A PROPOSAL FOR THE GENETIC IMPROVEMENT OF RABBITS FOR SMALLHOLDER UNITS IN NIGERIA

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ABSTRACT

Sustainable long-term genetic improvement programmes designed to assist smallholder rabbit producers in sub-Saharan Africa have recorded low levels of success. Reasons for this trend could be attributed to uncoordinated and poorly defined research agenda, research priorities that are not tailored towards the needs of end-users (backyard rabbit units) and heavy dependence on foreign aid, exotic breeds and lack of facilities needed to implement such programmes. The current presentation gives a conceptual framework for the implementation of a genetic improvement scheme specially designed for smallholder rabbit farms, so as to serve as a model to stabilize and promote such operations in sub-Saharan Africa. The dual objectives are: (a) to develop a line of domestic rabbits with productive adaptability to the conditions in smallholder units in southern Nigeria, and (b) to establish a management support package based on renewable local resources for the developed line. To achieve these objectives, and based on detailed consultations with village rabbit project leaders, a 120-doe closed nucleus breeding unit, comprising of a heterogeneous population of rabbits, will be established. Selection criteria will be based on a combined index for annual numerical doe productivity, a composite trait that reflects productive adaptability under smallholder conditions. Concurrently, a management support package based on renewable local resources (e.g. *ad libitum* forage and palm kernel cake–based concentrate, due to its relative low-cost and year-round abundance) will be included. A dissemination process for the genetic stocks with the accompanying management package, as well as a feedback system for backyard rabbit keepers will be established. Details on project funding and sustainability are discussed. The ultimate goal is for the nucleus centre to serve as a major source of quality genetic stocks and an accompanying management support package specifically designed for smallholder units.

Key words: Smallholder rabbit units, Genetic improvement programme, Productive adaptability.

INTRODUCTION

Lukefahr (2004) proposed the Small Scale Rabbit Production Model (SSRPM) as a holistic and sustainable model for subsistence rabbit project development. Among the internal factors mentioned in the model is the need for appropriate genotypes and support systems (nutrition, housing, healthcare) suitable for such operations. In Nigeria, a major limitation to the development of smallholder rabbit production is the absence of reliable sources for quality genetic stocks of rabbits (Oseni *et al*., 2008). This study showed that the availability of such centres could actually facilitate the development of backyard rabbit units through the provision of suitable stocks, as well as serve as a coordination and information exchange centre specifically designed for smallholder operations. Previous efforts in genetic improvement programmes in Nigeria have been largely uncoordinated (Somade and Adesina, 1990; Odubote *et al*., 1995) and were based on two- or three-way crosses among the most common commercial meat breeds (New Zealand White, Californian, Chinchilla, etc), under on-station conditions - studies that were mostly not tailored towards the needs of smallholder rabbit units. Currently, the stocks of rabbits used in backyard rabbit systems in many developing countries are heterogeneous populations derived either from crosses between local breeds and exotic meat type commercial rabbits or from crosses among exotic rabbit breeds (Opoku and Lukefahr, 1990; Lebas *et al*., 1997; Lukefahr, 2000). It has been emphasized that there are some inherent advantages in the use of such heterogeneous stocks on account of their performance under on-farm conditions (Lukefahr,

2000). Some authors (Valle Zarate, 1996; Olivier *et al*., 2002) have suggested that genotypes selected for any production system should be those that are able to survive and produce efficiently under the prevailing environmental stresses. A major challenge however, is how genetic variability for adaptation and performance traits can be exploited in small-scale production, preferably, using local resources. Lukefahr and Cheeke (1991a) have suggested that research priorities in developing countries should focus on the development of suitable genotype(s), as well as an accompanying management support package for smallholder units, based on renewable local resources. One such renewable resource in Nigeria is the palm kernel cake (PKC), which according to reports (Aduku *et al*., 1988) can be included up to 30% or higher in a maize-soybean based diet for growing rabbits, without any adverse effect on the performance of animals. Major advantages of PKC-based diets, according to these authors, include its year-round availability, abundance and low cost. Grant *et al*., (1996) noted that PKC-based diets have a suitable nutrient composition for rabbits. Currently, there are no rabbit research and development programmes tailored towards the needs of smallholder units in most countries in sub-Saharan Africa. Thus, the objectives of our proposal are to examine options and strategies for the development of a rabbit line suitable for smallholder operations, as well as the design of a management support package for such units in Nigeria.

