PROCEEDINGS OF THE ANIMAL PRODUCTION SOCIETY OF KENYA ANNNUAL SCIENTIFIC SYMPOSIUM

THEME: "INCREASED LIVESTOCK PRODUCTIVITY FOR FOOD SECURITY AND WEALTH CREATION".

HELD AT BOMEN HOTEL, ISIOLO, KENYA ON 8-10TH MARCH 2006

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SPEECH BY HON. JOSEPH K. MUNYAO, M.P., MINISTER FOR LIVESTOCK AND FISHERIES DEVELOPMENT, DURING THE OFFICIAL OPENING OF THE ANNUAL SCIENTIFIC SYMPOSIUM OF THE ANIMAL PRODUCTION OF KENYA AT BOMEN HOTEL, ISIOLO, 8TH MARCH 2006

Mr. Chairman,
Members of the Animal Production Society of Kenya,
Distinguished Guests,
Ladies and Gentlemen.

It is my pleasure as your patron to be invited here to officiate at your 2006 Annual Scientific Symposium on ***"Increased Livestock Productivity for Food Security and Wealth Creation"***. Your choice of the theme and the venue of the meeting are very appropriate at this time when, as a country we are faced with, not only the issues of productivity, but also the survival of our livestock. You are all aware of the difficult period we are going through, experiencing one of the worst droughts in recent times within the region. The effects are so severe that the loss of livestock and wildlife due to devastation of the forage and water sources is threatening the lives of communities, whose economic activities are mainly livestock production. It is therefore an opportune time that members of your Society address livestock productivity in Kenya, for food security and wealth creation, and give an overriding focus and concern to sustainability and long term stabilization of livestock production in the areas where this is almost the only economic option for the inhabitants of these areas.

As you are aware, in Kenya only about 40% of the land is arable and less than 20% is of medium to high potential. This is to say that about 80% is either arid or semi-arid land (ASAL) and cannot economically support crop production without massive and at times prohibitive investment in irrigation. It is only livestock, which I am told we have about: 13 million head of cattle of which 9.6 million are the zebus and other local breeds; 13.4 million goats; 1.2 million camels; 11 million sheep; 26 million chickens; and half a million donkeys; that can support the livelihood of the communities in the ASALs, who constitute about 30% of the Kenyan population. To those living in those areas, drought is almost a permanent feature of life, although the suffering is more severe when droughts like the current one occur. Even under normal conditions in those areas, the rainfall is on average below 625 mm per year, which can hardly support other forms of agriculture than livestock production. Except for the exotic breeds of livestock, which are also the most commercially exploited breeds such as the grade dairy cattle and exotic birds, most of the other

livestock are in the ASALs with over 70% of the country's zebu cattle and indigenous goats found in those areas.

Mr. Chairman, the effect of drought is not only confined to the productivity of livestock but is also felt on the water supply, both for human consumption and their livestock. With scarcity of water and forages, the communities living in the ASALs are forced to move in search of the same. This not only affects their lives, but also contributes to conflicts, livestock diseases and other social problems, which have major consequences on the welfare of the affected people. We need to find and come up with lasting solutions that in the long run reduce the effect of drought, engender stability and have an overall positive impact on the communities in the area, especially through improved incomes, resulting in improved welfare.

You are all aware that other than the prolonged drought, we experience drought of some sort every year, during the dry seasons, especially in the months of December through April. These dry periods also pose the same challenges as drought. The main drought challenge to our scientists and extension agents is to maintain reasonable production levels during these times of shortage. This requires availability of adequate feeds and water during these periods. This means that we develop the right feedstuff, the right management and the appropriate conservation methods, which will allow for adequate nutrition within environmentally and market acceptable costs. This is the main challenge to members of your Society who are scientists and development agents in their own rights. I am, however, happy that the theme you have chosen for this symposium, if properly handled during your deliberations will be able to address the challenge.

Issues of increasing livestock productivity are complex and challenging. Most of our livestock production systems are small-scale, which up to some level, are an efficient way of production. It has, however, been observed that the level of production per unit livestock and land is not at its maximal, and our livestock have more potential than they are delivering under our smallholder system. However, farming is complex and the objectives of the producer may not always be to maximize production but to, may be, optimize profitability and underwrite the probable risks. Maximisation of production may require increased use of commercial inputs and this poses the challenge of farm liquidity and farm gate price guarantee.

It is, however, possible to increase livestock productivity through new and available technologies, without necessarily increasing the costs and risks. In some of the areas, we are aware that our livestock are not exploited to the full potential. These include: milk production, broiler weight/ age to market, egg production, wool, hides and skins. Available information indicate that while most of our grade dairy cows can produce over 20 liters of milk per day, they are hardly producing 10 liters a day on average. Why then are our smallholder dairy farmers not producing at the highest level? The farmer, as a rational being, will only produce to meet his/ her needs at the

minimum risk and in the most rational way. If increasing production means spending more money, which the market is not going to pay back, then there will not be any incentive to do so.

Mr. Chairman, I am, however, aware that to alleviate the drought situation and livestock productivity issues, we not only need to address the management of production resource but also the infrastructure and policy. I note that you intend to address these other issues through your sub-themes of: market, marketing and policies; information and technology transfer; and technology development. It has been stated that the failures in the livestock industry are as a result of past poor government policies, which have translated into lack of adequate market infrastructures and other production factors, including inadequate and suitable livestock credit. We are addressing these issues and will soon publish a comprehensive livestock policy and a dairy sub-sector policy. Successive publication of these two policies will soon be followed by work on other livestock sub-sector policies. We in the Ministry will be happy to get your constructive input on all these initiatives.

Over and above the livestock sector policies, you are all familiar with other recent government policy initiatives such as the "Economic Recovery Strategy for Wealth and Employment Creation" and the "Strategy for Revitalizing Agriculture", which are an improvement and not a replacement of previous initiatives such as poverty reduction and the rural development strategies which you are all familiar with. The primary goal of the "Economic Recovery Strategy for Wealth and Employment Creation" is to achieve a broad-based, sustainable improvement in the living standard and welfare of all Kenyans, and recognizes that agriculture and rural development are critical in achieving this goal through enhanced food security, increased social and physical well-being for the rural people in a more sustainable environment and natural resources.

I am therefore looking forward to this symposium's proceedings with full hope that you will examine at depth, new ways to improve productivity and marketing of livestock products for the farmers and particularly the smallholder farmers. As a Ministry, our objective remains that of ensuring necessary contributions to the country's economic growth, poverty reduction, employment creation and contributing to food security through availability of quality and high value livestock products. This objective is even more challenging today when we appreciate the fact that diets of children and a majority of household members is deficient in foods and the associated micro-nutrients of animal source. We take this as a major challenge, in addition to the high cases of people living with HIV/AIDS, factors that slow our progress to achieving increased livestock productivity. We need pprofessionals to provide us with advice. We are aware that we cannot achieve meaningful progress in development without making use of our professionals and we expect to expand our consultations with you in livestock production.

Ladies and Gentlemen, I once again wish to thank the organisers of this symposium, those who have contributed in various ways, especially those who funded the symposium and all the participants who spared their time to come and share their ideas, and whose presence will surely contribute to the deliberations and success of this symposium. I wish you fruitful deliberations and I looking forward to receiving the symposium's proceedings.

It is now my ardent pleasure to declare ***The 2006 Animal Production Society of Kenya Annual Scientific Symposium officially open.*** Thank you.

SESSION II

POLICY, MARKETING AND SOCIO-ECONOMICS

DROUGHT EXPERIENCES IN KENYA: IMPACT ON FOOD SECURITY AND WAY FORWARD

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ABSTRACT

The recurring drought situation in Kenya is of grave concern as millions of animals are lost now and every other dreaded year. About 80% of the total land area is arid or semi-arid, implying persistent dry spells with the consequent negative impact on food security and loss of lives, especially among the pastoral communities. Experience has shown that the country is least prepared to deal with the drought catastrophe each time it occurs. Drought preparedness should be prioritized to manage the condition. Past remedies, which focused on relief rations, should be viewed as lessons to learn from. For sustainability, the adjacent communities need to be prepared to manage and cope with the situation. There is need for attitude change by all players and resources should be directed towards planning and preparation of the right policies to avert the adverse effects of drought.

INTRODUCTION

Drought is defined as a period of abnormal dryness due to below average rainfall that causes pronounced decrease in forage yield and water availability relative to what is expected, resulting in loss of livestock and severe socio-economic disruptions to humans, including threat to food security. The most seriously affected areas are the arid and semi-arid lands (ASALs) of Kenya, with over 25% of the human and 50% of the livestock populations, which are drought prone. Drought and its adverse effects on livelihood of people is not a disaster on its own, but the lack of preparedness for drought can heighten disaster.

The recurring drought in Kenya is of grave concern as millions of animals are lost, destabilizing the food security situation, especially among the pastoral communities. This spells a clear indication of drought un-preparedness, with instant food relief rations as a remedy. Furthermore, the adjacent pastoral communities are least prepared to deal with and manage such catastrophes. Planning as a management tool therefore needs to be reiterated and the right policies formulated, specific to drought-prone areas. Resources have to be directed towards awareness

creation and long-term projects that would turn the ASALS into profitable lands, while still sustainably tapping the already available resources. In addition, there is need for positive attitude change towards drought preparedness. Table 1 presents the chronology of drought for the period 1972-2005 while Table shows the drought intensity and frequency in the country.

Table 1. Chronology of droughts in Kenya for the period 1972 to 2005

YEAR	TYPE	LOCATION	IMPACT/ RESPONSE
1972	Drought	Widespread	Re-planning water shortage in Nairobi
1973-1974	,,	Most of the country	Food aid required, malnutrition widespread, deaths of humans, livestock and wildlife
1974-1976	,,	Eastern, Central and northern districts	
1980	,,	Central, Eastern, Western, Coast	Paralyzed farming: water shortages in most urban areas, cattle migration, food production down by 40%
1981	,,	Eastern Province	'Famine with cash in my pockets, large imports required; maize reserves depleted
1983	,,	All districts	High prices in markets, water shortages, cattle and human migration
1984	,,	Central, Rift valley, Eastern, North-Eastern	Large food imports averted famine
1987	,,	Eastern and parts of Central	Severe food shortages in Eastern, minor shortages in Central
1992-1993	,,	Northern, Central, Eastern	2.7 million affected, relief food required, Livestock lost
1994	,,	Machakos	Seasonal rivers dry up. Massive food shortages; Malnutrition
1996	,,	Isiolo, Wajir, Mandera	Livestock deaths, malnutrition, reported human deaths
1996	,,	Nakuru	Migration of people and animals, relief assistance
First half of 1997	,,	Nationwide	Shortages of pasture and water, livestock deaths; power rationing due to low water in dams, relief assistance
Oct., 1998-mid 1999	Prolonged dry spell	ASALs	Failure of short rains and poor distribution of long rains resulted in failing livestock prices, and increased food insecurity
2003-2004	Drought	,,	Rainfall below normal and poor distribution
2004-2006	,,	Nationwide	Shortages of pasture and water, livestock deaths, relief assistance, malnutrition and deaths, impending power and water rationing

Source: ALRMP (2006).

Table 2. Drought intensity and frequency in Kenya

Year	Area of Coverage	Number of people affected
1975	Widespread	16,000
1977	,,	20,000
1980	,,	40,000
1983/84	,,	200,000
1995/96	,,	1,450,000
1997	,,	150,000
1991/92	,,	1,500,000
1999/2000	,,	4,400,000
2004/2005	,,	3,500,000

Source: Tengemeo Institute (2006).

Costs of droughts

Drought costs huge financial expenses. In 1999 – 2000, it cost US$ 340 million (Kshs. 25 billion). In the Year 2004/2005, it cost US$ 400 million (Kshs. 32 billion). In terms of loss of livelihoods, 30- 40% sheep and 25-30% of goats were lost in the year 2005. The Social costs are equally devastating. These are reflected in: (i) damages social safety nets, (ii) desperation and helplessness, (iii) drop from production systems, and (iv) family breakdowns (Tegemeo Institute, 2006).

What is Food security?

FAO (1974) defines food security as food availability and food entitlement. Availability refers to supply while entitlement refers to capability of individuals to obtain food. People starve not because there is insufficient food but because they lack sufficient resources to acquire food (Sen. 1982)

The World Bank defines food security as access by all people at all times to enough food for active health life (Ellis, 1992); Supply- Availability and entitlement: UN: quantity, quality, safety and culturally acceptable.

Drought cycle management for food security

Drought cycle: drought cycle is the cyclic nature of drought in which the effects come and go in a predictable fashion.

Drought management: drought management means all concerted actions by the local communities, government, donors, NGOs and other actors, to prepare for, respond to and help recover from drought.

Main elements of effective drought cycle management

- The need for an institution and decision making framework.
- The availability of reliable and timely drought status information for decision making.
- The capacity to plan and implement interventions in a timely, effective and efficient manner.

Components of drought management systems

A drought management system has three components: (i) early warning, (ii) drought contingency planning, and (iii) policies to support drought resilience. Drought contingency planning in the ASALs should include the following: (i) mitigation - to minimize the impact of drought on production systems and livelihoods, (ii) fodder - to feed the lactating cows and calves during drought, and (iii) rehabilitation: of pastoral production systems in the aftermath of drought.

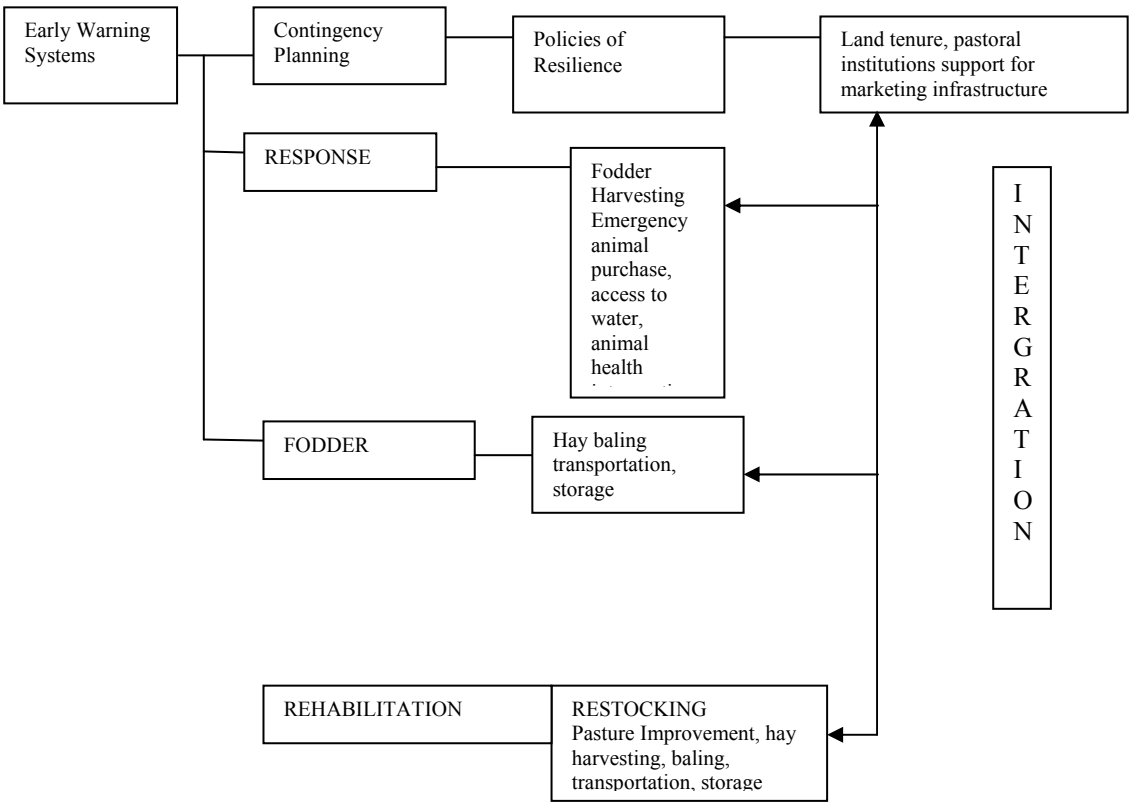

Figure 1. Drought preparedness

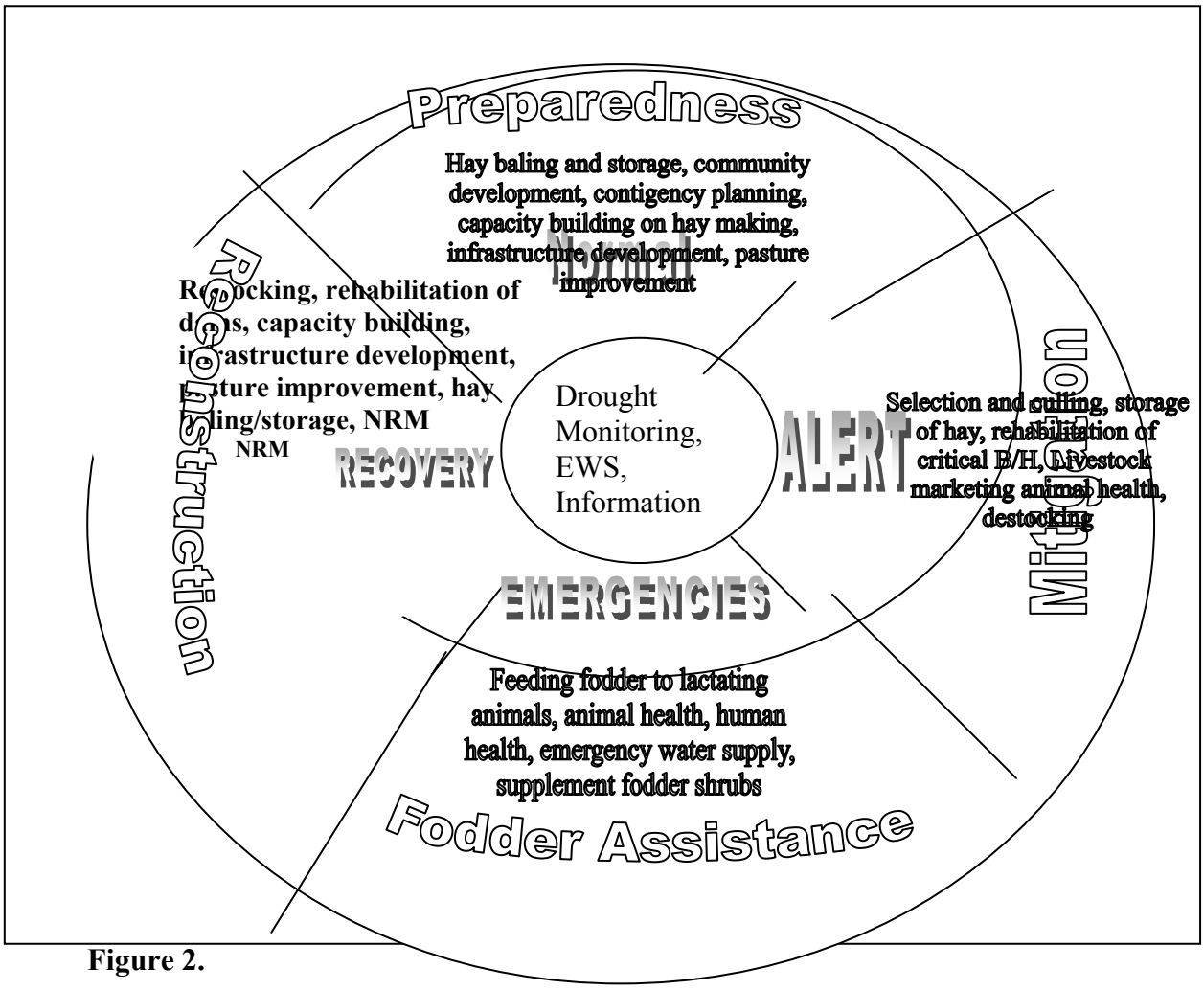

Figure 2.

The following are important issues from Figure 2:

- Livestock Early Warning Systems - being developed by the International Livestock Research Institute (ILRI), the Kenya Agricultural Institute (KARI) and the Ministry of Livestock and Fisheries Development (MLFD).
- Resource monitoring techniques.
- Resource mapping- mapping migration routes, forage, water resources, market places and diseases hotspots on migration routes for target communities.

They will be used for participatory development of model contingency plans and mechanisms for intervention by various stakeholders, particularly pastoralists, during drought situations.

Livestock parameters for monitoring

The following parameters can be used to monitor livestock management activities:

Forage resources: forage reserves spatial location, forage reserves area, temporal change in extent and quality of forage reserves, forage reserve carrying capacity (using a standardized conversion rate), forage reserve ownership, map forage reserve attributes, e.g. salt lick; describe major landform of forage reserve and major soil type of forage reserve.

Households: spatial location of households.

In/out migration routes: major migration routes, minor migration routes, and facilities along migration routes.

Disease outbreaks: identify type of disease and parasites, extent of disease and parasites hotspots, location of dips/crush pens, map agro-vet services in the area (human and physical).

Insecure/ conflict hotspots: category of conflict (resource based - RS, political - P, ethics - E, banditry - B and occurrence of conflicts).

Livestock Markets: category of market: primary-P, secondary-S, tertiary-T; network arcs; administrative centres.

Water Sources: Categories according to seasonality and ownership - boreholes, dug well, pond, reservoir/ dam, pan; others

Strategies used to prepare for and cope with drought

The following strategies can be used to cope with adverse effects of drought:

(a) *Human welfare*: stock sales and slaughter, planting drought tolerant crops, food purchases, use of food reserves, utilization of alternative diet, having smaller meals at lower frequency, dependence on relief food, development of small-scale money generating activities, casual employment, etc.; surveillance for water/ pasture and migration.

(b) *Herd/ flock management*: de-stocking, vaccination, prophylactic treatment, herd dispersal, herd splitting, supplement feeding, use of grazing reserves and leased pastures, longer daily grazing period, etc.

(c) *Pasture management*: lease of pasture, control of bush fires, etc.

(d) *Water management*: water conservation, rehabilitation of existing water sources, development of new sources, use of alternative sources, change of water frequency, etc.

ASAL communities' drought coping methods

Among the drought coping methods are: (i) use of livestock enclosures, (ii) wet and dry season grazing management, (iii) use of fodder trees, (iv) mobility/ migration, (v) sale of livestock, (vi) herd splitting and exchange, (vii) food sharing, (viii) consensus slaughter ('tie-the-dogs' system), and (ix) food aid.

Traditional early warning system

The following are some of the systems in use: (i) forecasting from flowers, (ii) forecasting from the seasons, (iii) astronomy, (iv) animal behaviour, (v) Gazelles mating, (vi) interpreting the forecast of a bird (the rain angel).

The Way forward

- Sustainable development focusing on 70% production systems and 30% alternative sources of income.
- Development of marketing, market infrastructures and policy issues related to livestock movement, disease control and resources utilization during crisis situations.
- Migration routes and resources inventory mapping as well as mapping of disease hotpots, conflict zones and market places.
- Matching of indigenous knowledge of indicators with scientific knowledge in order to incorporate the indigenous knowledge into conventional climate forecast models and other systems for early warning.
- Participatory development of intervention options and contingency plans for crises management.
- Monthly monitoring of the livestock situation and packaging and dissemination of early warning and advisory messages and bulletins.
- Establishment and training of districts crises management units for a future takeover of the monitoring, early warning and crises management system.
- Institutional, organizational and policy analysis and recommendations to facilitate adoption of timely interventions in response to early warning.
- Sensitization of policy makers, particularly at the district level, to prepare them for takeover of the monitoring system.

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KENYA'S LIVESTOCK DEVELOPMENT POLICIES –THE UNFINISHED BUSINESS

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ABSTRACT

The livestock sector plays a very important role in Kenya's national economy, although the government resource allocation to this sector does not reflect the same. The livestock ministry has been created and dissolved five times since 1980 when it was first created. It was after its creation that the first comprehensive national livestock development policy was developed in 1980. From 1990 to date, several attempts have been made to carry out comprehensive review of the existing livestock policies which are been scattered in various government documents like strategy, sessional papers and development plans. Despite many resources, i.e., time, money and manpower, invested in the process, the policy revision/ updating process has not yet been finished. This paper therefore examines the processes that are involved in policy formulation, the players in the process, the issues that should form part of the livestock policy and why all the attempts have never been completed.

INTRODUCTION

There is tendency in the country to always blame policy on the failures of different economic sectors, including the livestock[1] sector. However, there is a very great divide in the interpretation of what is meant when one talks about policy. Other than the use of the word policy in reference to statements and guidelines by the government for its routine and development activities, word policy is also used in reference to private organizations' internal guidelines and in insurance contracts. The Thesaurus dictionary, found in most computers MS Office software, refers to policy as the "rule, strategy, plan, guiding principle, course of action, guidelines, and procedures". The Chambers 20th Century Dictionary describes policy as "a constitution, the art of government, statecraft, a course of action, a system of administration guided more by interest than by principles, dexterity of management, prudence, cunning". But in a simplified form, policy refers to a planned and often stated effort to address and resolve identified issues or problems, with the

[1] In Kenya, the livestock of concern include cattle, both indigenous and grade; sheep, goats, camels, pigs, rabbits, poultry and the bees. In standard definition, poultry and bees are not livestock but in this paper, reference on livestock development also includes these species.

aim of improving the prevailing situation. In most cases, policy is used in reference to government's intended efforts to alleviate a problem for public interest. In other words, policy is a statement of intent to take some course of actions, elaborately planned to address the problems or issues and fulfill some laid down objectives.

The livestock policyeEnvironment in Kenya

Livestock development offers the greatest scope of any agricultural sector for increasing rural wealth and development, and is absolutely necessary if we are to ensure the health of a rapidly expanding population (Peberdy, 1970). In his report, Peberdy emphasises that this can only be achieved if we have the right policies in place and ensure their implementation. This is true today as it was when Peberdy made the observation.

Public policy is influenced by a range of public sector organizations, at national, regional and international levels. In addition, development partners, non-governmental organizations (NGOs and CBOs), consumers of livestock products and the processors of theses products also influence policy. The environment under which livestock policy is developed or made has changed considerably over the years. The livestock policy environment in Kenya can be said to be most unpredictable given the frequent structural changes of the Ministries that are responsible for livestock development. The Ministry of Livestock Development was first created from the Ministry of Agriculture in 1979. It was merged with Agriculture in 1983, split again in 1986, merged in 1992 and recently split again in 2003 into the Ministry of Livestock and Fisheries Development.

Policies comprise not only the statements contained in those documents written purposely for policy but also in other documents such as legislation, development plans, sessional papers and various statements and pronouncements issued by policy makers (FAO, 2003; Muriuki et al., 2003). Like other policies, livestock policies are contained in livestock specific documents and legislation and also as part of other government policy papers. A standard policy document and one that can effectively be implemented should contain sections on:-

- Background information and current situation to the issue;
- Problem statement;
- Purpose and objectives both for the sector and the particular policy;
- Those involved (Stakeholders) including their stake in the issue and their roles;
- Priorities;
- Implementation strategy, timelines, financing arrangement including sources and budgets where possible;
- Assumptions and risks;
- Targets, monitoring, evaluation and backstopping mechanisms; and

- The custodian of the policy or policy owner who is to oversee its implementation.

The lack of policy is a very common complaint whenever there is a problem in any sector of the economy. But having no documented policy does not mean there is no policy and in fact, lack of policy guidelines, documented or otherwise can also be by itself a policy. However, this causes a lot of discontinuity as each official will have his/ her own interpretation of the policy since there is no reference point, leading to contradictions.

A review of various policies, development plans and sessional papers shows that it is difficult to pinpoint any particular consistent agricultural (livestock included) policy in the country since objectives and strategies keep on changing but broadly, most policy objectives seem to be directed on growth, poverty alleviation, equity, inclusive participation, increased food supply, food security and self sufficiency, growth in agricultural and rural employment, expansion in exports and environmental/ resource conservation (Muriuki, et al., 2003).

METHODOLOGY

This paper is a review of various livestock and other policy documents produced since 1970. Knowledge gathered through work experience is used. The literature review is not only on those documents that are policy focused but includes other documents containing relevant ideas on policy. Over and above review of the literature, there were consultations between the authors and with senior government officers in the Ministry of Livestock and Fisheries Development to get insights and to clarify information obtained from the documents.

RESULTS AND DISCUSSIONS

Existing livestock policies

As already mentioned above, livestock policies are contained in both policy documents published specifically to address livestock and in other government documents such as development plans, sessional papers such as the 1986 paper on renewed growth, 1984 and 1994 sessional papers on food policy and others, including general pronouncements occasionally made by policy makers. Other policy instruments include the various legislations and standards, including those specific to livestock and those non-specific but impact on livestock development (FARM-Africa, 2004). The Strategy for Revitalizing Agriculture paper identifies 117 laws affecting agriculture (GOK, 2004). Out of these, only 13 are identified as specific to livestock, mainly focusing on veterinary services, animal welfare, and the establishment of livestock parastatals (the Dairy and Pig Industry Acts). There is no clear reference to indigenous livestock breeds, their improvement, conservation and utilization, yet in Agriculture almost every major crop has an act to guide its production and

utilization. Issues like traceability and genetically modified products are not mentioned even though they have gained importance in world trade.

Perhaps the first livestock specific strategy and policy publications were the 1970 Animal Production 1970 – 1980 and Beyond (Peberdy, 1970) and the 1980 National Livestock Development Policy. The 1980 policy was developed to guide the activities of the then newly created Ministry of Livestock Development in fulfilling the functions assigned to it (Republic of Kenya, 1980). Another reason there was need for a detailed livestock development policy was the fact that the prevailing and projected demand for livestock products indicated a large and possibly continuing deficits over domestic supplies. The main objective of the policy was therefore to help the nation avoid any shortfall in livestock production. The policy was also designed to address the national objectives of poverty alleviation through creation of income generating employment, production of surplus for export and conservation of the natural resource. Other broad objectives specific to livestock included production of sufficient animal protein for adequate nutrition for Kenyans, production of raw materials for agro-industries, intensification of production to ensure higher land and other resource productivity and full development of the Kenyan rangelands. Most of these objectives are still valid. The policy setting has, however, been overtaken by events since it was written before liberalisation of the economy, and its implementation was to be centred on government actions and subsidies. The policy was also formulated at a time when there was no stakeholder consultation. There have been attempts to revise and rewrite the livestock policy since late 1990s but so far the rewriting process has not been completed and is ongoing. Other than having been set in a different policy environment, the assumptions and projections used in the 1980 policy have definitely been made irrelevant by time (25 years later). The revision of the policy is therefore of paramount importance to the livestock industry in the country.

Another documented livestock specific policy is the Kenya Dairy Development Policy of 1993. Just like the 1980 Livestock Development Policy, it has been overtaken by events and time. The policy was written at the time of price decontrols of most livestock related inputs, services and products. The policy environment for the dairy sub-sector has since drastically changed and is dynamic. The milk market participants have changed with an increase of processors and informal milk traders. Like the Livestock Policy, completion of the revision of the Dairy Development Policy is also of importance.

Unfinished policy efforts

The need for up-to-date livestock policies is recognized as witnessed by various efforts to revise or write the above referred policies. As stated, attempts to update or revise livestock policies

dates back to mid-1990s. There are four notable efforts towards updating, revising or developing policies for the livestock sector:-

(i) The review and revision of the Dairy Industry Act and the Dairy Development Policy which began in 1996 and has been on-going since. The efforts towards completion of the revision process have been on and off, and have consumed a lot of resources and time with no tangible results so far despite the volumes of documents produced.

(ii) The effort to revise the Livestock Development Policy started towards the end of 1990s and as in the case of the Dairy Development Policy and Bill, it is still incomplete, although on-going, despite the amount of resources and time put into the exercise.

(iii) During the same time the Livestock Development Policy has been on the drawing board, there has also been effort to write a policy for the delivery of veterinary services in the country. This effort has also not produced tangible results other than a draft document. Due to possibility of repetition and possible redundancy in the two policy development efforts, an agreement within the Ministry to put together or merge the livestock development and the delivery of veterinary services policies into one livestock policy has been reached.

(iv) At the same time, there has been some effort to develop a livestock breeding policy. Notable activities have been efforts to write strategy for commercialization of Central Artificial Insemination Station, a policy for Artificial Insemination and the effort by the National Consultative Committee on the State of the World on Animal Genetic Resource (SOW-AnGR) to lobby for development of a national livestock breeding policy. The consultative committee has sought to also stimulate development and harmonization of livestock breeding policies in the East Africa region.

(v) The Ministry has also requested FARM-Africa to support it in developing a small ruminant improvement strategy and a breeding policy to support that strategy.

As mentioned earlier, livestock policies are also contained in other non-livestock specific policy documents such as the recent Economic Recovery Strategy for Wealth and Employment Creation, Strategy for Revitalisation of Agriculture, Poverty Reduction Strategy Paper, 2002-2008 Development Plan, and such other policy initiatives like Agricultural Sector Investment Programme, the Kenya Rural Development Strategy and various sub-sectoral strategic plans. Most of these initiatives do not seem to reach implementation stage since sub-sectoral objectives, strategies and priorities have been frequently changing even before the new policy formulation process is complete. The country has therefore so many unfinished livestock and other policy initiatives.

Policy formulation/ development process

Policy formulation, especially government policies, is complex and perhaps this is the reason the formulation or revision process seem not to ever get completed. Another reason policies take for ever to complete is that despite the importance of having the right policies in place, and the need for participation of various stakeholders in policy formulation processes, the government does not give this process the priority it deserves, hence there is no budget set aside for the process. In the recent past, civil society organizations (e.g., Action Aid, FARM-Africa and Oxfam GB) and other development partners have been supporting policy initiatives by financially sponsoring some of these initiatives. The support has ensured a shift from top-down process that has been used for many years to bottom-up where the target clientele, the farmers and other stakeholders have a say in the process. The civil society organisations have provided important links between the policy makers and the grassroots organizations (Table 1). Figure 1 at the end of the paper is a simplified model, with basic features, of a policy formulation process.

In an ideal situation, the policy process should be routine and continuous due to the dynamic nature of the policy environment and the changing time. This is not the case in most of the time. Over and above the fact that the policy process is an off-and-on activity, there are very few policy specialists devoted to livestock policy process, hence lack of a continuous policy analysis and development. Such specialists/ analysts should be able to compare policy alternatives on the basis of outcomes and likelihood of success as well as ensuring that livestock policy is integrated into other national policy goals. Policy development is only given attention when there is crisis or when a problematic situation exists and the general mood in the country demands for a policy direction. Considering the various policies and strategies, one can always identify the trigger to their formulation process.

As pointed out earlier, the 1980 Livestock Development Policy was as a result of a creation of a new ministry at the time the domestic demand for livestock products was expected to outstrip the local supply. The 1986 Sessional Paper No. 1 on Economic Management for Renewed Growth, which laid the foundation for economic liberalization, was necessitated by the government budgetary constraints, the pressure from development partners, the fact that the economy was on a downward trend and the fact that the population was rising against declining economic performance.

The poor performance of the agricultural sector and the realization that non-sectoral factors outside agricultural sector were also critical to its growth triggered the development of the Agricultural Sector Investment Programme (ASIP) which was sooner to be replaced by the Kenya Rural Development Strategy (KRDS) to address rural development and employment creation. But the Sector Investment Programmes, which were also being developed in other economic sectors

were not unique to Kenya and were replaced by the poverty reduction strategies on the argument that it is impossible to address poverty through investments in situations where the largest proportion of the population is very poor. The change of government after 2002 triggered revision and rewriting of major national policies and resulted with such policies as Economic Recovery Strategy for Wealth and Employment Creation and the Strategy for Revitalizing Agriculture, as an indication of the new government's direction and priorities. Unfortunately, while these non-livestock sector policies are intended to also address and impact on livestock production and development, their chapters on livestock are very weak and portray either ignorance on livestock or lack of importance (priority) on the sector. Livestock as a whole is usually equated to a single crop like sugar, maize, etc. It is therefore wishful thinking to expect such policies to adequately address and impact on livestock development.

As mentioned earlier, development of a policy requires a trigger mechanism to sensitize the system to want to have a policy on the issue. Once the need for a new policy or need to modify an existing one is identified, the initial stage is to get concurrency with the policy makers, i.e., to get the Minister and the PS responsible for the sector, in this case livestock portfolio, and at times the cabinet, to concur and authorize the development of the said policy. Thereafter, the structure of the policy development process is set. A committee/ task force or team to oversee the process is then established with a clear chain of command. The initial step is to identify stakeholders, subject matter specialists and policy experts to assist in putting up the policy draft that forms the basis of discussions in the subsequent policy development process. Discussion involves iterative interaction with representative stakeholders, bureaucrats, subject matter specialists and professionals, peer reviewers and the relevant policy makers. The process may be initiated by the ministry concerned, the cabinet or other players who may put pressure to bear on relevant authorities. Since the mid-1990s, it has been the norm to involve the wider sector stakeholders, through regional consultative workshops, over and above involvement of few key players, bureaucrats, professionals, specialists and policy makers. Once the minister, through the PS, is satisfied, the policy is brought to the cabinet for approval and further direction. After cabinet approval and direction, the policy may be published as a government policy or strategy on the issue or be taken to parliament for debate where it becomes a sessional paper if accepted and passed (Table 1; Figures 1).

It has already been mentioned that government policies are contained not only on those documents published as policy but also in other government publications such as strategies, development plans, position papers, pronouncement and the legislation. In case of legislation, it is the Attorney General (AG) who has to draft, publish the Bills and put them through parliament where necessary after approval by the Cabinet. The Minister responsible for livestock or any other appointed authority such as the Director of Veterinary Services can only amend or write the

subsidiary legislation, in consultation with AG's Chamber, if the Act so allows and recognizes him/ her as the executing/ implementing authority.

Challenges in livestock policy development

One major challenge in livestock policy development is the failure to institutionalize or mainstream the policy development activity as part of the ministry's routine work. The policy development process is therefore extra to other duties and cannot therefore get the attention it deserves. The second challenge is as a result of the above, i.e., the ministry does not have the capacity to develop policies since it is not a routine activity. Therefore, there may be no need to invest on building this capacity. The third challenge arises from the fact that the Minister, who is a political appointee, the Permanent Secretary, also political appointee and the Head of the Department have to individually concur on the issues raised and the proposed policy. Any change of one of them delays the policy development process in as much time as the replacement takes to be brought up to speed on the issues and the proposals. Changes in these offices may be the main reason why the processes of revision of livestock and dairy development policies have taken long to complete. The fourth challenge has been the frequent creation and dissolution of the Ministry of Livestock Development, which has been created and dissolved five times since 1980. The fifth challenge is lack of internalization of clear policy implementation, monitoring and backstopping systems. In most instances, policy interpretation and implementation is left to the whims of those in authority. A sixth challenge is associated with the foregoing. Because of lack of a monitoring system, there is no link between new policies and previous ones, a situation that leads to policy conflicts and at times waste of resources by developing new policies that are irrelevant and out of date even at the time of formulation.

Livestock policy gaps

Although the current standard norm in policy development is to incorporate stakeholder consultation as part of the process, the consultative process is rarely adequate due to budgetary constraints and bureaucratic biases. Most of the policy content is dominated by bureaucratic thinking and not by the stakeholder needs. A review of the existing and proposed livestock policies shows that the broad objectives are to contribute to national goals, which include: increased incomes through poverty reduction measures; employment creation; food security; and to meet the domestic demand for the livestock products while producing surplus for export. These policies, however, do not provide adequate details for implementation and monitoring. They also assume production and marketing efficiencies without providing safeguards for how efficiency will be achieved, and the source of resources and finances required to implement the policy. Of late, as has

been noted above, there have been attempts to identify and consult most of those players with a stake and role to play in the policy but again without adequate incorporation of their views necessary to give proper guidance for the implementation of the policy.

In a review of livestock development policy consultative workshops proceedings (FARM-Africa, 2004), the following concerns and issues from the stakeholders and their implications were identified:-

- Insecurity especially in the ASALs.
- Collapse of government support for services such as artifial insemination and clinical services and the failure of the private sector to fill the gap.
- Apparent lack of adequate attention by the government to livestock sector. There is a need for deliberate government investment in the livestock industry, proportionate to its contribution to the economy.
- Failure to identify, understand and appreciate stakeholders in the livestock industry, including community-based organizations (CBOs), non-governmental organizations (NGOs) and stakeholder groups (SHG), and their roles in development of the industry.
- Lack of appreciation by government on the contribution and role of different livestock species to food security and the economy as a whole.
- Lack of statutory recognition of livestock production services as the case of crops (agriculture and veterinary services whose directorates exist in law).
- Need for a Livestock Development Board (Council or Authority) in line with Central Agricultural Board or Veterinary Board.
- Failure to appreciate the indigenous livestock breeds and their potential and therefore failure to conserve and patent local breeds such as the Boran cattle, the Red Maasai sheep, the Gala goat and various other local breeds and species of livestock.
- Lack of livestock marketing infrastructure, especially in ASALs, and the need to develop or improve them where they exist.
- Need for an enforceable legal framework for agricultural land and its sub-division based on productivity and production capacity.
- Need for involvement of the local communities in the inception, design and implementation of development programmes which target them.
- Need for government to legislate the national position on genetically modified organisms (GMOs).
- Need for a central, up-to-date and accurate data and information depository (Data and Gene Bank) and distribution system for livestock.

- Need to review livestock credit situation in the country and find ways of establishing suitable credit schemes.

From the above, it is clear that stakeholders are interested in policies that will allow them to efficiently operate and produce livestock and livestock products at a minimum risk, and in a safe environment. They do not compartmentalize issues to specific sectors but view things in a holistic manner. They expect the government to provide leadership in policy development but consult appropriately. Issues such as security, land tenure, and condition of the infrastructure, which are not specific to livestock, may be more important to them and therefore policy addressing the livestock sector in isolation may not produce the desired results.

In an overview of major policy documents in Kenya (Mbogoh, 2003, not published), notes the following constraints resulting from an accumulation of poor past policies:

- Non-availability of quality seeds (semen) and inappropriate production technologies, especially for smallholder farming.
- Lack of access to credit by the majority smallholder farmers, particularly women.
- High cost of farm inputs.
- Poor and inadequate rural infrastructure, especially feeder roads, power supply and livestock marketing facilities.

Perhaps the most limiting factors to livestock policy are the inconsistency contained in them, lack of implementation and monitoring plan, and also lack of follow up mechanisms.

CONCLUSIONS AND RECOMMENDATIONS

As already noted, it is difficult to identify a consistent agricultural (livestock in this case) policy in Kenya, since both objectives and strategies have been changing over time (Muriuki et al., 2003). Most of these changes, while mainly due to the change in the policy environment and time, are also due to leadership and personalities. It is therefore important to institutionalize policy review and formulation process in government departments to ensure it does not depend on individual whims. This should include establishment of a mechanism that makes it routine for the departments to annually publish, in the public domain, their policies, priorities, implementation plans and expected outputs, including implementation timelines. This will ensure that policy review or formulation does not take forever, as it seems to be the case at present (considering that the national livestock and the dairy development policies, whose review process started in the 1990s are still ongoing).

The government should, as a matter of priority, develop a Livestock Development Master Plan, which should be updated every 3 to 5 years, or as will be determined. Perhaps the strategic plans currently being developed serve the same purpose. From the master plan, specific

development policies and legal framework for different livestock species would be developed. Other livestock related policies and legal frameworks such as for feeds, extension services, marketing and other livestock related non-production policies would also be developed from the master plan. The development or updating and implementation of the livestock policies and legal frameworks should be all-stakeholders inclusive.

In the past, there have been suggestions that the government develops an umbrella agricultural policy and umbrella Act to replace the plethora of agricultural policies and legislations (117 Acts of Parliament). This is a fallacy. Such an umbrella policy or Act would be too broad to adequately address specific issues and for effective implementation, and would therefore depend on individual interpretation by those in authority. While there is need to have an overall livestock policy and a legal framework, it will be important to have specific policies and legal frameworks for different species of livestock to adequately capture the relevant species details and develop focused implementation plans.

For the government to accord livestock production/ development its due priority and attention, in consideration to its contribution to the economy and to the wellbeing of the communities, especially in the ASALs, there is need to hasten the review and publication of the national livestock and dairy development policies, already at very advanced stages, embark on development of a livestock development master plan and develop statutory instrument to bring livestock production legal status at the same level with agriculture (crops) and veterinary services.

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Table 1. Policy formulation process

Civil Society Initiated (Bottom-up)	**Government Initiated (Top-down)**
Steps followed by the Civil Society • Identify the issue/ problem in a participatory manner by the affected group/ stakeholder • Awareness creation/ sensitization • Collect the necessary data, process to get the necessary information, compile policy issues for discussion with the primary stakeholders including government staff • Facilitate stakeholder workshops to further sensitize and involve as many stakeholders as possible, produce a policy draft. • A select committee of experts should refine this draft jointly with the experts in the Ministry Headquarters to get a final policy document to be handed over to the Ministry's Ministerial Policy Committee for approval • After approval by Ministerial Committee, a Cabinet memo for Cabinet's approval is prepared • Policy draft submitted to the Parliamentary Committee for Agriculture, Lands and Natural Resources for perusal and comments • Attorney General's office drafts the bill • Draft bill tabled in Parliament by the Minister • Parliament debates the bill and enacts the Act	***Steps followed by the Ministry*** • Existence of a need or a problem requiring policy formulation. • Multi-disciplinary Task Force (economists, technical experts) to collect information and compile policy draft. • Policy draft sent to field staff for comments • Policy draft discussed by stakeholders in workshops • Policy draft submitted to the Ministerial Policy Committee for approval (chaired by Permanent Secretary; Technical Directors are members) • Cabinet memo (for Cabinet to approve the proposed policy). • Policy draft submitted to the Parliamentary Committee for Agriculture, Lands and Natural Resources for perusal and comments • Policy draft tabled in Parliament for Sessional Paper and if law is being formulated: - • Attorney General's office drafts the bill • Draft bill tabled in Parliament by the Minister • Parliament debates the policy/ bill and approves as a Sessional Paper/ enacts the Act

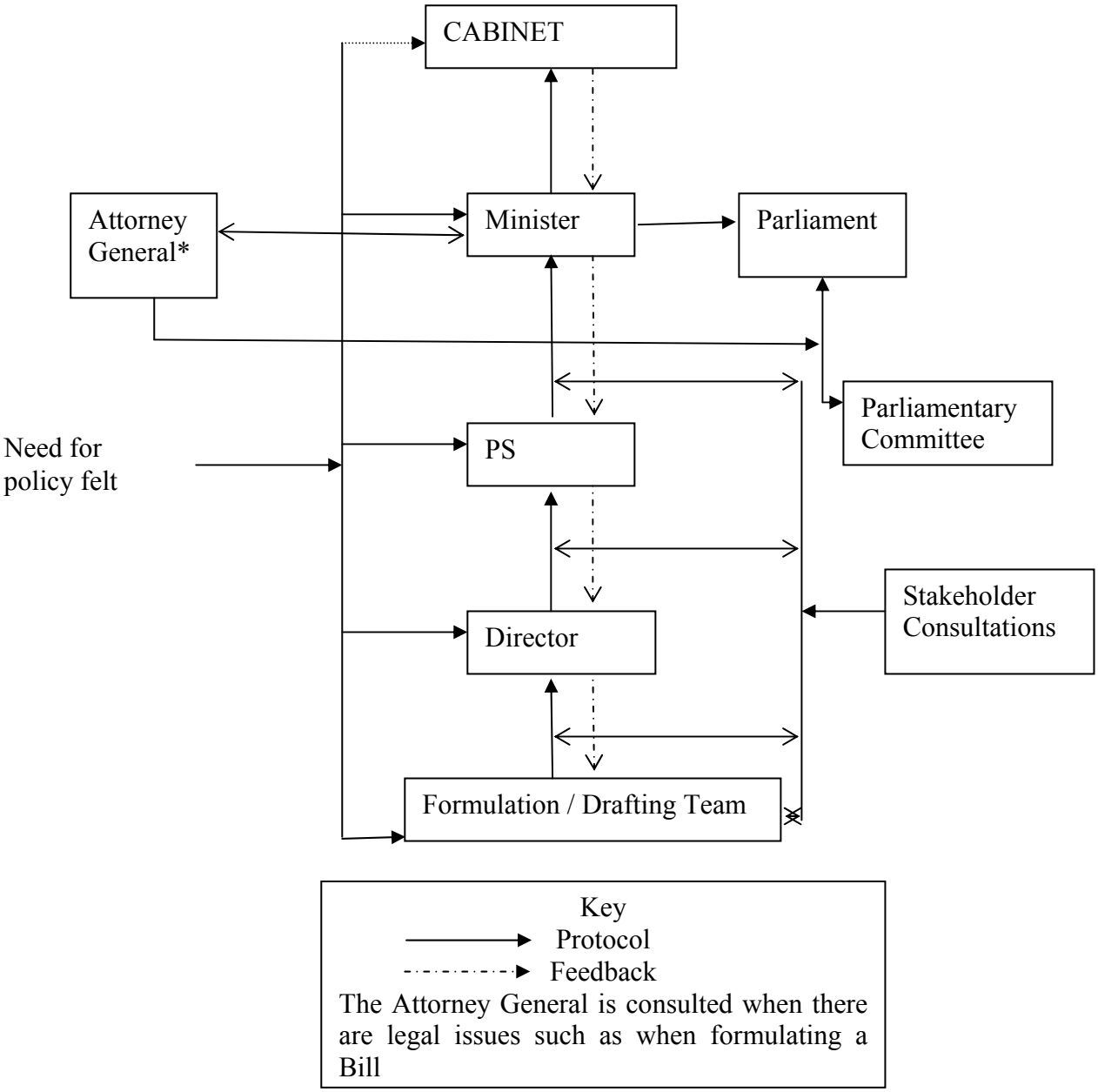

Figure 1: Simplified government initiated policy (development/ formulation) process

THE ASAL BASED LIVESTOCK AND RURAL LIVELIHOODS SUPPORT PROJECT

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ABSTRACT

Arid and semi-arid lands (ASALs) make up over 80% of Kenya's total land surface, support over 25% of the human population and over half the livestock population. The main economic activity of the ASALs is nomadic pastoralism, which utilizes about 24.2 million hectares (50%), while ranching and other livestock keeping utilizes about 15.1 million hectares (31%). The remaining 9.1 million hectares (19%) is used for agriculture, including agro-pastoralism. These areas are characterized by a very fragile ecosystem with scarce and erratic rainfall. Severe drought events have had a serious impact on ASAL communities, increasing their vulnerability to poverty and threatening the long-term viability of their livelihoods and natural resource base. Traditional drought mitigation strategies have been weakened by social economic changes. Widespread poverty is compounded by poor infrastructure, lack of organized market systems, including the lack of market information. The HIV/AIDS scourge is also spreading to the ASAL communities and affecting the most productive members. The ASAL Based Livestock and Rural Livelihoods Support Project, which covers 22 districts in the ASALs will attempt to address some of these issues. The specific objective of the project is to improve sustainable rural livelihoods and food security through improved livestock productivity, marketing and support for drought management and food security initiatives. Project strategies include training and institutional strengthening; gender sensitization; extension services, participatory processes involving community-based demand-driven initiatives; and collaboration with international and national research systems. The project focuses on four main technical components, i.e, sustainable livestock improvement, animal health services, livestock marketing improvement and drought management and food security initiatives. The project also has provisions for support to project coordination and management. The project has a 6-year implementation period beginning July 2004, and is estimated to cost KES 2.8 billion (comprising of an ADF loan of KES 1.9 billion, an ADF Grant amounting to KES 329 million, GOK contribution amounting to KES 314 million and beneficiaries contribution of KES 149.5 million). The project is implemented through the Departments of Livestock Production and Veterinary Services, working through the extension service and community animal healthcare

workers. Project activities will also be carried out by livestock traders and processors, users' Associations and specialist institutions such as ILRI and KARI.

AN OVERVIEW OF EXTENSION SERVICES IN KENYA

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ABSTRACT

The livestock sector contributes about 10% of the gross domestic product (GDP), accounts for over 30% of the farm-gate value of agricultural commodities, contributes more than 30% of the food consumed, and accounts for more than 10% of export earnings. The livestock sub-sector employs and accounts for 50% of the agricultural labour force. The sector also earns the country foreign exchange through export of hides and skins, dairy products, live animals and some processed pig meat products. Extension services play an important role in the dissemination of knowledge, technologies, information and also linking farmers to other service providers. Extension is critical in the transformation of subsistence farming to modern and commercial agriculture, which is key to promoting household food security, improving incomes and poverty alleviation. Historically, the country has used various extension management systems with varying degrees of success. The approaches during the colonial times were mainly tailored to settler and commercial farming systems. These were well-packaged programmes that combined extension services with credit and subsidized inputs. However, the extension approach used for the indigenous Africans, who were mainly engaged in subsistence farming and pastoralism, was coercive in nature and therefore not readily accepted. After independence, more persuasive and educational approaches and methods were adopted. These included the conventional agricultural extension approach in the 1960s and 1970s, establishment of Farmer and Pastoralist Training Centres (FTCs) and the Whole Farm Extension Approach (WFEA) and use of integrated agricultural development (IAD) approach. In the 1980s and 1990s Farming Systems (FS) and Training and Visit (T&V) approaches were introduced. Alongside these, the "commodity specialized approach" was predominantly used in the large export commodity sub-sector spearheaded by commodity boards and private companies. In general, all the approaches were essentially top-down and lacked participation in articulating clientele demands. Based on lessons learnt from the above approaches, the Government in collaboration with other stakeholders has in recent years embraced more participatory and demand-driven extension approaches. Over the years, extension has put emphasis on increasing production with little or no regard to value addition and marketing. However, it is now acknowledged that linking production with processing and marketing is a prerequisite in transforming agriculture from

subsistence to commercial enterprise. Other new concepts being embraced mainly to address financing of extension services include cost-sharing, commercialization and privatization. The provision of extension service is dominated by the public sector through respective Departments of Extension in the Sector Ministries. Until the late 1980s, public extension service was well staffed up to the sub-location level and adequately facilitated to perform its duties. However, during the last 15 years, the staffing and facilitation of public sector extension has declined mainly as a result of public employment freeze and reduced funding. In the absence of effective private sector operations to fill the vacuum, the situation has led to reduced spatial coverage, targeting and effectiveness of service delivery reflected by clientele complaints. Other Extension Service Providers include NGOs, community based CBOs and Faith based organizations. The entry of these new players has helped to fill that gap created by the reduced presence of public sector extension service. Extension services delivery is faced with several constraints and challenges. Some of these include: inadequate funding, shortage of extension staff and support staff especially at the front line level, Lack of harmonization of approaches by various service providers, poor accessibility of extension facilitating factors among others. In 2001, the first National Agricultural Extension policy (NAEP) was launched to guide and harmonize management and delivery of extension service in the country. NAEP emphasizes the importance of demand-driven extension system; the role of the private sector in pluralistic extension; and sets out modalities for commercialization and privatization of extensions services. The implementation of NAEP was less successful than initially anticipated due to inadequate institutional arrangements, narrow ownership, lack of legal framework, lack of goodwill and commitment among some of the top managers and slow flow of resources. In 2003, Economic Recovery Strategy (ERS) was developed and launched. It identified agricultural sector as the vehicle to achieve the desired development. In 2004, the "Strategy for Revitalizing Agriculture" (SRA) whose goal is to achieve economic recovery by providing an enabling environment for increased private sector participation in bringing about significant agricultural growth was launched. In June 2005, the government in collaboration with other stakeholders embarked on the review of NAEP of 2001 in order to accommodate new ideas occasioned by these recent policy developments. The revised NAEP, now referred to National Agricultural Sector Extension policy (NASEP), takes a "sector wide approach" and addresses key issues on extension service delivery. NASEP- implementation framework (NASEP-IF) is being developed to guide the NASEP implementation.

INTRODUCTION

The livestock sector in Kenya contributes about 10% of the Gross Domestic Product (GDP), account for over 30% of farm gate value of Agricultural commodities, contributes more than 30%

of food consumed**,** and accounts for more than 10% of export earnings. The livestock sub-sector employs and accounts for 50% of the agricultural labour force. The sector also earns the country foreign exchange through export of hides and skins, dairy products, live animals and some processed pig meat products.

Extension services play an important role in dissemination of knowledge, technologies, information and also linking farmers to other service providers. Extension is critical in transformation of subsistence farming to modern and commercial agriculture, which is key to promoting household food security, improving incomes and poverty alleviation. The vision of the extension service is to ensure that "Kenyan agricultural extension clientele demand and access appropriate quality extension services from the best providers and attain higher productivity, increased incomes and improved standard of living by 2015". The objective is to achieve a pluralistic, demand driven, efficient and effective extension service that is sustainable and responding to client's needs. It must respond and adapt to the changing macro-economic policies and the prevailing global trends.

Historical perspective of the agricultural extension service in Kenya

The extension system in Kenya has evolved through various stages since colonial and post-independence eras as highlighted next.

Pre-independence period

The extension approaches during colonial times were mainly tailored to cater for settler and commercial farming systems. These were well packaged programs that combined extension services with credit and subsidized inputs. However, the extension approach used for the indigenous Africans, who were mainly engaged in subsistence farming and pastoralism, was coercive in nature and therefore not readily accepted.

Post independence period

After independence, more persuasive and educational approaches and methods were adopted across the board, mainly implemented with the assistance of donor funded projects and programmes. These efforts included the conventional agricultural extension approach in the 1960s and 1970s, establishment of Farmer and Pastoralist Training Centres (FTCs) and the Whole Farm Extension Approach**Error! Bookmark not defined.** (WFEA) and use of Integrated Agricultural Development (IAD) approach. In the 1980s and 1990s, Farming Systems (FS), and Training and Visit (T&V) approaches were introduced. Alongside these, the "commodity specialized approach" was predominantly used in the large export commodity sub-sector, spearheaded by commodity

boards and private companies. In general, all the approaches were essentially top-down and lacked participation in articulating clientele demands.

Desirable attributes of extension service

For sustainability purposes, the following attributes are desirable for an extension system:

- Pluralism in service delivery.
- Demand driven and beneficiary led.
- Participatory planning with stakeholder involvement in decision making.
- In-built sustainability mechanism.
- Transparency and accountability.

Current Situation

Approaches

Based on lessons learnt from the foregoing mentioned approaches, the Government in collaboration with other stakeholders, has in recent years embraced more participatory and demand-driven extension approaches. These are intended to tap farmer participation and private sector**Error! Bookmark not defined.** contribution in providing extension services. Some of these approaches include:

- Focal Area Approach (FAA)– used by NALEP and DANIDA (group targeting, formation of CIGs and flagging opportunities)
- Farmer Field Schools – Farmer to farmer extension – promoted by FAO.
- Commodity-based approach
- Farming systems approach
- Multidisciplinary Mobile Extension Teams especially in ASAL areas

Over the years, extension has put emphasis on increasing production with little or no regard to value addition and marketing. However, it is now acknowledged that linking production with processing and marketing is a prerequisite in transforming agriculture from subsistence to commercial enterprise. Other new concepts being embraced mainly to address financing of extension services include cost-sharing, commercialization and privatization. The implementation of these concepts has to take cognizance of clear exit and entry mechanisms to avoid disruption of the service

Extension Providers

The provision of extension service is dominated by the public sector through the respective Extension Divisions of the Sector Ministries. Until the mid 1990s, public extension service was well staffed up to the sub-location level and adequately facilitated to perform its duties. However, during the last 10 years, the staffing and facilitation of public sector extension has declined mainly as a result of public employment freeze and reduced funding for operations and maintenance. In the public sector, for example, the ratio of frontline extension worker (FEW) to farmers is about 1:1000 compared to the desired level of 1:400. In the absence of effective private sector operations to fill the vacuum, the situation has led to reduced spatial coverage, targeting and effectiveness of service delivery reflected by clientele complaints. Other Extension Service Providers include NGOs, community based organizations (CBOs) and Faith based organizations. The entry of these new players has helped to fill that gap created by the reduced presence of public sector extension service

Constraints and Challenges

Extension services delivery is faced with several constraints and challenges. Some of these include: inadequate funding, shortage of extension staff and support staff especially at the front line level**,** lack of synergy among the various service providers (due to lack of/poor collaboration and networking) , non- adherence to the National Agricultural Extension Policy by the most of the extension providers, poor accessibility of extension facilitating factors among others.

Policy Trend

National Agricultural Extension Policy (NAEP)

The government, in recognizing the role of a well functioning extension service for agricultural sector growth and its contribution to the economic growth and poverty reduction, prepared the National Agricultural Extension Policy (NAEP) which was launched in December 2001 by the then Ministry of Agriculture and Rural Development. The policy spelt out, among others, the desirable characteristics of extension approaches and methods to be applied by extension service providers, and setting a stage for what would be acceptable best practices in extension service delivery.

NAEP emphasises on the following principles:-

- Extension service should focus on transforming subsistence agriculture to commercial agriculture
- Development of pluralistic and demand-driven extension service
- Participatory planning among the stakeholders involved in extension service

- Strong collaboration among stakeholders
- Holistic approach to solving farmers' problems, where complimentary services such as rural access roads, markets, affordable credit, irrigation water, machinery services and support institutions are made available to farmers.
- Providing extension services not only on primary production but also on services that support production such as marketing and processing of farm produce.
- Commercialization and privatisation of extension
    - Partial cost recovery (cost-sharing) –subsistence farmers, e.g. cost-sharing during training, etc.
    - Full cost recovery –for services, e.g. A.I., clinical services, dipping, farm planning services, etc.
    - Privatisation of extension –dairy, horticulture, coffee, tea, pyrethrum, etc.
- Establishment of standards to ensure that farmers are provided with quality services by all the extension providers, both public and private.
- Preferable use of extension approaches that utilize group extension methods
- NAEP implementation is guided by – National Agriculture and Livestock Extension Programme Implementation Framework (NALEP-IF)

The implementation of NAEP has been adversely affected by, among others, reduced funding in the public sector and inadequacy of complementary services such as input supply, credit, market and marketing outlets. Moreover, institutional arrangements for implementation of the NAEP were not well coordinated.

Policy changes since Launch of NAEP

The Economic Recovery Strategy for Wealth and Employment Creation (ERS-WEC) and Strategy for Revitalising Agriculture (SRA)

The Economic Recovery Strategy for Wealth and Employment Creation (ERS-WEC) which was launched by the government in 2003 identifies agricultural sector as an important vehicle for economic recovery. The strategy identified key reforms to be undertaken in the agricultural sector. Following this, the Strategy for Revitalising Agriculture (SRA) was launched in March 2004. The SRA overall goal is to achieve economic recovery by providing an enabling environment for increased private sector participation in bringing about significant agricultural growth. The SRA advocates for paradigm shift concept with the aim of conducting business in the agricultural sector differently and sets the pace for transforming the sector into a more commercially oriented and competitive and capable of attracting private investment. The SRA outlines the following six fast-tract interventions required to achieve the above:

i. Review and harmonise the legal, regulatory and institutional framework;
ii. Restructure and privatise non-core functions of parastatals and ministries;
iii. Reform the delivery of research, extension and advisory support services;
iv. Improve access to quality inputs and financial services;
v. Improve access to both domestic and external markets;
vi. Formulating food security policy and programmes.

Review of NAEP

In April 2005, a Study was carried out to review the progress and success of NAEP implementation. The Study Report pointed out the need to review the policy and bring on board other perspectives occasioned by sector and economic reforms which have taken place recently as outlined in ERS and SRA. In this connection, the government in consultation with the key stakeholders embarked on the review of NAEP in June, 2005 in view of making the policy more embracing and encompassing in terms of content and ownership by all key players in public, private and civil society. The revised NAEP, now referred to National Agricultural Sector Extension policy (NASEP), has put into consideration of the desirable NAEP principles and the recommendations of the NAEP implementation review study of 2005.

NASEP, takes a "**sector wide approach**" and addresses key issues on extension service delivery including crops, livestock, fisheries, cooperatives and natural resource management. It provides guidelines in addressing and devising funding modalities, packaging of technologies, technical capacity building and research-extension-farmer linkages. It also offers guidance on the role and modalities of the private sector in providing extension and other auxiliary services, given the emerging institutional structure of the agricultural sector. NASEP advocates for an extension service that is strengthened and reformed using well-coordinated, decentralised, multi-sectoral and multi-disciplinary approaches that responds to user-demands.

NASEP specifically advocates the following:

Retention of public extension service for the poor small holders and areas with low private sector participation

- Directly using the existing Government institutions or
- Indirectly (e.g. contracting out to private sector and other service providers mainly in areas where private sector participation is still low (e.g. in ASAL) with special attention to vulnerable groups.

Improvement in funding of extension services through:

Establishment of a stakeholder-driven Trust Fund managed by a Board of Trustees, for financing of pluralistic extension services. The private sector will contribute to the fund through sources such as produce and special contributions/ levy from agribusiness such as input suppliers. A competitive grant system will be among the systems to be used in accessing extension funds by private sector and public institutions including universities. Commercialization of public sector extension provision using two models:

Model, 1: Cost sharing and partial cost recovery where beneficiaries meet some costs of extension delivery.

Model, 2: Full cost recovery where the beneficially meet the full cost of extension service delivery.

- Decentralization by empowering and strengthening clientele/community organizations (e.g. CBOs and cooperatives) to provide extension services at different levels of stakeholder fora starting at the village or beach level all through to the district and national levels.
- Instituting measures to encourage the private sector to take over the extension service for commodity enterprises where established commercial farming is in place.
- Empowerment of extension clientele through promotion of diversification of enterprises and investments to enable them afford extension and agricultural services.

Regulation of Extension Services Providers

There will be an independent regulatory body established under relevant institutional and legal framework for the purpose of registering and licensing extension service providers. It will collaborate with stakeholders to develop guidelines, code of ethics and enforceable working standards for extension service providers in respect to quality assurance and monitoring. The government, in consultation with stakeholders, will spearhead this process; which will include the mandate to arbitrate among and between extension providers and extension clientele. Quality assurance in extension service delivery will be achieved through the following measures:

- Formation of a National Association of Agricultural Extension Service Providers.
- Mandatory affiliation of all extension providers to National Association for Agricultural Extension Service Providers.
- Setting the minimum level of acceptable professional qualification for extension agents.
- Developing guidelines for the operations of extension-led extension provision such as farmer-to-farmer extension, Farmer Field Schools (FFS) and community-based animal health workers (CAHWs).
- Undertaking periodic curricula reviews by training institutions to respond to the changing sectoral and global trends.

- The stakeholders' collaborative fora at various levels, which will assess the quality of services offered by extension service providers.
- The service providers who will develop and avail service charters to the clients to enhance accountability and transparency.
- Extension clientele (individually and through their groups/societies/cooperative), who will make formal complaints to the extension regulatory body.
- The regulatory body, in consultation with professional bodies, will also develop a penalty system to enforce compliance on established standards.

Decentralized planning process

A coordinating unit within the SRA framework will be established for the purpose of ensuring synergy and sustainability of extension services provision, which will be achieved through:

- Decentralizing by empowering district and lower levels to participate in priority setting, design of projects and programmes and resource allocation.
- Establishing a harmonised institutional framework for coordination of all extension programmes/projects within the sector.
- Instituting a bottom-up planning process for the stakeholders' fora and ensuring that resources are budgeted by and allocated to the lowest planning levels.

Extension Approaches and Methods

Extension Service Providers will be required to apply sustainable, dynamic, innovative and effective extension approaches and methods, especially those:

- Promoting demand-driven and beneficiary-led approaches in selection of technologies and extension messages; and have clear accountability mechanisms.
- Promoting decentralization by using clientele groups (e.g. common interest groups, small holder associations and primary co-operatives) and general public outreach for cost-effectiveness.
- Taking into consideration the importance of indigenous knowledge and technologies.
- With in-built sustainability mechanisms such as cost sharing with beneficiaries and discouraging dependency syndrome.
- Addressing agro-ecological diversity and recognize socio-economic and cultural characteristics of the clients and promotion of enterprise diversification.
- Supporting pluralism in service delivery and promoting strong stakeholder collaboration and networking to enhance efficiency in resource utilization.
- Using multi-disciplinary teams for holistic solving of clientele problems.

- Using ICT and mass media for wider coverage and enhanced sharing of information; and
- Mainstreaming crosscutting issues such as gender equity, HIV/AIDs, drug and substance abuse, governance, human rights, conflict mitigation and resolution, sustainable environment and natural resource management in agricultural development.

Content and choice of extension messages

Extension service providers at different levels will develop dynamic and comprehensive extension packages so as to improve adoption of technologies. The messages will focus among other aspects on:-

- Client's socio-economic status, promoting farmer innovations, consumption of locally produced goods
- The whole value chain from production, value addition, storage, marketing to utilization.
- Transformation of agriculture from subsistence to farming as profitable business.
- Quality standards of inputs, products and food safety.
- Mainstreaming cross cutting issues in extension messages.

Clientele Empowerment to access extension facilitating factors

Extension Service Providers will develop sustainable mechanisms for clientele empowerment by

- Promoting the establishment of farmer-based institutions and fora at different levels starting with common interest groups and linking to division and district-level clientele fora.
- Promoting good governance in such clientele fora (e.g. groups, associations and cooperatives).
- Support the development of well managed and vibrant community-based organizations for savings mobilization, provision of credit, marketing and procurement of farm inputs.
- Harmonizing clientele empowerment approaches by different extension service providers.
- Building clientele capacity to link and access service from other service providers such as CDF, LATF and Produce Cess Fund.
- Promoting the ability of extension clientele to mobilise resources and linking with financial institutions such as MFIs, SACCOs, Village Banks, Formal Banks and AFC.
- Influence the strengthening of MFIs operations through periodic reviews of the Micro Finance Bill, so as to provide a fair playing ground for access to financial services by rural communities
- Empower extension clientele to link with relevant organizations on issues related to local and international trade.

- Promotion of inter-sectoral planning at all levels, to ensure provision of rural infrastructure such as roads, water, electricity, telecommunication, security and medical facilities.

Technology Development and Packaging

The Government will collaborate with other stakeholders to:

- Develop sustainable funding mechanisms to increase funding levels as stipulated in the SRA for technology development, packaging and dissemination.
- Place both public and private agricultural research organizations under one coordinating authority and/or establish mode of operation through well defined MOU's with other stakeholders.
- Strengthen coordination of research activities by existing institutions such as the National Council of Science and Technology (NCST) and create collaboration fora for agricultural research stakeholders.
- Develop client-based/responsive research approach within the framework of NARS by improving the composition of research advisory committees.
- Ensure technology development is market and demand-driven and it covers the entire value chain.
- Ensure that sector Ministries, research organizations and training institutions take a leading role in ensuring a workable mechanism for strengthening research-extension-client linkage and feedback.

Use of Information and Communication Technology in AKIS

The Government in collaboration with other stakeholders will:

- Establish an integrated and dynamic database for the sector and improve access and utilization of generated information and experiences.
- Increase investment in agricultural information and knowledge systems, which will include capacity building in ICT and establishing information points in rural areas.
- Harmonize standards for packaging of user-friendly extension messages.
- Encourage use of participatory learning approaches and improving the reliability of information exchanges through farmer-to-farmer interaction and use of existing informal channels for enhancing the two-way flow of information between advisors and farmers.
- Motivate the private sector, through interventions such as rural electrification and lowering tariffs on solar power, to set up and operate ICT-based rural information centres and establishment of community- based radio.

Stakeholder Collaboration and Networking

Partnership, collaboration and networking among extension service providers, clientele and other stakeholders will be strengthened through:

- Formation of harmonized stakeholder collaborative fora at all levels (village, division and district), which will promote joint programme planning and implementation, information sharing, participatory M&E and impact assessment.
- Formalization of collaboration through Memoranda of Understanding.

PROMOTION OF EMERGING LIVESTOCK SPECIES FOR INCREASED FOOD SECURITY AND WEALTH CREATION

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ABSTRACT

The development of Emerging Livestock focuses on Species of animals that have not, until recently, received adequate attention for production and commercialization, with potential in the provision of proteins and other products of economic importance. They have not been exploited and accepted fully, due to limited awareness, in addition to religious and cultural values. These include: Crocodiles (for meat and skin), Ostrich (meat, skin, egg, feathers), Guinea fowls (meat, skin, feathers), Quails (meat), Snakes (venom and skin), bees (venom, honey, beeswax, pollen, royal jelly, propolis), frogs (meat), Snails (meat), Termites, Donkey (draft power, milk, meat), among others. Emerging Livestock is increasingly being incorporated in the diets of both the rural communities and the urban affluent, to supplement the conventional proteins (milk, beef, pork, mutton, poultry, eggs and fish). It has and is still being utilized by certain communities as a delicacy. This is best demonstrated in folklores and tales. The art of domesticating Emerging Livestock (quails and bees) is at times inherited. Aside from the provision of high quality dietary proteins, other products include: Venom for production of anti-histamines, skins for manufacture of a wide array of industrial products (handbags, belts, shoes, jackets, hats). Some of the animals (Crocodiles, Guinea fowls, Ostriches, Quails, Snakes and Termite mounds, are tourist attractants, immensely contributing to ecological tourism and the associated posterity. The paper identifies the current Emerging Livestock Species and compares them, economically to the conventional Livestock species. It further highlights the essence of dietary complementation to enhance food security and wealth creation, in terms of value addition. It is imperative that emerging Livestock be harnessed, sustainably, with the support policy, to avert the looming hunger situation, currently being experienced due to recurring droughts.

INTRODUCTION

Livestock is a major component of the East and Central Africa economies, contributing 10-40 % of Gross Domestic Product (GDP). In Sub-Saharan Africa, Livestock products provide 17-

18% of human dietary protein and contribute to at least 25% of the Agricultural Domestic Product or 8% of GDP (Winrock International, 1992). About 80% of Kenya's population of is dependent on crop and livestock production as the main source of income. Livestock production plays an important role in the Kenyan economy, contributing about 10 per cent of the national Gross Domestic Product (GDP) and accounting for approximately 30 per cent of the farm gate value of agricultural commodities (Agriculture and Livestock Strategic plan, 2002). The livestock sub-sector employs and accounts for 50 per cent of the agricultural labour force. The country is largely self-sufficient in livestock products, especially small stock meat, except at times of re-occurring droughts, when Emerging Livestock (ostrich, crocodiles, guinea fowls, quails, donkey, snails, snakes, frogs, termites and other) comes in handy to supplement the conventional Livestock (cattle, goats, sheep, camel, poultry, pigs, fish, honey), in wealth creation and food security. Most of the Emerging Livestock species, especially the ostrich (which can tolerate air temperatures of 56°C) and the donkey can easily withstand dearth conditions, matched only by the camel. Guinea fowls and quails, which are considered a delicacy in Western Kenya, from the folklores and tales, could be resistant to some of the devastating poultry diseases that have recently curtailed the poultry industry, including other *Avian species*, like flamingoes.

Livestock's Role in Poverty Reduction

With Kenya's land area of 582,000 Km, 80% (percent) is either marginal or arid and semi-arid land (ASAL) where livestock, wildlife and honey production are best suited, livestock remains one of the sub- sectors with the highest potential to contribute to alleviation of poverty for both the rural and urban poor, through a wide range of value adding activities, at modest levels of investment. There is considerable potential in the Livestock sector in terms of increased employment and income generation. This however requires modernization of the sector through the use of appropriate technological packages, improved management and policy support. The latter is critical in the development of Emerging Livestock, most of which are governed by Kenya Wildlife Acts and regulations on domestication of Animals in the wild (The Forest Act, Cap 385).

Key livestock exports

The main markets for Kenyan livestock and livestock products include the East African Community (0.3 % of the share of all Agricultural exports), the Central African Region, COMESA region, the Middle East, Asia and Europe. The products sold range from beef, processed and raw hides and skins, dairy products such as processed milk, butter, cheese etc. Processed pork products to the Middle East, catering largely to the hospitality industry, and live Animals to Rwanda and Mauritius, mainly. Poultry and poultry products such as eggs, meat and day old chicks are exported mainly to the regional trading partners. These could be diversified to incorporate ostrich and

crocodile meat, guinea fowls, quails and honey, among other emerging Livestock products. Already, guinea fowls and quails from private farms are being exported to Tanzania, in addition to the domestic use at the lucrative tourist hotels, especially at the Coast.

Economic valuation

The Livestock sector contributes US$ 9 billion or 34.5% of the total value of Agricultural production in East and Central Africa. The sector registered an average growth rate of 2.4% between 1991 and 2000 (Ndikumana and Kamidi, 2004).The estimated value of Livestock products in Kenya in the Year 2002 was as follows: Dairy (2.8 M Litres, valued at Ksh. 42 B), beef (305,000 MT, valued at Ksh. 42.8 B), chevron and mutton (84,900 MT, valued at Ksk. 8.2 B), camel meat (6,600 MT valued at Ksh. 0.8 B), chicken (22,100 MT, valued at Ksh. 2.94 B), pork (16,100 MT, valued at Ksh. 1.79 B), eggs (1.3 B valued at Ksh. 7.15), honey (21,700 MT, valued at Ksh. 4.59 B), crocodile skin (3,500 pieces, valued at Ksh. 1B) and Emerging Livestock meats (various). Other products included: wool, hides and skin and live animals, for export.

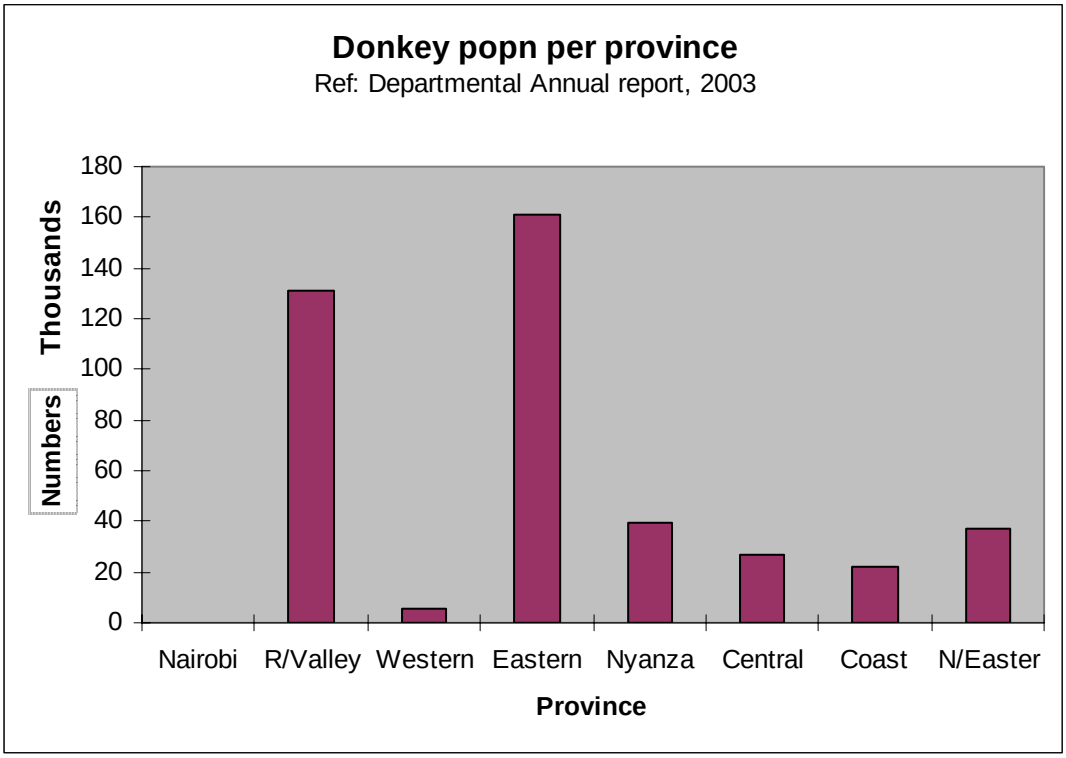
Aside from the provision of high quality dietary proteins, there is tremendous potential in Emerging Livestock products (low cholesterol meat, skins for manufacture of a wide array of industrial products (handbags, belts, shoes, jackets, hats), Venom for production of anti-histamines, feathers, ostrich eggs, honey, beeswax, propolis, royal jelly and pollen) all of which are highly priced. Crocodiles, Guinea fowls, Ostriches, Quails, Snakes and Termite mounds, are tourist attractants, immensely contributing to ecological tourism and the associated recreation and posterity for future generations.

EMERGING LIVESTOCK

Emerging Livestock entails those species of animals that have not, until recently, received adequate attention for production and commercialization, with potential in the provision of proteins and other products of economic importance. They have not been exploited and accepted fully, due to limited awareness, in addition to religious and cultural values. These include: Crocodiles (for meat and skin), Ostrich (meat, skin, egg, feathers), Guinea fowls (meat, skin, feathers), Quails (meat), Snakes (venom and skin), bees (venom, honey, beeswax, pollen, royal jelly, propolis), frogs (meat), Snails (meat), Termites, Donkey (draft power, milk, meat), among others.

Major Emerging Livestock population and production areas

Donkeys



Quails

Quails are abundant in Ikolomani and Lurambi Divisions of Kakamega District and Butere/Mumias district where the art of domestication is inherited (passed from father to son). Quail trapping is seasonal and about 120,000 birds are trapped annually or 60,000 birds per season. Other areas of production are: Bungoma, Nyanza and Coast Provinces (basically at Bamburi and other private ranches).

Guinea fowls

These are predominant in Kajiado and Narok Districts of Rift Valley Province. They are also found at the Coast Province, mainly on private ranches/farms.

Ostrich

Rift Valley Province has the highest concentration of ostriches (158,300), mainly in Kajiado, Nakuru and Narok. Other areas include Nairobi and Coast Provinces. The Maasai Ostrich, characterized by its large body size, basically black with white plumes for males and predominantly brown in the case of females, is the fastest growing bird of its kind in the world. Its potential lies in the low cholesterol meat, and skin that is more expensive than the hide and skins of the conventional livestock.

Crocodiles

Mamba Village in Mombasa remains the largest crocodile farm in Kenya and Africa. It keeps about 10,000 crocodiles mainly for skin. The meat is mainly used in the tourist industry. There is an extension of the Mamba village in Nairobi with a reasonable number of Crocodiles. In Coast Province, Private ranches (Bamburi, Mtwapa, Kilifi) dominate Crocodile farming.

Progress in Emerging Livestock

Farming in Emerging Livestock is mainly done by private ranches, groups/associations and financially able individuals. Marketing of Emerging Livestock products is still highly restricted. So far efforts are directed towards strengthening the institutional framework for the sector. Dissemination of relevant information, especially in the production of ostrich, guinea fowl and crocodiles, and awareness creation on utilization of these emerging livestock, is in progress. A few training workshops for staff have been held and a stakeholders' workshop was held to identify issues within the sector. The number of ostrich farmers rose steadily to sixty (60) in the early 1990s. However, ostrich production trends dropped to about 4,000 in 1995 and a further reduction to 1,000 birds in 2002, due to problems relating to marketing, particularly the export market. Production is concentrated in the Arid and Semi-arid areas and is estimated at 100M Kenya Shillings.

Constraints in Emerging Livestock domestication

►Difficulties in obtaining breeding stock, especially of guinea fowls and ostrich

►Inbreeding, especially in guinea fowls

►License restrictions in production, marketing and export of emerging Livestock products (skin, meat etc).

►Impartial licensing from Kenya Wildlife services, which favours large-scale, as opposed to small-scale production.

► Lack of an abattoir that meets international standards for Emerging Livestock meat export. Meat control Act (CAP 356).

►Certification of exports

►Existence of bits and pieces of Acts, which contradict conservation and use of Emerging Livestock, including Human/ Livestock/Wildlife conflicts (Kenya forest policy, 1957, 1968; Draft forest policy, 2000, 2003; The Kenya National Biodiversity Strategy and Action plan, 2000; Environmental Management Control Act, 1999).

►Inadequate technologies and knowledge on production of the intended animals and marketing outlets.

►Inadequate trained personnel in the field to advise the producers.

►Inadequate research on these animals

Way forward

- Laws that restrict the domestication and utilization of some animal species and their products, should be revised to accommodate up-coming small scale farmers, who wish to venture in: ostrich, guinea fowl, quail and crocodile farming, as a diversification measure for increased food security.
- Encourage sustainable use of the available natural resources with adjacent communities, like the Maasai and the ostrich. (Kenya Forest Policy, 1957, 1968, 2001, 2003).
- Pertaining to traceability and food safety, the Kenya foreign Policy (currently being developed), should deal with pesticide, heavy metals, antibiotics and other chemicals/contaminants as stipulated in: OIE, WTO, Codex Alimenterius and Eure-cap, including Kenya-cap (for both domestic and export markets).

Key investment opportunities in Emerging Livestock Development

- The key areas of investment include value adding of primary products such as: honey, beeswax, skin (crocodile, ostrich, snake) for handbags, belts, hats, shoes, jackets, for wealth creation through income generation. Venom from snakes and bees is vital in anti-histamine production.
- Investment in ostrich and crocodile production for food security, eco-tourism and posterity.

Major Challenges in emerging Livestock

- Policy and legal issues affecting emerging livestock
- Adding value to emerging livestock products
- Marketing problems of emerging Livestock, restricting their local sale as well as their products.
- Intensification of awareness on use of emerging Livestock.

Action in Progress

1. Review of existing laws and regulations with a view of allowing for domestication of Emerging Livestock by farmers (both small and large scale).
2. Promotion of production, identification and accessibility to local as well as external markets, for both live and Emerging livestock products.

CONCLUSION

The rapid growth of human population poses a serious challenge to the ability of the livestock sector to adequately supply the required products, particularly with persistent droughts. This calls for supplementation, which is readily available from those species of livestock that have

so far received little attention or are gaining momentum as the preferred low cholesterol protein sources.

ACKNOWLEDGEMENTS

I wish to acknowledge all Divisions in the Department of Livestock Production, particularly the Chief of Apiculture and Emerging Livestock, and Staff for their input. I appreciate the information obtained from the Managers of the visited private ranches and farms, and their willingness to allow photographs of the ostriches, guinea fowls, crocodiles, donkeys and other Emerging Livestock to be taken and used in this paper.

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Appendix I

Table 1: Livestock Population Estimates (2002)

Species	**Est. Population (in millions)**
Cattle (Dairy)	3.2
(Zebu)	8.1
Camels	0.8
Goats (Dairy)	0.09
(Meat)	10.0
Sheep (wool)	1.2
(hair)	7.7
Poultry (layers)	2.8
(Broilers)	4.4
(Indigenous)	21.7
Pigs	0.32
Rabbits	0.42
KTB and other	0.125
Log hives	1.0
Langstroth hive	0.025

Appendix II

Table 2: Estimated Value of Livestock Products (2002)

Industry	**Quantity/Volume**	**Value (in billion of Kshs)**
Dairy		
Milk	2.8 billion litres	42
Processed Products	Various	1
Red Meat		
Beef	305,000 MT	42.8
Chevron &Mutton	84,900 MT	8.2
Camel Meat	6,600MT	0.8
White Meat		
Chicken	22,100 MT	2.94
Pig meat	16,100 MT	1.79
Egg Production	1.3 billion	7.15
Beekeeping		
Honey	21,700	4.59
Beeswax	3,100	0.07
Emerging Livestock		
Crocodile Skins	3,500 pieces	1.0
Meats	Various	
Fibres, Hides and Skins		
Cattle Hide	1.7 million pieces	1.2
Sheep Skin	1.7 million pieces	
Goat Skin	2.0 million pieces	
Wool	2,067 MT	0.062
Livestock Feeds	389,259 MT	7.8
	Gross Value	**121.4**

Appendix II1

DONKEY POPULATION PER PROVINCE

Ref: Departmental Annual report, 2003

PROVINCE	DONKEY NUMBERS
Nairobi	70
R/Valley	130,800
Western	5,900
Eastern	161,100
Nyanza	39,700
Central	26,900
Coast	22,200
N/Eastern	**37,400**

BEEKEEPING AS A TOOL TO ALLEVIATE POVERTY AND HUNGER IN ARID AND SEMI-ARID REGIONS OF KENYA

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ABSTRACT

About 80% of Kenya lies in the arid and semi-arid areas (ASALs). These areas have the highest beekeeping potential, contributing about 80% of the total honey produced in the country. The beekeeping industry contributes about 1.89% of Kenya's GDP. The country has a potential to produce approximately 100,000 metric tones of honey, but only 25% of this potential has so far been tapped due to several limitations. This paper addresses these bottlenecks and their possible impacts on the livelihoods of communities living in the ASALs in an effort to reduce poverty and enhance food security.

INTRODUCTION

Kenya's has about 80% of its landmass classified as arid and semi arid lands (ASAL) and 20% are made up of the high potential areas. The ASAL is characterized by low rainfall that is poorly distributed and unpredictable, low potential for agriculture unless under irrigation, frequent droughts / famine that sometime extend for three (3) or more years. The ASAL has a high beekeeping potential that is not fully exploited. Introduction of modern and appropriate beekeeping equipment especially hives like langstroth and technologies in harvesting and processing will enhance the alleviation of poverty in these areas. The ASAL people (pastoralists) derive their livelihood from livestock which occasionally are wiped out by drought. The vegetation cover is scanty leading to massive soil erosion and land degradation through frequent overgrazing. There is more trees and shrub cover compared to grasses. Grass growth is seasonal (annuals) which appear just after the rains, hence the frequent migration of pastoralists and their livestock. The trees and shrubs have high densities along riverine ecosystems. There is a high diversity of bee plants in these areas, some plants flower in the dry season when other animals have no forage. This makes bees as the only animals that can effectively exploit vegetation in the ASAL without causing the effects of land degradation. Water sources are poorly distributed; some are permanent while others are seasonal. Bees collect water from livestock and domestic water points. The ASAL areas are rich in bee diversity having many races of *Apis mellifera* and stingless bees. The local bees are adapted to the ASAL areas that have high temperatures which render other animals inactive. They manage to

survive through water cooling. They have adapted to foraging early morning and late afternoon to avoid the high temperatures. The bees aid in pollination of wild and cultivated fruits which causes increased food production especially from irrigation schemes. Bee pollinated plants produce high quality seeds and pods that are fed to other livestock during the dry season. The seeds of some plants self regenerate hence increased ground cover and more herbage for other animal species. Bees also tend to introduce hybrid vigour among cross pollinated plants and produce mutants that can survive in the ASAL. Without cross pollination, some plants would go extinct and therefore, beekeeping ensures a sustained environment unlike when other livestock species are kept in the fragile ASAL ecosystem.

Hives

Pastoralists obtain honey and other products from the many traditional hives kept on top of trees and also from tree trunks and rock crevices. These bee habitats make harvesting difficult and complex. The use of modern hives like langstroth is recommended due to ease of inspection and handling of bees and harvesting of honey; produces large quantities of honey due to their large capacity; occupation rates are higher compared to Kenya Top Bar Hives (KTBH) due to high temperature prevalent in such areas. However, placing of the langstroth hives should be on platforms in fenced apiaries to control the honey badger. The technologies that are used in honey harvesting include harvesting only ripe and sealed honey. During processing, honey should be warmed and sieved without burning to avoid spoiling its quality.

Hive products

Honey

This is the primary product from beekeeping. Honey from the ASAL areas is purely organic – food sources are natural wild plants free from pesticides, agro- chemicals and industrial fumes; it is a food with almost limitless shelf life and plentiful in arid and semi arid areas like in the Biblical Canaan, Deuteronomy 32: 13, Psalms 81: 16, Judges 14: 8, I Samuel 14: 25-27; used in the preservation of many foods, beverages and bodies of Kings and Generals who died in war; it's sold for income generation both locally and for export; valued for its medicinal value since its source is herbal – treats common colds, allergies, burns and stomach upsets; used as an offering e.g. II Chronicles 31: 5, Leviticus 2: 11.

Beeswax

This product is produced from the wax glands of the bees about two (2) weeks of age and some is collected from plants. Beeswax is used for comb making and combs are useful for brood rearing and storage of honey and pollen. Most communities do not produce beeswax; they throw away combs after extraction of honey. Combs are obtained after refining honey or collected from deserted nests. If uncollected, they get destroyed by wax moth. Extraction of wax involves boiling the combs in water. It melts and strained using cotton cloth. The filtrate is allowed to cool and form a cake of beeswax. Currently, beeswax is sold at Ksh. 300 per kg. The largest consumer of wax is cosmetic industry followed by pharmaceutical and candle making industries especially for religious purposes, lighting in the rural ASAL areas and insect repellant if incorporated with other herbs like neem extracts. It's used by bees to make comb foundation and also to lure bees to the hive. It's also used in textile industry; dentistry for making base plates; water proofing materials; polish, soap, crayons and chewing gum industries, therefore it is important for income generation locally and for export.

Propolis

This is a sticky, gummy resinous material collect by bees from plant buds, barks and exudates. Bees collect it to fumigate the hive; filling cracks and crevices in the hive; reduce openings; smooth over interior of hives; vanish interior of brood cells; strengthen comb foundation and bury dead and large objects that cannot be thrown out of the hive. It is the principal constituent in vanish; used in ointments for treatment external wounds and abscesses in man and animals; treating of backache, burns and external ulcers in man; has been experimented in treatment of hearing defects; anaesthetic in dental practice; sealant; income earner both locally and for export.

Pollen

This is the germplasm of plants used for fertilizing ovules. Bees transport it to stigma during their pollen collection hence aid in cross pollination of plants. Pollen is a rich source of nutrients like protein, minerals, vitamins and lipids. Bees collect pollen from plants, trap using their hairy bodies and special structures on legs, pack them in the corbicula and transport to the hive. There are many different pollen producing plants with different composition of nutrients. Bees require ten (10) different amino acids daily (Davis, 2004). Bees may add nectar and honey for preservation and store it as bee bread. Bees use pollen to raise their brood; it is a material for making royal jelly for the queen and larval bees. Pollen has high nutritional value and is used as food for bees, dietary supplement for man and livestock; maintenance of health of prostate gland and treatment of prostate cancer; pollen from the date palm reverses sterility in man; treatment of allergy as well as for income generation. Excess pollen can be harvested from hives by placing a pollen trap at hive

entrances, dried and stored to be fed to bees or other livestock later. Pollen can be used to identify bee plants for propagation. Potentially, a lot of pollen can be produced but traps have to be removed at times so that bees store the pollen for brood production and avoid reduced size of the colony. Pollen is available in markets in small vials or in capsule form.

Brood

These are immature bees in the larval and pupa stages. Traditional beekeepers use it as a natural food product for man and livestock. It is rich in nutrients like protein, vitamins and minerals and competes with other high quality protein sources like meat and beans. It is documented as food in Africa, Tropical Asia, Australia and South America. The composition of fresh brood is 3.71% fat and 15.4% protein, high in Vitamin A and D. Consumption of large quantities of Vitamin D has been strongly linked to reduced chances of Ovarian, colon and breast cancer as quoted from the American Journal of Public Health in The Standard newspaper 22nd Feb 2006. It is used as food for pet reptiles, small mammals, poultry and fish. Lately, Japanese have reared beneficial insects for biological control of pests like lady beetles and lacewings on a diet of honey bee brood (Okada, 1970, 1971; Okada and Nujiima, 1971)

Bee venom

This is the material extracted from bee stings. It is produced by bees above 5 days old especially for defense of the colony in the poison gland and stored in the poison sac and injected through the bee sting. It is a clear liquid with sharp and bitter taste and aromatic odour. It has an acid reaction and specific gravity of 1.3 (Beck, 1975). It quickly dries up at room temperature to 30-40% of original liquid weight. It is more toxic than wasp venom (Benton and Heckman, 1969). One sting is capable of causing death through anaphylactic shock to hypersensitive persons. Death may occur within 30 minutes unless prompt medical attention is given such as administration of ice packs, adrenaline and antihistamine shots. Venom is bio-chemically active material useful in treatment of rheumatoid arthritis and reverses allergy to insect bites and stings. The venom is collected using the venom extractor and to obtain 1 gram of venom, you require 60,000 bees. 1 gram costs 500 US $. Once produced by the bees, no venom will be manufactured again. It is possible to collect venom every 3-4 months with every new generation. Extraction of venom has no effect on the bees (no death) or their honey production capacity. Venom collector has to be removed after sometime to avoid aggression of bees.

Conclusion and Recommendation

1. Promotion of beekeeping activities in ASAL areas will not only promote livelihoods, alleviate hunger and reduce poverty levels among pastoral communities but enhance the preservation, maintenance and sustainability of the fragile environment and biodiversity.
2. Bees pollinate endemic or endangered plant species which have medicinal value to man e.g. *Bankia Brownii*, Rosy periwinkle in Australia and Madagascar respectively
3. Pastoral communities should be encouraged to use Langstroth hives as their production capacity is high and the ease of harvesting the honey.
4. Honey produced is free from heavy metals like lead, cadmium and zinc which are common in urban settings and highways
5. Honey, pollen, royal jelly and wax are bio- collectors / accumulators of heavy metals, pesticides and radioactive compounds
6. Credit facilities need to be extended to pastoralists to carry out beekeeping and diversify their income and reliance on livestock
7. Beekeepers get income from bees and would help in discouraging fire that destroys forage sources and this becomes positive to the environment

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ENHANCING FOOD SECURITY IN THE ARID AND SEMI-ARID DISTRICTS OF KENYA: THE ROLE OF THE DROMEDARY CAMEL

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ABSTRACT

Kenya has over 80% arid and semi-arid lands (ASALs) of low agricultural potential. It is estimated that the ASALs support 25% of the total human population of the country and slightly more than half of the livestock population. These areas are characterized by low rainfall (<400 mm annually) that is unpredictable and erratically distributed, and frequent dry spells. Periodic droughts are a common occurrence in Kenya's ASAL districts and cause loss of livestock, and at times human lives. There are many nomadic communities in these areas, depending on livestock as their main source of livelihood. The main kinds of livestock kept in these areas are: camels, cattle and small stock (i.e., sheep and goats), of which camels are highly regarded by most pastoralists. Camels have over the centuries developed various adaptations that enable them to not only survive but also do well in the harsh environmental conditions of ASALs. Camels play multiple roles in pastoral production systems, of which milk production is perhaps the most important. Camel meat is a delicacy not to be missed especially during festivities. Communities that consume blood also bleed camels for food. Male camels are also used for transportation and draught work. Besides, camels play an important role in traditional social relations, like payment of dowry, and compensation of injured parties in clan feuds. In most communities, camel ownership (in terms of herd size) is an indication of social status. Also, in the traditional pastoral economy, camels are the main reserve stock, and therefore act as a store of wealth and security against drought, disease and other natural calamities. Consequently, the diverse roles played by camels amongst pastoral communities, shows their great potential to contribute towards food security and poverty alleviation in ASALs.

TRAINING ANIMAL SCIENTISTS IN KENYA – THE OPPORTUNITIES AND CHALLENGES

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ABSTRACT

Human resource in every section of the economy is an essential element of any national development. In Kenya, agriculture is the backbone of the economy, with livestock contributing good share of it. The diversity in species kept in systems of production and management imply that personnel involved in extension services, whether government NGO's or the private sector should have adequate training, both theoretically and practically. Hardly are there any studies that have highlighted and elaborated on the challenges and opportunities of training animal scientists in Kenya. This paper examines the challenges and opportunities of training animal scientists in Kenya, with a view to providing points for future consideration for training personnel to man the livestock sector.

INTRODUCTION

Lack of qualified manpower is one other major constraint to sustainable genetic improvement programmes in smallholder production (e.g., Nimbkar, 2000). Few trained animal breeding personnel exist in developing countries (Okeyo et al., 2005). Even where they exist in relatively elevated numbers, the farmers cannot afford to hire their services, and sometimes the governments too cannot afford to keep them for long enough periods to allow for consistency. Consequently, well-intended genetic improvement projects fail, especially when management is left in the hands of less qualified personnel, and ill-prepared farmers (Okeyo, 1997).

Human resource in every section of the economy is an essential element of any national development. In Kenya, agriculture is the backbone of the economy, with livestock contributing good share of it. It therefore becomes appropriate to train personnel to run this sector**.** The agricultural sector contributes about 20% of the country's GDP, of which the livestock such sector

contributes 60% (GOK, 2004). The sector drives other sectors of the economy. The species kept are cattle, sheep, goats, pigs, poultry, camels, rabbits, fish and non-conventional species (e.g., ostriches, quails, snakes and guinea fowls). Livestock contribute to the livelihoods of the rural populace in terms of nutrition, and socio-economic and cultural requirements, and constitute a lot to their security. They should therefore be taken care of in order for the farmers to reap optimum benefit from them. The animals are kept in both smallholder and pastoral production systems. The characteristics of these systems can be found in the literature (e.g., Peeler and Omore, 1999; Kosgey et al., 2006). The diversity in species kept in systems of production and management imply that personnel involved in extension services, whether government NGO's or the private sector should have adequate training, both theoretically and practically. The challenge facing the universities in the country and the nation at large is the production and retention of the skilled animal scientists to train others, do appropriate research and provide extension and consultancy services. Few studies have highlighted the importance of this issue and elaborated on the challenges and opportunities of training animal scientists in Kenya. This paper examines the challenges and opportunities of training animal scientists in Kenya.

The opportunities

A number of opportunities for training of animal scientists exist in the country. These are discussed in the following sections of this paper.

Infrastructure and personnel

Almost all public universities in Kenya train on agriculture and/or related fields. Egerton, Nairobi and Moi Universities each have that department that specifically offers animal sciences, either as a discipline or providing service courses. These departments have highly qualified lecturers and some of the basic equipments for undergraduate and postgraduate training. However, due to competition, the universities have spread themselves too thin.

Agriculture as the backbone of the economy

Given that agriculture is the backbone of Kenya's economy and that livestock constitutes a larger proportion of it implies the need for trained manpower for the sector. With more informed investment in the livestock industry, skilled managers would be required to optimise benefit from the investment made.

The increase in human population

The human population in the country is currently growing at the rate of 4% annually (CBS, 1999). This population requires nourishment and food security. For this to occur, trained personnel are required to help and guide in appropriate technologies to produce food and secure sustainable production.

Investment in research

The Government's recognition of the importance of research in the agriculture sector is crucial. The establishment of KARI, KETRI, KEVAPU and other institutions that handle research on livestock vouches for this fact. It becomes imperative to have appropriate manpower to do research and run these institutions. The existence of international organizations involved in livestock research, e.g., ILRI, ICIPE and Coopers in the country signifies the importance of qualified manpower.

Agro-based industries

There are many agro-based industries in the country. These industries provide various inputs and services to the livestock sector and therefore require trained personnel in animal science. The personnel would be involved in research, consultancy, and as marketing managers and agents of products and services.

Livestock oriented NGO's and development agents

There are many NGO's and development agents on livestock projects in the country. Notable examples are FARM-Africa and Heifer Project International Kenya (HPIK) that are promoting dairy goats in various parts of the country, and Land 'O' Lakes which is involved with dairy cattle. Trained animal scientists are required to run such projects activities, which therefore provides a demand for them.

Private entrepreneurs

There are a number of entrepreneurs who are interested in investing in livestock and related industries, e.g., Tuzo, Delamere, Wangu-Embori and Brookside dairies, to name but a few. To

effectively run these enterprises, technological progress is desirable. A need therefore arises for qualified scientists.

Government projects

Accelerating development and growth is a pressing problem for the country. Recently the government extolled a strategy for revitalization of agriculture (GK 2003) in which livestock is mentioned as key The MLFD has been set up, indicating the import of this sector. There are a number of development projects on livestock under this ministry. For example, IFAD-funded dairy projects. There is need to develop support institution and change attitudes and values of people. The social attitudes, values and institutions should therefore be changed or modified for economic developments to take place. Education and demonstration can play a huge role in these aspects. Education enlightens people. To achieve desired results, trained animal scientists are required to carry out the tasks.

Challenges

There are number of notable challenges to the training of animal scientists in the country. These are discussed in the following sub-sections.

Declining popularity of agriculture

The world over, there is a declining trend in enrolment and interest in agriculture and related courses over the years that is worrisome in all the universities that offer the courses. The subsistence nature of our farming, illiteracy and lack of enthusiasm by the older generation of farmers add to the gloom of agriculture. Due to peer or parental/guardian pressure most students are forced to go for programmes that are regarded as “trendy” and with job opportunities, without due regard for the students aptitude. No wonder there are huge enrolments in courses such as IT, medicine, education, business management and social sciences, among others, and fewer and fewer in agriculture. This appears ironical because the country is dependent on agriculture and with a population that is growing to be fed.

Training curricular and marketing of programmes

The curricular in most universities are still traditional and have become largely non responsible to the needs and dynamics of the nation. The maintenance of the *status quo* has meant that farmers and other clients have become apathetic to graduates from local universities. The standardisation of the 8-4-4 system of education so that science-based courses like agriculture took as long as arts–based courses to complete was an oversight that requires re-consideration. The reduction of courses in the old curriculum meant dilution of the programmes both in content and coverage, especially the practicals. The graduates therefore end up leaving universities with more theory than practicals. Since no emphasis is placed on internship after graduation, hardly do the graduates feel adequate competent to face employers. It also takes long painstaking process to get promotion when one opts for agricultural courses, especially in teaching. Most of the jobs advertised currently in the dailies are social science-, medical-, business-, law-, information technology and engineering-based, and rarely on agriculture.

The universities are not engaged in a deliberate to attempt to inform high school leavers, the parents, stakeholders of existing agricultural programmes and their importance to the national economy. The end result is that the programmes are ignored and food insecurity sets in. Generally, opportunities are tied with jobs and job creation. The media remains the strongest channel to push for awareness in agricultural courses.

Liberalization of the agricultural sector

The liberalization of the public sector in the early 1990's s a World Bank recommendation was a drastic step that required careful implementation. This meant farmers were free to seek extension services and advise from anywhere. Consequently, there have been a number of extension agents from the private sector involved in advising farmers. Whereas a good number are well-trained, some are "quacks", who hardly have basic training in animal sciences. This has led to wrong (unprofessional) extension messages getting to the clients and given extension services a bad name occasionally. The persuasion nature of extension services and historical occurrences have not helped as much. The peasant farmers always view extension agents as intruders and a source of unnecessary trouble.

Lack of scholarship and research funds

Deliberate efforts to fund higher education have been declining for the last one and a half decade. The shift towards private sponsorship of higher educations has seen a decline in the enrolment of postgraduate students. Most qualifying students apply to post-graduate programmes but fail to report for lack of fees. Those who manage to pay tuition still end up getting problems

with research due to inadequate funds. Ultimately, they take long to complete their studies, which reflect badly on the already declining popularity.

High turn over of qualified staff

Training, especially at postgraduate level, requires highly qualified and competent staff. Such staff are hard to come by and their retention at the public universities for long becomes difficult. Remuneration at public universities is often not competitive and facilities are lacking to an extent of discouraging productive scholarship and personal academic devolvement.

Access to information, communication and technology (ICT) services

The state of ICT services in the public universities are pathetic to say the least. Lecturers have to spend long hours accessing the slow services or have to always travel to nearby towns to cyber cafes that have faster services. The time wasted and high expenses incurred discourage regular update of information and timely response to mail. This mostly results into missed opportunities for further personal development by the lecturers, e.g., short courses, seminars and workshops.

GENERAL DISCUSSION

Taking into account that Kenya's economy is almost entirely dependent on agriculture and agro-based industries, the lack of interest in agricultural training by the young population is worrying. If the situation is not arrested the agriculture industry will suffer permanently and thwart industrialization in the country. Immediate action should therefore be undertaken to reverse the dangerous trend. It is therefore important to critically examine the reasons causing the decline and devise ways of reforming agricultural-oriented programmes in order to generate more interest in them. Issues to address include: (i) the relevance of agriculture training to industrial needs in the country, (ii) the causes of decline in student enrolment, and (iii) ways of promoting student acceptance of agricultural related courses. Stakeholders who play key roles in agricultural, research and education sectors in the country need to meet and have their views used to form a common front in regenerating the interest in agricultural courses. Among these are professional (from colleges, universities and the private sector), agro-based industries, farmers (small- and large-scale), secondary school heads, NGO's, international organizations and Government line ministries.

Investment in ICT services is imperative for any institution that desires to provide quality education and training. Consequently universities should annually have funding set aside for establishment and expansion of ICT services. This would enable access to latest information on

courses; enable lecturers to network with colleagues in their areas of specialization and effect quick response to questions by stakeholders in animal science. Websites that are regularly updated would act as marketing points for programmes and lecturers (for consultancy services).

It is important to realise that the supply of skills should determine the remuneration. The cardinal economic principle is that marginal productivity should act as a regular for wages. Unclear national policy on wages requires careful consideration in order to avoid discrepancies among personnel with similar qualifications. University lecturers are sometimes demoralised by salaries that do not reflect their qualifications. Strikes pressing for salaries are always time-consuming wasteful and haphazard.

The final result is disruption of academic programmes, lengthening of completion time of programmes and an estranged atmosphere between the lecturers and the university authorities. There are usually obvious discrepancies between the level of the skill possessed and remuneration across employers. Mostly, the levels of productivity are disregarded and this acts as a disincentive for highly productive individuals and encourages unproductive ones. It is important to realise that morale generally diminishes where remuneration is not commensurate to productivity and the inclination is for highly skilled trainers to reduce their productivity to the general disadvantage of the graduates and subsequently to the national economy. Home grown research, production of goods and services national economic growth and improved standard of living of the population be seen and valued.

There is need for adept and energetic attempts to figure out optimum strategies and tailored efforts for ensuring high enrolment and to curb despondencies. To reduce strikes, the is need to regularize and with commitment review of remunerations for trainers to avoid unnecessary hiccups. National guidelines on the awarding of salary increases are necessary based on careful assessment of the productivity of trainers to national development. The concept of knowledge driven economy should be embraced and research should be allocated specific funding from the exchequer annually. In addition, is the need for creation of an enabling environment conducive for professionals to increase productivity. The university animal scientists and researchers and others in research institutes should be accorded the respect and recognition they deserve. The highly productive lecturers and professors need to be highly valued and compensated as they are a rare lot. This would first require a system that recognizes our value system in perpetuating the status quo. A system that nurtures what we re rather than what others want us to be. Destroying an animal scientist to build another profession is not a healthy development to be cherished. Incentives would make them to become more productive.

It is important to realise that lecturers contribute immensely to national income and development through production of appropriate manpower. At the national level it is apparent that

the directorate of personnel management is not adequately pro-active in informing the training institutions of the human resource requirements of the country. The universities have therefore to train as per capacity declared based on bed and classroom spaces instead of the projected labour demands in the job market.

Currently, hands-on training and entrepreneurship are little emphasized on. This renders graduates from the local universities to be reliant on formal employment, which creates a "dependency syndrome". This is largely the reason why agricultural related programmes are facing declining student enrolment. It is necessary to ask parents to stop living their dreams through their children and let them make their own free choices in life. Career masters in secondary schools also need re-orientation in their thinking. The issue of commodification of knowledge is something that requires urgent attention, and imparting of entrepreneurial skills to animal scientists. There is lot of money in animal products (but requires a lot of value addition)

The education system from primary school should be able to nurture intellect and give students an empowering environment compatible with this century's aspiration of learning society. Incentives to students to participate in workshops and conferences are required. In addition, recognition of excellence through awards as does other programmes (e.g., marketing and pharmacy), including upfront employment opportunities becomes relevant in the promotion of agricultural based courses. There is need to produce checks in extension service delivery to ensure that only trained personnel are allowed to practice. Restriction through licensing becomes necessary in this case. There is need for talent meritocracy instead of examination meritocracy that will make students do better in the real world.

ACKNOWLEDGEMENTS

The authors are grateful to Egerton University (Njoro, Kenya) for provision of facilities to undertake the study. The opinions expressed in this paper are entirely those of the authors and do not reflect, in any way, the views of Egerton University or that of any other University in Kenya or the Government of Kenya nor APSK.

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SESSION III

LIVESTOCK IMPROVEMENT AND GENETICS

LIVESTOCK BREEDING UNDER PASTORAL PRODUCTION CIRCUMSTANCES IN KENYA: ISSUES FOR CONSIDERATION

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ABSTRACT

The role of livestock in the livelihoods of the pastoral communities cannot be gainsaid. They are a source of both tangible and intangible benefits. The communities can therefore gain optimally by improving the management and genetic make-up of their livestock. Genetic improvement is permanent. It is evident that the pastoral people are endowed with intricate indigenous knowledge on animal breeding and breeds. It becomes imperative to tap this knowledge and the unrecognized advantages. However, genetic improvement under pastoral conditions faces many challenges: technical - livestock lack of veterinary and extension services, resulting in diseases that weaken and decimate large numbers of animals and poor management (breeding, nutrition and housing); infrastructural (poor road and communication network); socio-cultural practices that value large numbers of animals, insecurity; lack of water and seasonal pastures; and inefficient marketing system. The mobility of animals in search of water and pastures makes it difficult to have an effective performance and pedigree recording. Marketing facilities are lacking in most cases and animals have to be trekked for long distances to the to the market. To have effective breeding strategies, the foregoing bottlenecks should be tackled holistically.

INTRODUCTION

EFFECTIVE STRATEGIES FOR GENETIC IMPROVEMENT OF SMALL RUMINANTS IN KENYA

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ABSTRACT

This study demonstrates the implication of using progeny testing, pedigree selection and performance testing for small ruminant breeding in Kenya. It answers apparently simple technical questions why a specific selection scheme should be appropriate for small ruminant farmers. For illustration purposes, a simple example of a breeding programme to improve the 12-month live weight of small ruminants was described. From the responses to selection point of view, the study almost exclusively favoured the performance-testing scheme (about 0.29 kg) at the expense of pedigree selection (0.28 kg) and progeny testing (0.22 kg) schemes. This was because candidates in this scheme had a high selection intensity (2.42) and short generation interval (2 years). Although response to selection for the progeny-testing scheme was low, candidates in this scheme were selected with higher accuracies. This was because of the fact that information sources from related individuals were used. For a simple, low-cost approach to making genetic change, performance testing can be recommended. However, other schemes should be taken into account because they increase the accuracy of selecting the candidates.

INTRODUCTION

The potential of small ruminants to contribute to food security, economic development and environmental sustainability is tremendous (Kosgey, 2004; Lebbie, 2004). The genetic diversity and compatibility of small ruminant indigenous genetic resources with the exotic breeds make them appropriate for crossbreeding. Crossbreeding is therefore widespread in the smallholder systems, and in most cases has led to a remarkable rise in productivity in the first crossbred generation (Mwandotto et al., 1992). In contrast, use of imported genetic material in the pastoral production systems is negligible and therefore animals in this areas categorically posses genetic properties

crucial for survival and reproduction in the prevailing production conditions, and in most cases are used as purebreds.

Both pure breeding and crossbreeding rely on effective selection strategies. Three selection strategies can be distinguished: progeny testing, pedigree selection and performance testing. The worth of progeny testing is to: (i) obtain genetic information on sex-limited traits, (ii) determine sires' status for recessive genes and (iii) obtain a more accurate estimate of a sire's true genetic merit than is attained simply by assessing his own performance (see Banks, 1993 for more details). On the other hand, pedigree selection and performance testing are alternatives to progeny test because they reduce the generation interval among the selected breeding animals. Pedigree selection is also good particularly for sex limited traits. In Kenya, progeny testing as means of genetic improvement in the small ruminant populations seems to have been assumed at the expense of pedigree selection and performance testing strategies. It is worth pointing out the essentials of these selection strategies and reasons why they should be carried out for small ruminants in the country.

This paper demonstrates the implication of using progeny testing, pedigree selection and performance testing for small ruminant breeding in Kenya. The effectiveness of these selection strategies in terms of genetic gains are justified, valuable reasons of encouraging a specific strategy as a means of genetic improvement for small ruminants are also enumerated.

MATERIALS AND METHODS

General

Selection response is influenced by the genetic variability of the population, which is expressed by the additive genetic standard deviation of the trait under consideration, s_A; selection intensity, i; that is, the standardised selection differential; accuracy of selection, r, which depends primarily on the heritability of the trait selected and the generation interval, l, which is the amount of time required to replace one generation with the next. A simple expression of the response per year (R) is derived as:

$$R = \frac{s_A . i . r}{l} \qquad (1)$$

Strategies for genetic improvement

A breeding programme to improve the 12-month live weight of small ruminants was assumed. The trait, 12-month live weight, was chosen for this study because studies have reported high economic values for 12-month live weight for small ruminants in Kenya and the trait is perceived by farmers as being of primary importance (Kosgey et al., 2003 and 2004; Bett et al., 2005). Three selection strategies were assumed, performance testing, progeny testing and pedigree selection.

In performance testing, selection of breeding sires and dams was based on exclusively their own 12-month live weight records. In this case, individuals were evaluated on their own performance within a period of time (one year). The assumption is that selection is equal in males and females. On-station performance testing was assumed in this study since it is the most commonly used technique for genetic improvement of small ruminants in Kenya. This means that performance testing was only done in the nucleus flock. The accuracy of selection in this case is equals to the square root of heritability (Syrstad and Ruane, 1998). Own information plus a further progeny test and pedigree information among the young sires and dams were used in the remaining selection strategies, respectively. Artificial Insemination (AI) is not well established for small ruminants in Kenya, so only natural mating was considered. A mating ratio of 1:50 was assumed. Table 1 outlines the set of breeding programme variables used for the prediction of genetic response per year for the three breeding strategies.

In progeny testing, four selection pathways through which genetic material can be transmitted from one generation to the next were considered: sires of sires (SS), sires to dam (SD) dams to sires (DS) and dams to dams (DD) pathways. The assumption was that all commercial breeding females were available but only 60% of the commercial breeding females had performance records. If 20% of the females with performance records in the commercial flock were used for progeny testing, this gives a total number of 6,000 females. With a mating ratio of 1:50, the number of males required for mating would be 120 males, out of which only 40 were progeny tested. Only five were selected out of 120 as elite sires (sires of young males). Therefore, the selected fraction for SS and SD pathways were 0.04 (5/120) and 0.33 (40/120), respectively (Table 2). In the DS pathway, the number of young males to be progeny tested was 120 and only 4 elite pregnancies were needed to obtain a young male, the number needed was therefore (4*120 = 480). The number available was however 0.3*50,000+2500 = 17,500 (i.e. the fraction of breeding females suitable to be elite dams * the number of commercial breeding females + the number of breeding females in nucleus). The selected fraction was therefore 0.027 (480/17,500). In the DD pathway, the number needed was 2*0.2*50,000 = 20,000 (i.e. the replacement rate in breeding females * the number of commercial breeding females). The number available for selection was obtained from, 0.7*50,000*0.60 = 21,000 (i.e., the fraction of commercial females suitable to have offspring * the number of commercial breeding females * the percent performance recording in commercial flock). The proportion of animals selected was 0.95 (20,000/21,000).

Unlike the progeny testing, pedigree selection assumed only two paths of selection, sires to offspring (SO) and dams to offspring (DO). This is because parents are not specifically selected to breed offspring of a given sex. The pedigree information was from the dam, half sisters of dam, his maternal granddam, half sisters of his sire and his paternal granddam clearly illustrated in Figure 1.

Based on the assumptions made earlier, and considering that 120 proven males were selected each year for breeding, the proportion of animals selected in the SO and DO pathways would be similar to the DS and DD pathway in the progeny testing strategy. The selection of males and females were carried out using the same pedigree data.

RESULTS

Table 2 presents the accuracy of selection, selection intensity, response per generation, generation interval and response per year for 12-month live weigh. The accuracy of selection was highest in the progeny testing (0.72) and lowest in the performance testing (0.5). The difference in the selection accuracies were created by the amount of information sources used to select the candidates. In progeny testing, the accuracy of selection varied across the male and female selection pathways. The difference occurred probably because of the variation in the amount of information sources available for a specific selection pathway. In pedigree selection, similar selection accuracies to those in progeny testing were experienced because the candidates (individuals to be selected) were selected based on the same pedigree information. The lowest accuracy of selection for the performance testing was expected because the candidates were selected based on their own sources of information. Apart from the candidate own records, information available from the relatives were used in progeny and pedigree selection leading to higher accuracies (Figure 1). Sources of information used to higher extent determine the accurateness of a candidate selected. Use of information sources from related individuals increases the possibility of selecting the right candidates for a specific trait in a genetic improvement programme. However, recording systems for small ruminants in the tropics especially in the commercial sector are not well established because record keeping involves a lot of costs.

Performance testing reported the highest intensity of selection (2.42) when compared to the other selection strategies. This occurred because the selected fraction was low. The selection intensity is determined by the proportion selected, that is, the ratio of number needed and the number of animals available during the selection process. High proportion of the individuals selected corresponds to low selection intensities and vise versa. In progeny testing, the intensity of selection (*i*) was higher in the sires of sires (SS) and dams of sires (DS) pathways than the dams of dams (DD) and sires of dams (SD) pathways. The *i* for the SS pathway was 2.13, while *i* was 0.10 in the DD pathway. Higher selection intensities occurred for pathways selecting candidates to breed sires because a small number of males are usually required to produce offspring.

Response to selection can either be expressed as response per generation or response per year. However, the latter is more informative than the genetic change per generation. The genetic change in a trait per year accounts for the generation interval of the individuals to be selected. The

generation interval differed among the selection strategies. The selected individuals in progeny testing and pedigree selection have longer generation interval when compared to those in performance testing. Progeny testing and pedigree selection programmes suffers from the fact that it takes so long for the male or female daughters to be recorded. Generally, the average response per year of the selected candidates was highest for performance testing (i.e., 0.61 kg). The average response per year for progeny testing (across the four paths) and pedigree selection (across the two paths) were 0.22 kg and 0.28 kg, respectively. Higher response per year for the selected candidates in the performance testing strategy occurred due to higher selection intensity and short generation intervals.

DISCUSSION

The results presented in this study suggest that breeding programmes selecting animals based on 12-month live weight can achieve reliable genetic gains for the trait. The degree of genetic gain for the trait however differed depending on the strategy used. The genetic gains differed among the strategy because theoretical arguments concerning genetic gains tend to favour practical strategy with lower generation intervals (Syrstad and Ruane, 1998). Progeny testing have longer generation intervals compared to the other strategies. Syrstad and Ruane (1998) predicted an approximately 20% lower genetic gains for milk yield in a strategy based on progeny testing of bulls relative to pedigree selection. In this study, the genetic gains for a strategy based on progeny testing of males had a genetic gain of 0.22 kg for 12-month live weight which was about 27% and 177% lower than pedigree selection and performance testing, respectively.

In progeny testing, parents were selected specifically to breed offspring of a given sex. Pathways selecting candidates to breed males were responsible for the largest part of the response per year while those to breed females contributed only slightly. When a pooled generation interval was used across the pathways to predict the genetic gains, the estimates drastically reduced from 0.39 (SS pathway) to 0.22 (sum across the paths) kg per year. Similar results were also experienced for pedigree selection, the difference between the sires of offspring (SO) pathway and the sum across the paths was however small. The genetic response per year for the SO pathway in pedigree selection was 0.29 kg, while the sum across paths was 0.28 kg. The difference between the SO pathway and the sum across the paths was negligible (about 0.03%) because parents in this selection strategy were selected to breed offspring of both sexes. In general, the results from this study suggest that selection strategies where parents are not selected to breed offspring of a given sex realise higher responses per year for the 12-month live weight while sire selection is important in situations where a given sex is anticipated.

In terms of response per year, performance testing is recommended as a strategy for genetic improvement for small ruminants. However, the accuracy of selection of the candidates was low. On the contrary, progeny testing and pedigree selection have higher selection accuracies but their responses per year were low. Equally, to achieve a marginal improvement in the rate of genetic progress in these strategies some considerable extra costs are expected. The reason is that candidates' pedigree and performance records in the nucleus and commercial flocks are used during selection. Apart from keeping sire or dams' pedigree for the test progeny, there are other extra costs from keeping a separate flock of animals simply for progeny testing (Banks, 1993) that cannot be avoided. Costs arising from performance and pedigree recording in the commercial populations can however be evaded in the presence of a nucleus unit. Nevertheless, performance and pedigree records in the commercial sector are important especially: when an open nucleus breeding system is in use where superior females in a flock needs to be transferred to the nucleus; when comparing animals among the flocks, for small ruminant commercial breeders serious about selling competitive animals; and as means of monitoring actual genetic progress in the commercial populations. The challenge now remains on how to run a breeding program aimed at a cost-effective genetic progress while incorporating formal pedigree information to increase accuracy of selection.

Usually, progeny testing is more accurate than the rest of the strategies for sex limited traits. The startegy is more widespread when obtaining genetic information on such traits e.g., milk yield. Daughter's lactation records are still the main data for selection of males bred for milk production. Very elaborate and succesful breeding programes selecting males for milk production are built upon well-designed progeny testing programnmes.

CONCLUSION

For a simple, low-cost approach to genetic change, performance testing is recommended. However, to increase accuracy of selecting the candidates, progeny testing and pedigree selection strategies are indispensable. For sex limited traits and traits with low heritability, progeny testing reamains so far the most importat strategy. It is also important to note that the genetic responses achieved in the nucleus should be disseminated to the commercial flock. Well structured breeding systems which disseminate quickly the improved genetic material to the commercial flock should therefore be encouraged. If performance testing is a strategy of choice, future studies should also consider on-farm performance testing strategy to evaluate their feasibility at the farm level.

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Table 1. Set of breeding programme variables used for estimation of genetic response per year

Set of breeding programme variables	Progeny testing	Pedigree selection	Performance testing
Number of breeding females in nucleus	2500	2500	2500
Number of commercial breeding females (available for progeny testing)	50000	50000	50000
Performance recording in commercial (%)	60	60	-
Used for progeny testing (%)	20	-	-
Number of young males to be progeny tested	120	-	-
Number proven males used for natural mating	40	120	50
nr of elite sires (sires of young males)	5	-	-
Replacement rate in breeding females	0.20	0.20	-
Generation interval-males	4.0	4.0	2.0
Generation interval-females	4.0	4.0	2.0
Fraction of breeding females suitable to be elite dams	0.3	0.3	-
Fraction of commercial females suitable to have offspring	0.7	0.7	-
Number of elite pregnancies needed to obtain a young male	4	-	-
Number of pregnancies needed per test progeny	5	-	-
Heritability of 12-month live weight	0.25	0.25	0.25

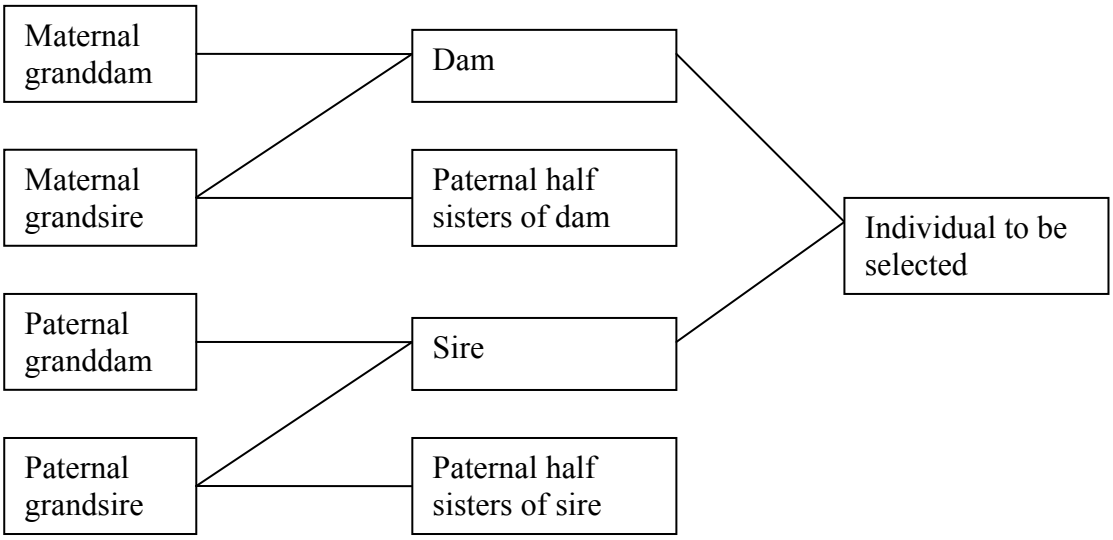

Figure 1. Sources of pedigree information used for evaluating individuals for selection in pedigree selection strategy.

Table 2. Accuracy, selection intensity, response per generation, generation interval and response per year for 12-month live weight

Selection strategy	Selection path	Accuracy of selection	Number needed	Number available	Selected fraction	Selection intensity	Respon per gener
Progeny testing	Sires of Sires (SS)	0.72	5	120	0.04	2.13	
	Sires of Dams (SD)	0.72	40	120	0.33	1.09	
	Dams of Sires (DS)	0.51	480	17500	0.027	2.29	
	Dams of Dams (DD)	0.51	20000	21000	0.95	0.10	
	Sum across the paths						
Pedigree selection	Sires of offspring (SO)	0.51			0.027	2.29	
	Dams of offspring (DO)	0.51			0.95	0.10	
	Sum across the paths						
Performance testing		0.50			0.02	2.42	

GROWTH PERFORMANCE OF RED MAASAI, DORPER AND MERINO SHEEP BREEDS AND THEIR CROSSES IN SEMI-ARID KENYA

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ABSTRACT

The objective of this study was to compare the performance of different sheep genotypes raised in semi-arid Kenya. Data on body weight of 2425 lambs weighed between 1987 to 1996 at the Sheep and Goats Development Project of the Ministry of Livestock Development and Fisheries, Naivasha, were used. Growth traits considered were body weights at birth (W0), one month (W1), two months (W2), weaning (WW), six months, (W6), nine months (W9) and at yearling (YW) for the Dorper (DP), Red Maasai (RM), Merino (MR), 75% DP:25%RM (R1) and 87.5%DP:12.5%RM (R2) sheep genotypes. Overall means for W0, W1, W2, WW, W6, W9 and YW were (kg) 3.6, 9.7, 13.3, 18.0, 22.9, 27.5 and 32.0, respectively. The DP had significantly heavier W0, W1, W2, W6 and W9 than the RM. The RM had significantly heavier WW and YW than the MR but W0 was lower. Crosses of R1 and R2 were generally heavier than the DP, RM and MR. The R2 weaned at a heavier weight than the other genotypes. The results indicate substantial breed differences. Performance would be improved if appropriate selection strategies are exploited and satisfactory flock management provided.

PRODUCTIVE AND REPRODUCTIVE PERFORMANCE OF LARGE WHITE PIGS AND THEIR F1 CROSSES WITH LANDRACE UNDER INTENSIVE MANAGEMENT SYSTEM

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ABSTRACT

Performance records of Large white (LW) and its F1 crosses with Landrace (LR) i.e. LR x LW, kept at the National Animal Husbandry Research Centre were use to determine sources of variation in productive and reproductive traits and obtain mean estimates for these traits. Productive traits considered included; piglet birth weight (BW, kg), weight at 3 weeks (3W, kg), weaning weight (WW), pre weaning average daily gain (PWDG, kg/day), average litter weight at birth (AWB, kg), average litter weight at weaning (AWW), litter size at birth (ASB), number of piglets born dead (NBD), and litter size at weaning (ASW). Sex had a significant (at least $P<0.05$) effect on all traits except PRDG. Management level significantly ($P< 0.001$) affected all traits except AWB and ASB. Dam parity influenced production traits but had no effect on reproductive traits. The overall means for BW, 3W, WW, PRDG, AWB, AWW, ASB, NBD and ASW were 1.26 kg, 4.74 kg, 0.20 kg/day, 1.28 kg, 11.7 kg, 9.88 piglets, 2.6 piglets, and 8.1 piglets, respectively. Crosses of LR x LW were heavier at 3 weeks and at weaning compared to the LW. Pre-weaning daily gain was comparable in both LW and LR x LW. There were no significant differences in AWB and AWW between the two genotypes but LW had a larger ASB and ASW compared to its crosses with LR. There were more stillbirths in the crosses than LW. Appropriate herd management practices should be able to improve both growth and reproductive performance under intensive management systems.

BREEDING FOR RESISTANCE TO GASTROINTESTINAL HELMINTHS: EVALUATION OF ALTERNATIVE SCHEMES

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ABSTRACT

Deterministic simulation was used to evaluate the efficiency of alternative schemes breeding for resistance to gastrointestinal (GI) helminths in meat sheep. Four breeding objectives and schemes were assessed. The first breeding objective simulated a situation where the flock size cannot be increased due to non-feed related constraints (FLOCK). The second specifically assumed that the flock size is restricted due to limited amount of feed resources (FEED). The third and fourth objectives assumed that sheep performed only tangible roles (TR) and both tangible and intangible roles (IR) in the production system, respectively. Within these breeding objectives, four breeding schemes that differed in the measures available for use as selection criteria were compared. The schemes ranged from one that utilised birth weight, weaning weight, yearling weight, litter size and lambing interval, currently measured in most sheep farms in Kenya (scheme 1), to one that included two measurements of faecal egg count (FEC, eggs per gram) in young rams immediately after weaning (scheme 4). For scheme 1, resistance to GI helminths was not included in the breeding objectives. A two-stage selection process was assumed in the selection of rams to be used in the nucleus. The annual monetary genetic gain and profit per ewe for all schemes varied within breeding objectives but were highest in TR. Within each breeding objective, the annual monetary genetic gain and profit per ewe was highest for the breeding scheme with the highest level of recording (scheme 4). In all objectives, the difference in the profit per ewe between a scheme that included records on FEC measured once in rams immediately after weaning (scheme 3) and scheme 4 was small (1.3% to 3.7%), indicating that there is little benefit taking a second measurement of FEC.

BEEF CATTLE BREEDING IN JAPAN AND LESSONS AND PROSPECTS FOR RESEARCH AND DEVELOPMENT FOR KENYA

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ABSTRACT

Japan and Kenya have totally different climatic, political and socio-economic conditions but both utilize indigenous cattle genetic resources (CaGR) for beef production. These genetic resources are utilized as purebreds and in crossbreeding systems that include foreign breeds. In Japan for example, crossbreeding of CaGR with Holstein for beef production is very common. In Kenya, CaGR are crossbred with *B. taurus* dairy (e.g., Holstein) and beef breeds (e.g., Hereford, Simmental, Charolais and Angus) for beef production. The beef production systems are also different. In Japan, two beef production systems can be distinguished; cow-calf and feedlot (fattening) production systems where animals are heavily supplemented with concentrates. In Kenya, beef production from CaGR is practiced within two main systems found in the arid and semi-arid areas; large-scale dairy-meat commercial ranching and small-scale dairy-meat production system and is pasture-based. While there are differences in the cattle genetic resources used for beef production and in the management and production systems applied, an understanding of breeding of CaGR in Japan may be of use in stimulating similar activities in Kenya and in other developing countries. This paper presents an overview of indigenous beef cattle breeding in Japan and identifies and discusses six lessons that Kenya can learn from Japanese experiences to help in stimulating sustainable management of CaGR for beef production. It explores the prospects and possible intervention measures for the improvement of beef production in Kenya.

BEE BREEDING TOWARDS A DOCILE AND HIGH HONEY HOARDING HONEYBEE

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ABSTRACT

Virtually, all bee-keeping colonies found in Kenya are hived from wild swarms from among the honeybee races. The honeybee colonies found in the Kenya are very defensive in nature, a major factor that keeps away new beekeepers. There is a lot of genetic variability among the bees found in the country. Four honeybee races are found, namely, *Apis mellifera monticola, A. mellifera scutellata, A. mellifera littorea and A. mellifera nubica*. Using the inheritable traits like defensiveness, reproductive swarming, disease resistance, migration, oviposition rate and honey yield, a docile but high honey-hoarding honeybee can be developed. This paper discusses possibilities of developing a more productive but docile colonies.

INTRODUCTION

Livestock sub-sector contributes 10% of GDP. The sector employs more than 50% of Agricultural work force. A higher percentage depends on agriculture directly or indirectly. Many Kenyan / East African communities have kept bees since time immemorial. Virtually all bee populations in Kenya are from wild swarms. Kenya has a honey production potential of 100,000 metric tonnes per year. However, only one third of this potential has been tapped. This could be done to:- fear of bee stings- our bees are highly defensive; poor infrastructure; cultural believes; untapped potential; inappropriate skills; environmental degradation and loss of plant diversity; swarming; frequent droughts; and inadequate research. Honeybees have a wealth of genetic variability. Morphological, physiological and behavioral differences can be found in various races, strains and populations. This means many characteristics of the honeybee are open to improvement by means of application of genetics to the breeding of a better bee. One of the problems hindering progress in bee genetics and bee breeding has been the peculiar mating habit of the queen. Natural mating takes place in flight at some distance from the parent colony with little or no control of the drones involved. Genetic makeup of a colony is further complicated by the fact that the queen bee usually mates with 6-8 drones, thus confusing the task of evaluating her colony. In view of these

facts, the advent of instrumental insemination of queen bees has opened a door for bee breeding and genetics.

The honeybee has been domesticated throughout the world. In the temperate zone, the bee has been bred and wild colonies are almost non existent. However, in most tropical Africa, the beekeepers rely on wild colonies and bee breeding does not exist. So the present form of honeybees developed without any human interference. The honeybee in.Kenya has remained under natural selection for a long time. In Kenya, different regions with different climates, flora and enemies has led to the formation of natural or geographical races. These geographical races are the result of natural selection in their natural homelands. They have adjusted to the local environment but not always to the economics of local beekeepers, but offer raw materials for breeding. In Kenya, three distinct races based on colour, size, length of tongue, hair coverage and veins of the wings have been identified. They are:-

a) *Apis mellifera monticola;*
b) ,, ,, *scutellatta;*
c) ,, ,, *littorea;*

Unconfirmed reports also say that two other bee races are also found in the country. They are *Apis mellifera yamenitica and Apis mellifera nubica. Apis mellifera* monticola is found in high altitude areas around Mt. Kenya, Aberdare ranges, Mt Elgon, Cheranganyni hills and in Mau escarpment. Apis mellifera *scutellatta is* found in the savannah region while *A.m. littorea* is found in the coastal belt. *A.m. nubica* is found in the north western part of Turkana district while *A. m. yamenitica* is found in northern parts of eastern province and in North Eastern province. There is a wide variation of the bee colonies within the races and between the races in their behaviour. Some of the variations are found in defensiveness, foraging, honey hoarding and in reproductive swarming. There is therefore a wide variation in their genetics which can be used to breed bees towards docility and honey hoarding.

To economically exploit a bee, we need good honey-flows, ambitious beekeepers and a capable bee. The bee should have vigour, ability to develop the colony, gentleness and quietness on the combs and the capability to hoard large amounts of honey and pollen. Further increase of production can be achieved by selection within races but intensive inbreeding should be avoided as it leads to a decrease in vigour and fertility of the colony.

Adaptation

Apis mellifera scutellata- This is a small bee with a scarce pilosity, variable pigmentation on the abdomen (one or more yellow bands) mostly bright yellow scutellum on the thorax and a characteristic wing vanitin as described by Its warms often into small swarms which can survive; migrates; absconds; defends itself with minimal disturbance; good in honey and pollen gathering; has caused some deaths and are temperamental – causes fear hence honey potential is not fully exploited. Research has shown that honey gathering; defensiveness; hygienic behavior and pollen gathering are heritable traits. Therefore, using bee breeding, it is possible to breed a bee that is good in honey production; docile; and disease resistance (Davis, 2004; Cale and Rothenbuhler, 1982).

It is the most widely distributed, excellently adapted to the environment from hot climate to climates with sub-zero temperatures. In East Africa, it is found in the savanna and Miombo woodlands. The region is characterized by a generally hot climate with a long dry season, abundant nectar and pollen flows and many enemies including honey badger (*Mellonella capensis*) , birds, man and army ants (*Dorylus affinis*). Although local honey hunters and beekeepers extensively exploit the bee, it is able to survive and thrive not only in this native environment but also in other areas where it has been introduced. This bee is also good in nectar and pollen collection but due to the harsh environment, it vigorously defends its colony. It is the most studied race of bees in Africa due to its notoriety and defensiveness after its introduction in South America. The honey bees are migratory in nature, moving to the mountains in the dry season and to the lowlands during wet seasons and vice versa. The National Beekeeping Station usually loses some of the colonies because of this behavior. On the other hand, there is a big variation between colonies in terms of honey production and defensiveness (selection is possible).Colonies swarm frequently during the honey flow. Honey production is 5kg per colony in traditional hives (1.5 million), 40kg per colony in the langstroth (5000) and 30kg per hive in Kenya Top bar (100,000) (MoLD 1999). In the recent past, the use of the langsthroth hive has been approved and encouraged but affordability may limit its adoption and other beekeeping technologies that may require substantial amounts of inputs due to low capital base of beekeepers. Until now, selection and breeding is being done only in Ivory Coast otherwise no selection has been done in the rest of tropical Africa. Therefore, farmers are forced to deal with wild swarms, which are very defensive leading to death of people and livestock, hence the fear of keeping bees. The potential of this region is enormous but not fully exploited. Also, most farmers are not aware of the advantages of cross-pollination. As Agriculture is modernized, the use of bees (being kept by farmers) as a pollinators will increase. Studies conducted at the National beekeeping station showed that inadequate pollination of some crops from *Cucurbitaceae* family gave low yields and what is more important that fruits were often deformed and thus unsuitable for the market. It is also worth

noticing that Kenya exported honey at an average of Ksh. 115 a kilogram and imported honey at a higher rate, Ksh. 170 per kg (wax respectively Ksh. 32 export and Ksh. 470 import).

Therefore, there is an urgent need to start a bee breeding program in the region to improve the behavior and performance of the native bees for the benefit of people and ecology in the area and also to protect these bees (pesticide hazards and diseases

Objectives

a) Short term objectives: - is to prepare proper background to start a breeding program.
   (i) People – identify people and train them
   (ii) Bees – start apiaries at KARI centers, FTC , ADC and Universities

b) Long term objective: Produce the most gentle, easy to handle and most productive bees from the local bee races.

Safety rules

1) No importation of bees
2) Gene bank of native bees should be preserved and maintained
3) Artificial insemination to be used
4) Productive traits to be maintained

WORKING WITH BEES

It is critical to develop in the centers a system for protecting the bees against human beings and other predators

Evaluation of traits

a) Defensive behavior – performed by worker bees. The "ball test" will be used. Evaluation to be done in 5 grade scale as follows:-

1- Very defensive
2- Defensive
3- Medium
4- Gentle
5- Very gentle

b) Reproductive swarming – The colonies will be fed throughout and swarming tendencies evaluated.

1- issued most swarming
2- issued many swarming

3- Issued average number of swarm

4- Issued least number of swarms

5- Did not issue any swarm

c) Honey yield – honey should be weighed

1- produced largest amount of honey

2- produced good quantities of honey

3- produced average amounts of honey

4- produced low quantities of honey

5- produced least amount of honey

d) Colony build up / oviposition rate

1- Number of frames with brood

2- Brood area to be measured

3- Bees to be counted

4 Colony to be weighed and synchronized as:

(i) Highly prolific

(ii) Prolific

(iii) medium

(iv) Low

(v) Very low build up

e) Migration- Bees migrate to avoid drought situation. Therefore, the colonies will be fed throughout

NB. During the first period of the breeding program, queens will be evaluated based on phenotype (later on behavior of daughters). Defensive behavior will be treated as the most important because in this trait "will open the gate'' to good management and efficient breeding. Therefore, mother queens and father queens will be selected (if possible) This is because defensive behavior is a heritable and parentally transferable trait

MATERIALS AND METHODS

Work with bees

The work should answer the following questions. The main purpose of the study is to create a background to handle, manage and manipulate the bees in order to perform different tests for future breeding and also to acquire some information about possible ecological hazards.

a) Is it possible to find or establish proper, well isolated places, which can be used as congregation (mating) areas or for gene bank

b) Is it possible to establish anew colony artificially (or only naturally)? In the affirmative, what is the best way to do it? Is this possible to establish and maintain small colonies or nuclei or divide a single colony artificially?
c) What is the best way to get and maintain samples of worker of bees for cage tests? What is the most efficient way of re-queening? What is the easiest way to collect the drones? Treating by CO_2narcosis and freezing the colonies should be checked up
d) How will the isolation of queens and brood in four frame isolator (in connection with feeding) affect their tendency to migrate and swarm?
e) Can you observe a really large variability of the traits mentioned above (in the same conditions)?
f) Other bees and their ecological niches. Why there are so many different races, are they really pure? In the affirmative, what are the isolation mechanisms? What about inter- racial hybrids?
g) What is the annual pattern of colony development (brood, bees)

Organization of the work and types of hives

The project development will be based on the supplying centers with satellite farms. The breeding will be carried out in the centers. Genetic material, know how and extension will also be provided by the centre. Satellite beekeepers will have to contribute in the program. Equipment will be delivered partly by the centers. Beekeepers should be supplied only in nature and equipment, not with money. We plan to cooperate with Kenya Beekeepers Association, Christian Intermediate Training Centre and Lomaiywet Youth Group. This model closely fits the Program of Ministry of Livestock and Fisheries of Kenya which has adopted Kenya Top bar hives and is gradually introducing the Langstroth through education on bee management techniques. The staff of the centre is responsible for promoting it's program. Therefore it was decided to use both langstroth and Kenya top bar hives 20 + 20 per centre at the beginning. This strategy allows introducing slowly langstroth hives and at the same time to compare with KTBH. It is worth noticing that the price of the langstroth is Ksh. 3000 whereas KTBH is Ksh. 800. We should not force farmers to introduce these hives because most of them are small scale, living in poor areas and their skills and management levels are low.

Bee population

At each of the centers, a population of the native bees is maintained. We are going to acquire more bees from different parts of the region to enrich the population. Exchange of material

between the centers is possible. Because an important variation has been observed in defensive behavior of the local, we try to create a population of bees which is as gentle as possible (the preliminary phenotypic selection).

WORK WITH PEOPLE AND WITH DATABASE

The proper data bank will be created at the beginning. All the information about each colony traits will be gathered. The hard link to internet is required (if it is not possible by cable we use proper dish antenna). Then, other programs including animal model will be developed. The second data base to be created will gather references and also personal information. This address book of the people will cooperate with them (internet consultations) will be included.

Farm beekeepers will be selected and prepared (both people and equipment) to work as satellite farms with the main centre. At the beginning, beekeepers selected by local extension service will be visited to work with them. To learn from them and at the same time to teach and encourage them to initiate modern beekeeping. Next, the beekeepers will be invited for the training courses. Continuous contact, extension and cooperation with them will be maintained. We will also make efforts to send the best of them for training abroad (e.g. CINADCO) not only in order to learn but also to stretch their minds (to see gentle bees at least). