also kept Tanzania Short-horned Zebu (TSZ) strains (i.e. Gogo, Hehe, or Sukuma) as well as other breeds including Ankole, Friesian (including Friesian crosses), and Jersey cross, with Gogo being the most common (54) (Figure 2). Apart from cattle farming, all respondents were also engaged in other agricultural and economic activities such as crop cultivation, entrepreneurship and other livestock business. Respondents had been keeping cattle for up to 40 years, with individuals starting to do so from 1982 to 2022. A range of reasons for keeping cattle were recorded (Figure 3) with family economic activity (70), family need (11), and inheritance (10) being the most important.

*Farm management*

On most farms, the father was mostly responsible for making decisions (82 of respondents); more rarely the mother (1) or the whole family (17) were involved in decision making. Across farms, livestock-related activities were carried out by a range of people, principally immediate family, relatives and paid labourers. The median farm size across all farms was 12 acres (range: 0.4-500), with a small majority of farmers (56) reporting that this included land they grazed their cattle on. Grazing was the principal feed source for all respondents with most (73) using grazing only, with the remaining 27 also feeding concentrates. Most respondents (59) grazed a combination of natural pastures and crop residues. Feeding regimens are summarised in Table 1, along with use of conserved forage in the dry season. Most respondents (59) grazed a combination of natural pastures and crop residues. Farmers who grazed crop residues were over 6 times more likely to feed concentrates (RR 5.6; 95%CI 1.8 -17.2) than farmers who only grazed natural pastures. In contrast the proportion of grazing-only farmers who owned grazing land (40/73; 54%) was similar to the proportion of grazing landowners amongst farmers who used both grazing and concentrates. (16/27; 59%) (RR 0.93; 95%CI 0.63 - 1.3). A majority of farmers (61) reported feeding preserved forage over the dry period. Of the 61 farmers, 12 reported using hay alone, 21 fenced off pastures or crop residues for use during the dry period, and 26 used hay and fencing, while 2 reported purchasing hay and crop residues. The proportion of farmers who used both grazing and concentrates who reported using preserved forage (16/27; 63%) was similar to the proportion of grazing only farmers who reported feeding preserved forage (44/73; 59%) (RR 1.07; 95%CI 0.74 to 1.47). In contrast, there was an association between owning grazing land and feeding preserved forage. Farmers who owned their own grazing land were more likely to use preserved forage than farmers who did not (41/56 vs 20/44, respectively) (RR 1.61; 95%CI 1.12 to 2.31). Most farmers (69) reported having water shortages during the dry season. Farmers who experienced water shortages were more likely to feed concentrates in addition to grazing than those who did not (24/69 vs 3/31, respectively) (RR 3.59; 95%CI 1.17 to 11.04), but there was no clear association with owning grazing, grazing crop residues or preserving forage for feeding in the dry period (RR 1.23, 1.02, and 1.13, respectively; 95% CI of all these RR include 1).

**Animal health regimens**

Eighty-five respondents reported treating their cattle for intestinal worms. The most common regimen used was treating cattle once cases were observed (32 respondents), with 17 treating based on cattle performance and health condition. Treatment on a routine basis was reported by 36 respondents. Reported intervals between doses ranged from 1 to 6 months, with treatments every 3 months being the most commonly reported regimen (32 respondents). All respondents reported treating their cattle for ectoparasites using dips. Again, the regimens used could be divided into reactive and routine with 42 respondents dipping once cases were observed and 58 dipping routinely. Intervals between treatments on farms that used routine dipping ranged from every 2 weeks to every 3 months, with the most popular being monthly (45). A majority of respondents (74) vaccinated their cattle. There were a range of vaccination regimens, with the two most common being: once cases were observed (41), and once per year (27). Other respondents vaccinated once every 3 months (1); or once every 3 years (5).