METHODOLOGY

The description of the proposed genetic improvement scheme is based on the guidelines described by Galal *et al*. (2000).

1. *Rationale and justifications for the scheme:* A new research agenda hinged on a clientele-based research and development (R&D) that focuses on the critical needs of smallholder units, by employing the SSRPM described by Lukefahr (2004). There is no genetic improvement programme for meat rabbits under smallholder units in Nigeria, in spite of the high country ranking provided by Colin and Lebas (1996), that Nigeria has over one million breeding does, of which over two-thirds are raised under subsistence conditions. Also, there is no national rabbit programme (NRP) in Nigeria. Further, there are no reliable and steady sources of good quality breeding stocks for smallholder operations in Nigeria (Oseni *et al*., 2008). After due consultations with owners of smallholder rabbit units, the establishment of a nucleus centre may help to jump-start the processes towards a NRP.

2. *Options for the development of suitable genotypes for smallholder unit:* We are proposing the use of locally available heterogeneous stocks of rabbits as are currently being used in many smallholder operations (Odubote *et al*., 1995; Lukefahr, 1998; Oseni *et al*., 2008). These stocks are the result of various crosses of purebred stocks. Lukefahr (2000) noted that such heterogeneous populations are usually more suitable for small-scale extensive production systems than recently imported stocks. Such populations, having being used in backyard systems for many years, possess some degree of "productive adaptability", which Horst (1984) defined as the ability of an animal to give some acceptable level of performance, under a stressed environment. Lukefahr (1998) suggested that the creation of a synthetic line(s) or breed(s) based on such heterogeneous populations is an attractive alternative. Our strategy is to exploit these heterogeneous populations in the development of suitable genetic stocks for backyard rabbit units.

3. *Approach to establishing the breeding goal and traits included in the selection criteria:* Small- and ultra-smallholder rabbit units in southern Nigeria are typically established as backyard systems to provide principally, meat for the family and occasionally, generate income through the sale of excess stock (Oseni *et al*., 2008). The main target of the production of rabbits under smallholder operations is to obtain 4 to 5 litters per doe per annum, with 4 fryers surviving per litter, which translates to 16 to 20 fryers per doe per year, which, for a 4-doe unit, yields 64 to 100 fryers per year. As report by Oseni *et al*. (2008), this level indicates that even this minimal output under subsistence conditions is barely met by a significant proportion of the producers. Numerical doe productivity (measured through the number of weaners per doe per year) was therefore considered as the key goal for improving the performance of rabbits under subsistence conditions. Thus, the breeding objective of our proposal is to improve numerical annual doe productivity by developing a line of meat rabbit that is suitably adapted to the subsistence conditions of smallholder rabbit units in the humid tropical southern Nigeria, and thus, provide smallholder rabbit keepers with improved breeding stocks. Selection criteria include: number of matings to conception, litter sizes and weights at kindling and at weaning and kindling

interval. These traits are all related to annual doe productivity. Conventionally, genetic evaluation based on several traits requires the weighting of the corresponding estimated breeding values (EBVs). Economic weights for the traits included in the selection criteria can be calculated, based on data of costs and prices. However, for smallholder operations where inputs are mainly based on renewable farm resources under resource-limited conditions, such conventional approaches would prove difficult to implement. Thus, in setting the breeding goal, there were no economic values assigned to these objectives and selection was based on a combined index of annual doe productivity of weaner rabbits.

4. *The breeding plan*: The breeding plan for the actualization of our breeding objective is the use of a closed nucleus breeding unit, with village backyard rabbit units as the base populations.

a. Animals: The proposed nucleus will comprise of a 120-doe closed unit, made up of heterogeneous stocks of rabbits sourced from all nooks and crannies in southern Nigeria. This is to create as diverse a population of rabbits as possible for the foundation stock. A total of 150 animals, consisting of 120 does and 30 bucks will be maintained in the nucleus. These animals will comprise of ten sire families (of 12 does and 3 bucks, one and two alternates per family). Each breeding animal will be identified by ear-tattoo and kept individually in cages. Animals will be housed on-station at the Rabbit Unit of the Agricultural Research in a national university in Nigeria. Data collection will include separate recording cards for does, bucks and litters, within each family.

b. Breeding programme: On account of the sub-optimal level of management in many smallholder units, reproduction will not be intensive, since the feeding is based on affordable PKC-based diets described below. At a kindling interval of 66 days (or 5.5 kindlings per doe per year), and assuming an average of 5 fryers surviving per litter, total progeny will be 3,300. Assuming equal sex ratio, this translates to 1650 weaners for each of the sexes. Selecting 30 and 120 replacement males and females respectively, gives a selection intensity of approximately 2% (or i_m=2.054) for males and 7.3% (or i_f = 1.887) for females (Falconer and Mackay, 1996). The proportion selected can be doubled (i.e. 5% for males and 15% for females) to account for losses due to culling, poor fertility or attrition (Lukefahr, 2000). Details are presented in Figure 1. Selection will be based on a combined index of numerical annual productivity of weaners in separate generations, as used by Matheron and Rouvier (1977, as described by Lebas *et al*., 1997). This was based on the results for the selection of a strain on the basis of litter size at weaning in INRA, France. Detailed theoretical framework for combined selection is presented by Falconer and Mackay (1996). Such a selection strategy will increase the annual total fryer yield per household.

c. Management support package: Concurrent with the development of an adaptive line of rabbits for smallholder units, a management package will be developed, based on the resources that the resource-limited farmers have access to, or can afford. Such a management package will be labour- rather than capital intensive and easy to establish and manage.

(i) Nutrition: emphasis will be made on the use of palm kernel cake–base diets, using the results of Aduku *et al*. (1988). The diet reportedly gave an average daily gain of 19g (Aduku *et al*., 1988). While this is not very impressive, it represents the type of ration that most smallholder units can afford. (ii) Healthcare management in the nucleus will follow a hygiene and preventive healthcare plan (Lebas *et al*., 1997).

d. Dissemination and multi-locational testing: (a) *Dissemination* - The dissemination process will be on-going, since part of the goal is to have a reliable centre for the acquisition of rabbit breeding stocks for backyard units. As breeding and selection continues in the nucleus, it is hoped that the centre will produ-ce stocks of does, that are, on the average, better than any randomly picked doe in the base population. (b) *Multi-locational testing*: Data capture forms will be designed for on-farm recording and monitoring in backyard units in villages. Regular feedback information from the farmers will be accommodated.

5. *Sustainability*: Options for sustaining the breeding programme include: (a) Funding sources, principally from local and national government, who have a critical role to play in initiating and implementing a comprehensive policy for smallholder rabbit development. That such programmes can succeed have been well demonstrated in Mexico (Lebas *et al*., 1997), the Benin Republic (Kpodekon *et al*., 2000) and Ghana (Opoku and Lukefahr, 1990). Grants and technical support from external sources (e.g. FAO Telefood, Heifer International, Winrock International, etc) can be nested within the main R&D programme. (b) Cost reduction measures include sourcing of all inputs (foundation stocks, feeds, housing materials, etc) locally. (c) Revenue generation through the sale of breeding stocks. (d)

Collaboration and synergy among international funding agencies with a common plan and agenda may also help. (e) Links with organizations having similar mandates and breeding schemes (e.g. CECURI in Benin Republic, DGAEM in Mexico, Crusader Rabbit in Australia, etc. and (f) A sense of project ownership is paramount to the ultimate project success (Lukefahr, 2007). In this regard, full participation of project leaders from each village will be a cardinal key in the implementation of the project. The ultimate goal is to handover the centre to village project leaders to manage and maintain the existing structures.

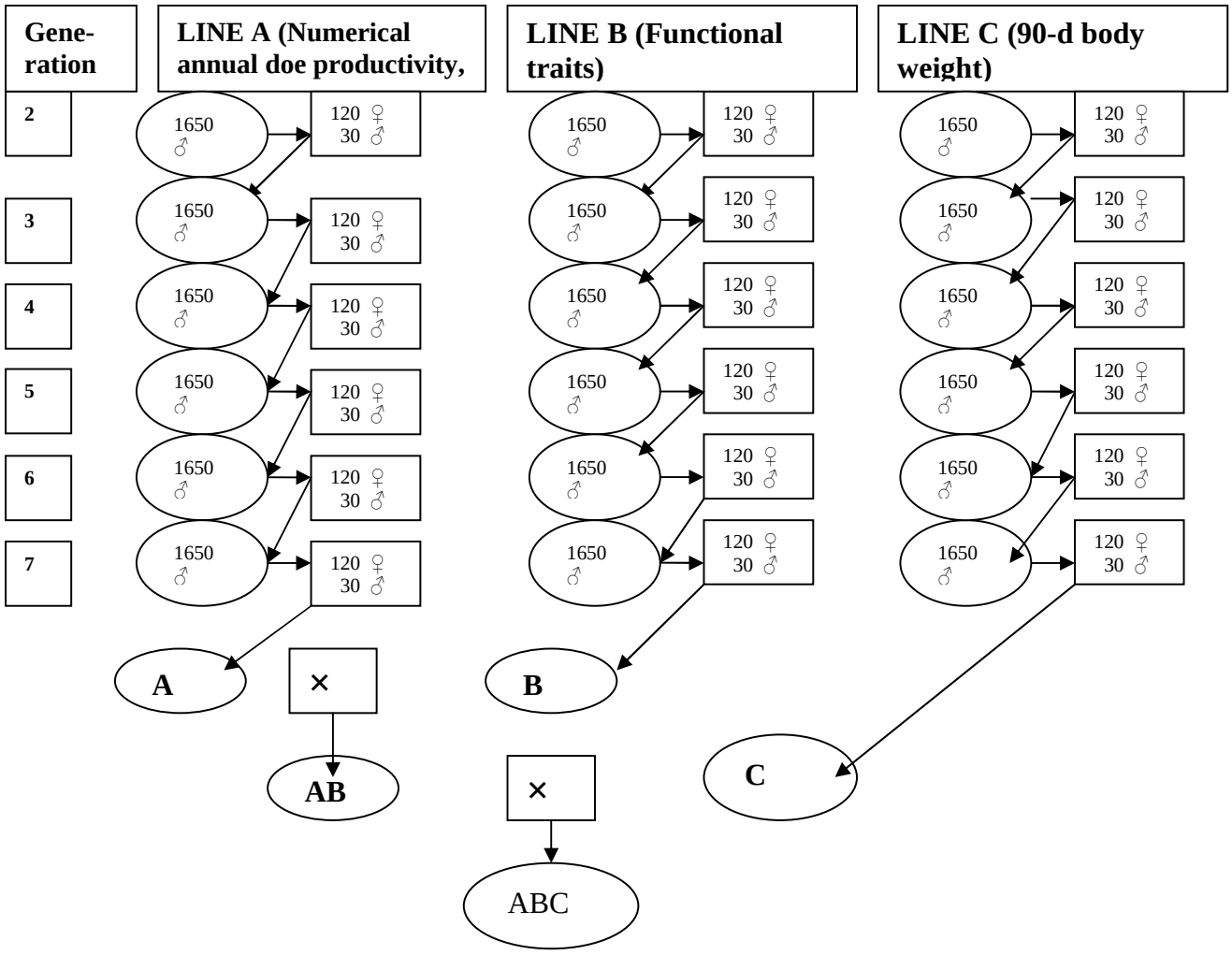

Figure 1: Schematic representation of a breeding programme for the development of suitable rabbit line for smallholder rabbit units in the humid tropics

DISCUSSION

Our proposal highlights options in R&D programmes that are oriented towards smallholder rabbit production. In the short term, the focus is on productive adaptability, measured through annual doe fryer yield for rabbits fed palm kernel cake (PKC)-based diets and *ad libitum* forage. Selection for productive adaptability is assumed to reflect traits that include adaptability and performance under sub-optimal condi-tions. After a comprehensive evaluation of the short-term breeding objectives, medium to long-term plans will involve some modifications of the existing breeding objectives to include: (a) functional traits – ear length, fur density, body surface area, fertility during hot months, forage intake capacity, thermo-tolerance (Lukefahr, 1998) and (b) 90 d body weight (Opoku and Lukefahr, 1990). An illustration of the breeding and selection plan for the long-term plan is shown in Figure 1. Ultimately, three lines of rabbits based on (a) annual doe fryer yield, (b) functional traits and (c) 90-d body weight will be developed for further genetic evaluation. Some likely impact of the proposed project include the following: a) it may engender endogenous small scale rabbit project

development by insisting on local solutions to problems of such units by facilitating a clientele-based approach to R&D in smallholder rabbit production; b) delivery of a dual package of improved stocks of rabbit and an accompanying management support package suitable for such holdings; c) create greater awareness, renewed interest, strengthening and promotion of backyard rabbit production activities and d) creation of an information resource centre for smallholder units.

CONCLUSIONS

We proposed a genetic framework for the development of line of meat rabbits suitable for smallholder units. A range of issues including options, methodology and sustainability were considered. It is hoped that the arguments presented will stimulate further discussions towards the realization of the goal to boost food security among impoverished families.

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