Deutscher Tropentag 2004
Berlin, October 5-7, 2004

Conference on International Agricultural Research for Development

Open Nucleus Cattle Breeding Programme in the Lake Victoria Crescent Region of Uganda

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Abstract
The availability and accessibility of livestock products, facilitated by efficient farm production, is highly recognized by Uganda as one of the major ways of alleviating poverty. Although animal genetic improvement offers one of the most powerful and cheapest means of improving the productivity of farm animals, its effective exploitation has been hampered by lack of well planned and executed breeding programmes. With the help of the open nucleus breeding strategy, recommended by many authors for developing countries (Bondoc et el., 1993; Smith, 1988; Kahi et el., 2004), the National Animal Genetic Resources Centre and Databank (NAGRC&DB) is making efforts to put systematic cattle breeding programmes in place. The essence of this study therefore, is to evaluate a range of open nucleus plans (genetical and operational) for the Holstein-Friesian and Ankole (local) cattle breed populations. The best plans will then be recommended for execution. The study covers the Lake Victoria crescent region in Uganda, a region with an on-going Herd/Milk Recording Scheme, which has provided much of the data. SelAction (computer programme) which uses deterministic simulation, will be used in the evaluation of the different genetic plans. The modes of operation (modus operandi) of the nuclei are to be derived from other studies and literature.

1. Background and aim of the study

The multifaceted role of livestock in combating rural poverty, and enhancing food security in terms of quality and quantity makes it an indispensable tool in development. Increasing the availability of nutrients, especially of protein, produced by farm animals is one of the ways out of poverty and malnutrition prevailing in many developing countries. The per capita availability of livestock products in Uganda is 40 litres of milk and 5.6 kg of meat, a pathetic level compared to the FAO recommendations (FAO, 1974-1977) of 200 litres and 50 kg, respectively.

At the political level, Uganda has responded to this problem by making animal breeding an important component of its Poverty Eradication Action Plan (PEAP), which is a comprehensive development framework (MAAIF/MFPED, 2000). The National Animal Genetic Resources Centre and Databank (NAGRC&DB), a body corporate under the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF) with the mandate to oversee animal breeding activities in the country, is trying to streamline cattle breeding programmes in the country. The legal basis of its operation is a law entitled "The Animal Breeding Act" (Nakimbugwe et al., 2002). Uganda is one of the few developing countries which have recognised the importance of livestock breeding up to this level.

In response to the agro-ecological diversity, suitable for different types and breeds of cattle, NAGRC&DB has plans and/or operates countrywide, several large cattle breeding stock farms with different types of breeds (Holstein-Friesian, Jersey, Simmental, Ankole, Nganda, Short horn Zebu, Boran). These farms are expected to act as nuclei in open nucleus schemes, where superior animals are multiplied at a central farm (nucleus), distributed to farmers and the best animals from the farmers are brought back to the central farm for further breeding. The best bulls are recruited for semen production in the bull stud. Their germplasm is distributed via artificial insemination, a technique well developed and used in Uganda.

During the diagnostic survey carried out in 1997, under the Livestock Systems Research Programme (LSRP), farmers explicitly pointed out the lack of **productive adapted genotypes** for their production systems as a major hindrance to livestock production. The diagnostic survey, a component of the Farming Systems Approach in which the farmer is the core and motor of all activities, was conducted by a multidisciplinary team which identified priority areas of research through a process of stakeholder consultation and field diagnosis. Its objective was to describe and understand the production systems (what, where, when, why, who, how?); identify, prioritize and analyse major problems; and explore potential solutions/interventions (LSRP, 1999).

Breeds developed in the temperate regions of Europe and North America (called "exotic breeds" in tropical countries) have the potential of producing milk at a much higher level than local breeds. This has been recognised long ago and pure breeding and cross breeding with such animals, especially of the Holstein-Friesian breed, has been carried out in many tropical countries (CIDA, 1992; Cunningham et al., 1987; Kahi et al., 2003; MAAIF, 1997). Many programmes, systematic or based on individual entrepreneurship, have failed because of the lack of adaptation of exotic breeds to tropical conditions resulting in poor performance and quick deaths of imported or even crossbred animals. Nonetheless, exotic breeds fit very well into particular agro-ecological niches of Uganda where the climate is moderate (temperatures not exceeding 30°C) as long as the disease pressure from, e.g., East Coast Fever (ECF) is controlled by regular immunisation, tick control or treatment. Under such conditions, Holstein-Friesian cows produce 5 to10 times more milk than local breeds at a sustainable level. This provides an option to substantially increase production of animal protein and individual incomes of farmers while keeping the pressure on agricultural land reasonably low. Such a scenario has led to the development and increasing adoption of a special "cut and carry" (zero grazing) system for smallholder farmers combining agriculture and livestock production in the highly prolific areas close to markets. Holstein-Friesian is the most popular exotic/temperate dairy breed among such production systems focused on high milk producing animals. Preference for this breed is highlighted by Wakabi (2000) who quoted, Mr. Museveni, Uganda's head of state, as having been perplexed by fellow tribesmen who demand for only Friesian cows as bride price.