**Livestock Breeding**

*Breeding and calving seasons*

Breeding data and outcomes are summarised in Table 2. Most respondents (82) reported that they bred their cows all year round, with only 14 and 4 reporting breeding exclusively in the rainy season or dry season, respectively. The average number of times that cows had calved over the three-year period was not known by 22 respondents. The most common estimate (51 respondents) was that cows had calved, on average, twice in three years (Table 2b). The number of calves born per farm over the last 12 months is summarised in Table 2c. The most frequent range of calves born per farm per year was 1-5 calves (67 respondents), with the highest reported number on a single farm being 80 calves. Of the 88 farms which reported having calves in the last year, 76 were able to state when the calves had been born. Of the 358 calves born on these farms in the previous year, 204 had been born in the rainy season (49/76 farms; 64%) and 154 in the dry season (42/76 farms; 55%). Twenty-four of the 76 farms (32%) reported calves being born in both seasons, much less than the 82% of all respondents who reported breeding cows all year round.

*Breeding cows and bulls*

The mean reported lifespans of breeding cows and bulls were 8.2 and 7.8 years respectively, and the average age of the bulls currently servicing the herd was 5.7 years. Most respondents (76) used homebred bulls for breeding, with the remainder responding that they purchased bulls from neighbours (11) and livestock dealers (13).

**Breeding Programme**

*Breeding goals and bull soundness examination*

Table 3 summarizes the respondents breeding goals and their practices in relation to bull soundness

examinations (BSE). The vast majority of farmers (95) aimed for one calf per year from a cow. Of the 100 respondents, 55 stated that they used BSE, with 54/86 (63%) farmers who only used bulls reporting they used BSE compared to 1/14 (7%) of farmers who used AI in addition to bulls. Across the 55 farmers who stated that they used BSE, the most common reasons for doing so were to check mating ability (33; 61%) and checking body and structural soundness (20; 37%).

*Natural mating (NM) and Artificial insemination (AI)*

Table 4 summarizes the knowledge, attitudes and practice of the respondents towards AI. Majority of

respondents had heard of AI (58 vs 42) but only 18 used it (31% of those who had heard of AI). Of the 40 respondents who had heard of AI but had not used it, the most common reasons for not using AI were lack of access to AI services (including education about AI) (26 respondents; 65%) and insemination cost (9 respondents; 23%). Of the 82 respondents who had not used AI, 52 (63%) would be interested in using it in the future. This includes 23 (54%) of the 42 respondents who had not previously heard of AI and 29 (73%) of the 40 who had heard of AI but had not used it previously on their farm. These data suggest that, in farmers who had not used AI but knew about it, knowledge of AI could increase their likelihood of being interested in using it in the future (RR 1.3; 95%CI 0.95 to 1.9). Of the 18 respondents who had used AI before, 17 (94%), stated that they would be interested in using AI again, resulting in a total of 69 respondents stating that they were interested in using AI in the future. Of these respondents, the main reason for using AI was to improve the genetics of their herd (55/69; 80%). For the 31 respondents who expressed no interest in using AI in the future, the three most important reasons were not believing it works (11; 35%), lack of availability of AI education (10; 32%), and cost (9; 28%).

*Oestrus Synchronization*

Of the 18 respondents who had previously used AI, 13 (71%) had used oestrus synchronization

before AI. All 13 had used synchronisation principally to facilitate mass breeding, and all reported that they had synchronised their cows using a single dose of prostaglandin F2α (PGF). Of the 13 respondents who reported having used synchronisation, 12 (92%) reported that the protocol had been effective.

*Cooperation with TALIRI Mpwapwa*

Of the total respondents 58 stated that they had had a previous relationship with TALIRI Mpwapwa. Nevertheless 84 respondents were interested in collaborating with TALIRI Mpwapwa, with 79 being interested in participating in a trial of AI methods run by TALIRI Mpwapwa, and 83 interested in being involved with an open nucleus breeding scheme undertaken by TALIRI Mpwapwa.

The effect of previous relationship with TALIRI Mpwapwa on interest in participating in reproduction-related research is summarised in Table 5. Irrespective of previous relationship the majority of respondents in both groups were interested in both research options, but the odds of a respondent with a previous relationship being interested were ~4 times higher than the odds of a respondent without a previous relationship (OR 3.67; 95%CI 1.1 to 12.2).

The Mpwapwa breed was developed to fit the environmental conditions encountered by smallholder farmers across the different agro-ecological zones of Tanzania, particularly those areas not suitable for dairy farming [8; 10]. The present survey targeted a group of farmers who were local to the TALIRI research centre and recommended by the local ward livestock extension officer. These farmers are thus the part of the population of farmers that will be targeted by TALIRI Mpwapwa, at least initially, for participation in an AI and fertility program.

No survey of this nature has ever been done within Mpwapwa district, nor indeed anywhere in the entire central zone, or even in the other zones found in Tanzania. The present survey, unlike other surveys undertaken elsewhere in Africa [14; 15; 16; 17; 18], addresses the current situation of fertility and AI programmes in beef cattle production, covering aspects which are generally under-reported in the African continent [19; 20] as well as within the Mpwapwa region in the Tanzanian context. In this regard, limited studies exist on how institutions and social dynamics affect smallholder farmers breeding preferences. As such, there is much work to be done in order to understand the perceptions and preferences of smallholder farmers in breeding programmes with regard to the present institutions and social dynamics. If this is not properly addressed, the result could be continued low adoption and utilisation of AI technology by smallholder farmers [19; 20]. Thus, this survey was designed to identify potential issues which could affect the dissemination of TALIRI Mpwapwa AI and fertility program to these farmers, and thus the impact of that program. Of the 100 respondents, 58 were aware of AI technology. Given that there has been no active AI programme in the region for 23 years apart from previous studies by the first author [11] and the TALIRI Mpwapwa herd breeding programme, this was considered to be a significant achievement. Previous use of AI was very strongly associated with willingness to use it again in the future (17/18 respondents), with the principal issue for these respondents being the prevailing challenges affecting the delivery of AI services. For the remaining 82 respondents it is clear that improving knowledge and understanding of AI in farmers is likely to be crucial for any successful program, alongside ensuring that the program is reliable and cost-effective. It is thus clear that, TALIRI Mpwapwa will need to provide AI education/training to farmers prior to them being involved in the AI and fertility program (or ensure that such education is provided). Nevertheless, it is clear that there is support among target farmers for such a program, and that the re-equipped animal biotechnology laboratory at TALIRI Mpwapwa research centre will be able to leverage smallholder farmers’ willingness to adopt and utilise AI technology into their production systems. One important area of focus for future research is the use of a fresh/liquid semen AI programme as this will reduce costs (as has been for the case of New Zealand: [21; 22]) as well as the reliability of AI services (as it does not rely on the use of liquid nitrogen which has inconsistent availability).

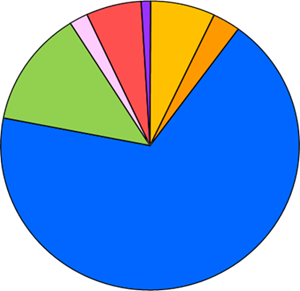
Nevertheless, despite the interest of the farmers in this survey in adopting and utilising AI technology into their breeding programmes, it is important to recognise where AI services presently sit in Tanzania, particularly in non-dairying regions such as Mpwapwa. Currently, AI services are only partially accessible and mainly confined, as a result of high delivery costs and centralisation of AI services [10] to the northern zone of the country. This means that adoption and utilisation of AI technology within Mpwapwa district and the entire central zone of Tanzania is still in its ‘infancy’, and progress is likely to be incremental (at least at first).

Management practices on-farm have a large impact on fertility outcomes, and it is important to acknowledge that, as identified by this survey, the level of management on many farms is likely to be a significant constraint to the success of an AI and fertility programme. As such, for effective adoption and efficient performance of that program, we need to focus on improving management practices on smallholder cattle farms. These improved management practices will not only enhance the performance of the AI technology, but also improve beef cattle productivity more generally [23; 24]. This is likely to require education, either through TALIRI or from partner organisations.

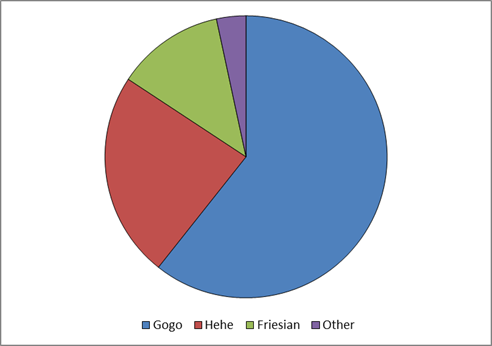
It is clear that the use of AI in cattle can result in improved reproduction and productivity through increased genetic gain, reduced generation interval, and control of the spread of venereal diseases [25; 26; 27]. The contribution of AI technology to cattle improvement is evident in countries within and outside the African continent that have similar climatic conditions to Tanzania. For example, countries in Africa (e.g. Kenya, Ethiopia and South Africa) and South America (e.g. Brazil, Argentina, Mexico and Peru) have used AI technology widely and managed to utilise it within smallholder farmers’ settings [28; 18]. Many studies have evaluated the effect of adoption and utilisation of AI technology on smallholder farmers (e.g. [28; 29; 30; 16; 18]). Generally, almost all studies show the positive impact of the use of AI on livestock genetic gain and productivity and, hence, the livelihood of smallholder farmers. However, getting smallholders to fully adopt the use of AI can be complex and difficult as research from India shows [31]. The principal limitations identified by that study were: inadequate number and training of AI technicians, inefficient oestrus detection methods, low conception rates, high charges for AI services, undeveloped AI facilities/infrastructure, ineffective post-AI nutritional management plans, as well as the unreliability of AI services and AI service providers. The same limitations also apply within the Mpwapwa district [32], and although it is anticipated that the TALIRI Mpwapwa AI and fertility programme will solve most of the reliability and infrastructure issues, the adoption and progress of AI technology by farmers within Mpwapwa district will still be limited by the lack of appropriate herd health, fertility, and nutrition programs alongside the lack of proper record keeping.

One key area identified by the present survey is the variability in routine management procedures (such as drenching and dipping) across respondents, which is also matched by the variability in nutritional arrangements. Optimising herd health and nutrition are therefore both critical for achieving the goals of the TALIRI Mpwapwa AI and fertility program.

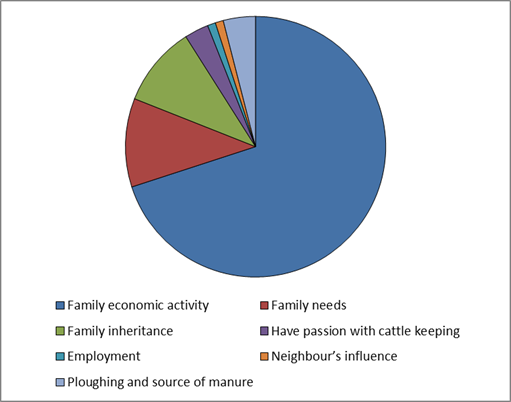
At the time of the survey, the previous breeding programme for smallholder farmers led by TALIRI, which used an open-nucleus breeding scheme with Mpwapwa breed bulls, had fallen into disuse. Instead, farmers had reverted to using unproved and untested homebred bulls to breed their cattle with no specific focus on a breeding programme. This has led to significant inefficiencies in breeding. For example, although 95% of respondents had a target of having one calf per year per cow as their breeding goal, only 10% of respondents reported that they achieved this. Similarly, although 82% of respondents reported breeding cattle throughout the year, only 32% of farms who knew when calves were born reported that calves were born in both the rainy and dry seasons.



**Figure 1:** Maximum education level of farmers from the 14 selected villages of the Mpwapwa district.  Never attended school,  Never completed primary school,  Completed primary school only,  Completed secondary school,  Adult education,  College,  University.



**Figure 2:** Other breeds of cattle kept by farmers from the 14 selected villages of Mpwapwa district in addition to Mpwapwa breed cattle. Gogo 54, Hehe 21, Sukuma 1, Friesian 11, Ankole 1 and Jersey 1.



**Figure 3:** Reasons for keeping cattle reported by farmers from the 14 selected villages of Mpwapwa district.

**Table 1**: Reported feed sources for 100 cattle farms in the Mpwapwa region of Tanzania

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| *Principal feed source* | | *Feeds grazed* | | *Own grazing land* | | *Conserved forage in dry season* | |
| Grazing | 73 | Natural pastures | 38 | Yes | 40 | Yes | 44 |
| Natural pastures  / crop residues | 35 | No | 33 | No | 29 |
| Grazing plus concentrate | 27 | Natural pastures | 3 | Yes | 16 | Yes | 17 |
| Natural pastures  /crop residues | 24 | No | 11 | No | 10 |

**Table 2 (a-c)** Season of breeding and outcomes (calvings and calves) as reported by farms in 14 selected villages in Mpwapwa district (n = 100)

|  |  |
| --- | --- |
| a) *Season in which cows are bred* | |
| Season | Farms |
| All year round | 82 |
| Dry season (Jun – Dec) | 4 |
| Rainy Season (Jan - April) | 14 |
| Total | 100 |

|  |  |
| --- | --- |
| b) *Average calvings/cow in last 3 years* | |
| Range | Farms |
| 1 x | 17 |
| 2 x | 51 |
| 3 x | 10 |
| Don’t know | 22 |
| Total | 100 |

|  |  |
| --- | --- |
| c) *Calves born/farm (last 12 months)* | |
| Range | Farms |
| None | 12 |
| 1 – 5 | 67 |
| 6 – 10 | 15 |
| 11 – 15 | 1 |
| 16 – 20 | 3 |
| ≥21 | 2 |
| Total | 100 |

**Table 3.**  Breeding goals, reliance on bulls and use of bull soundness examination (BSE) by Mpwapwa district farmers

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| *Breeding goal for your cattle* | |  | *Do you rely only on bulls for breeding?* | |  | *Do you conduct BSE on your bulls?* | |
| Goal | Response frequency |  | Response | Response frequency |  | Response | Response frequency |
| 1 calf/cow/year | 95 |  | Yes | 86 |  | Yes | 55 |
| No goal | 5 |  | No | 14 |  | No | 45 |
| *Total* | 100 |  | *Total* | 100 |  | *Total* | 100 |

**Table 4** Knowledge, use, perception and interest in relation to using artificial insemination (AI) to bred cattle of Mpwapwa district farmers

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| *Have you heard about AI?* | |  | *Have you tried AI to breed your cattle?* | |  | *If you have heard of AI, do you prefer natural mating over AI?* | |  | *If you have not used AI, would you be interested in trying it?* | |
| Response | Response frequency |  | Response | Response frequency |  | Response | Response frequency |  | Response | Response frequency |
| Yes | 58 |  | Yes | 18 |  | Yes | 32 |  | Yes | 52 |
| No | 42 |  | No | 82 |  | No | 25 |  | No | 30 |
|  |  |  |  |  |  | Both | 1 |  |  |  |
| Total | 100 |  | Total | 100 |  | Total | 58 |  | Total | 82 |

**Table 5** Association between previous relationship with TALIRI Mpwapwa and interest in reproduction-related testing

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  | *Interested in a test of AI methods* | |  | *Interested in an open nucleus breeding*  *programme* | |
|  |  | No | Yes |  | No | Yes |
| *Previous relationship with TALIRI* | No | 16 | 36 |  | 13 | 39 |
| Yes | 5 | 43 |  | 4 | 44 |

4. Conclusion

The Mpwapwa breed is specifically designed to be suitable for smallholder farms in non-dairying areas of Tanzania. However, in recent years there has been negligible genetic progress of the breed, and even local farmers are no longer benefiting from a continually improving productive cow designed for their conditions. It is clear that a different strategy is needed if we are to improve productivity of beef and dual-purpose cattle in Mpwapwa and other similar districts. Recent developments at the TALIRI Mpwapwa laboratory mean that it can act as a focus and base for the development of a new AI and fertility program designed for smallholder cattle. However, for such a program to be successful, we need to understand the perceptions and preferences of smallholder farmers towards such a program. This survey has shown that there is clearly an appetite within the target population for such a program, but for it to be successful we need a focus on education and training around AI and breeding management, and that this needs to be combined with improving the standard of animal health and nutrition management on target farms. If this is effective, then, we believe that TALIRI Mpwapwa can provide a reliable cost-effective AI and fertility service.

Ethical approval

Research ethical clearance was obtained from the Tanzania Livestock Research Institute (TALIRI) (Feb 2022).

**Disclaimer (Artificial intelligence)**

Author(s) hereby declare that no generative AI technologies such as Large Language Models (ChatGPT, manuscript.

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