Acquiring independence from semen imports from Europe and North America plus evaluating the potential of bulls under local conditions, i.e. developing a "tropicalised" type of Holstein-Friesian is a reasonable development goal. Enough genetic variation within the population of the breed exists, given that its importation into the country dates way back to 1962. Massive importations of live animals in the 1970s and 1980s from Canada and Germany respectively, have been compounded with semen imports from all over the world, notably, the USA, Denmark, Sweden, South Africa, New Zealand and Kenya (MAAIF, 1997). The planned selection within the Holstein-Friesian population in Uganda is to capitalize on this variation. The centrally located Njeru stock farm is to spearhead and serve as a nucleus in the improvement of the Holstein-Friesian population.

The on-going indiscriminate massive crossbreeding of the indigenous long horned Ankole cattle with more productive exotic breeds in terms of milk is a response to the prevailing market forces that favour high milk producing cattle. These forces are a threat to indigenous cattle breeds reputed for their adaptability to the local environment and having a great cultural significance to their local keepers. Conservation of the Ankole through selective breeding to improve on its milk production has been NAGRC&DB's answer to this dilemma. Nshaara stock farm, located in the traditional Ankole cattle keeping area in Southwestern Uganda, is to spearhead and serve as a nucleus for the Ankole cattle population.

This study is part of conceited efforts to provide a solution to the aforementioned farmers' concern of lack of **adapted productive genotypes**. Its overall objective is to develop a sustainable dairy cattle improvement programme for increased milk production so as to improve on the nutritional status and income of farmers. The specific objectives are:

1. Estimate reproductive biological coefficients, essential amongst others in decision making and for designing of breeding programmes, for the Holstein-Friesian and Ankole cattle breed.

2. Simulate various breeding (genetic) plans for both the Holstein-Friesian and Ankole cattle breed in order to find out optimal ones for recommendation in developing and conservation of vital genotypes to meet present and future demands.

3. Work out operational plans (modus operandi) for the Holstein Friesian and Ankole breed nuclei.

2. Materials and Methods

2.1. Study area

The area of study covers the Lake Victoria crescent region found in the Southern part of Uganda. It was selected for the following reasons:

a. An operational Herd/Milk Recording Scheme (HRS), under the management of NAGRC&DB and targets mostly exotic dairy cattle and their crosses, is found in this area. About 200 farmers with approximately 600 milk recorded animals are on this scheme. Record keeping promoting independent bodies like NGOs (e.g. Send-a-Cow, Heifer Project International) and breeding firms (e.g. World Wide Sires) are also very active in this area, an attribute which brought in more data for the study.

b. The region is heavily populated prompting farmers to appreciate more, the fact of increasing production per animal through genetic improvement.

c. The LSRP diagnostic survey was carried out in six districts which are found in this region. Therefore, farmers in this area would highly appreciate the outcome of this study because they were part of the team that identified this research area as a means of intervention to low livestock production.

d. The Ankole cattle are kept mostly in the southern part of the Lake Victoria crescent.

2.2 Production systems

The targeted production systems for the Holstein-Friesian breed

a. The zero-grazing system
It is an intensive system of "cut and carry" stall feeding with recycling of manure in and around urban areas with a good market for milk but where land is scarce. Most farmers in this system, mostly women, have one to three exotic or crossbred cows and rely entirely on artificial insemination (AI) for breeding their animals.

b. The fenced dairy farming system
This is an intensive or semi-intensive system where three or more exotic or crossbred animals are kept in fenced units, mostly with improved pastures, because of their high susceptibility to tick-borne diseases. Farms with few animals depend on artificial insemination (AI) for breeding their cows while medium and large-scale farms may at times have their own bull.

The targeted production system for the Ankole breed

c. Enclosed ranching
It is an extensive system usually with mixed herds of indigenous livestock (cattle, goats and sheep). Both milk and beef production plays an equal role in this system.

2.3 Nucleus farms

As part of the planning process, an analysis of the status quo on nucleus farms as regards their production systems was done.

a. Njeru stock farm
Lies on one of the short grass lush hills along the northern shores of Lake Victoria. The farm occupies a total area of 302 ha capable of supporting 275 livestock units (LU) at a stocking rate of 1.1 ha/LU. Currently, it has 167 LU of different grades of the Holstein-Friesian breed. Most of these have been screened from the existing population from farmers in the zero grazing and fenced dairying production systems that keep some form of records and use AI.

b. Nshaara ranch
Located in Southwestern Uganda, in a region characterized by a savannah shrub type of vegetation. It covers a total area of 6,000 ha capable of grazing 3,000 LU at an estimated carrying capacity of 2 ha/LU. Currently, it has 1,617 LU mainly of the long horned Ankole cattle breed. The founding stock was screened from farmers in the enclosed ranching system most of which do not keep records. Therefore, selection was based on oral information and physical appearance of the animals.

2.4 Data collection, compilation and analysis

An MS Access database was created for both the Ankole and Holstein-Friesian breeds. Data for the former was entirely compiled from records kept at Nshaara ranch since Ankole farmers rarely keep records. For the latter, data was compiled from record forms used by farmers on the Herd/Milk Recording scheme, farmers under the supervision of

NGOs and private breeding companies, University farms, and independent progressive farms. Further information was got from the following databases:

- Panacea, a database created in the early 1990s during a study of dairy farmers in Southern Uganda. The Panacea programme was developed by the Pan Livestock Services of the University of Reading, England.
- AIDA (Artificial Insemination Database Application), developed by the International Atomic Energy Agency (IAEA), is used by NAGRC&DB in compiling AI data.

Using the three databases, an estimation of the biological coefficients with SAS was done.

2.5 Use of published and unpublished literature

Use is to be made of published and unpublished literature especially from tropical studies.
Some genetic and phenotypic population parameters needed for the genetic plan will be derived from other studies especially from neighbouring Kenya. Ideally such estimates should come from experiments with the particular population used in the breeding system (Kahi et al., 2004). Since this is difficult to achieve, as in the case of Uganda, estimates are usually got from a search of literature (Koots et el., 1994a, b).
The operational plan in this study refers to the organization and logistics needed in running of the nuclei. For example, the conditions to be met by the cooperating farms, regularity of farm visits by record assistants, the infrastructure needed at nucleus farms, appropriate incentives for farmers etc. Much of this information will be got from analyzing literature.

2.6 Simulation

Breeding plans will be simulated using SelAction, a deterministic simulator. Basing on the biological, population and economic parameters, SelAction will calculate the annual genetic gain for the breeding objective.

3. Results so far

So far, only the biological coefficients for the Holstein-Friesian population have been worked out (see table 1). Results of milk yield per lactation are comparable to those got in other tropical countries (Syrstad, 2004; Demeke et al., 2004; Rege, 1991). The long calving interval can be attributed to poor adaptability and poor herd management of the breed. Services per conception i.e. 1.7 is relatively good. However, use of natural bulls especially in the fenced dairying production system is common.

Table 1. Biological coefficients – Friesian Population[1]

Trait	Unit	n (numbers evaluated)	m (mean)	s_P (phenotypic standard deviation)	C.V. %	Minimum	Maximum
1. Milk yield	kg	361	3313	987	29.8	766	7293
2. Lactation length	days	361	336	85	25.3	172	714
3. Calving interval	days	271	449 (411.6)[2]	100 (96.8)[2]	22.3 (23.5)[2]	306	864
4. Age 1st Calving	months	122	30.96 (35.1)[2]	5.93 (8)[2]	19.2 (22.8)[2]	20	48
5. Services per Conception	services	844	1.7	1.09	64.1	1	6
6. Bull Age 1st offspring born	years	9	2.37	0.19	8.02	2.1	2.7

4. Conclusion

In many developing countries, the dominant issues relate to reducing under nutrition, enhancing food security and alleviating poverty (FAO, 1995), an important indicator of poverty. The role of animal breeding in improving on the availability and accessibility of livestock products is highly appreciated by Uganda, which has made it an important component of is Poverty Eradication Action Plan. Given the socio-economic and political situation, the Open Nucleus Strategy has been recommended for use in streamlining cattle breeding programmes in the country. This strategy will enable farmers to be provided with productive adapted genotypes, a need they expressed during the LRSP diagnostic survey. Holstein-Friesian, a popular temperate high milk producer, can fit well in certain agro-ecological niches and production systems in Uganda. Improving on is adaptability through in-country based breeding programmes is a sustainable realistic approach. Market forces that favour high milk producers, have overridden the cultural significance and the good adaptability to local conditions of the Ankole cattle leading to its inexorable dilution with exotic genes. Improving on the milk production of the Ankole through selective breeding, is a plausible approach to conserve the breed. Since genetic changes are usually permanent in nature, thorough planning of animal breeding programmes is important to avoid making changes in the wrong direction. Implementation of these programmes is also long term in nature so valuable time and resources should not be wasted due to poor planning. A detailed analysis of a potential intervention and predicting its outcome is essential. This study, therefore, aims at evaluating a number of genetic and operational breeding plans for the Ankole and Holstein cattle breeds and is to recommend the best ones for implementation.

[1] Data analysed covers a period from November 1975 – February 2002.

[2] Figures in brackets are for the Holstein-Friesian population in Kenya (Rege, 1999). For comparison with results got in Uganda.

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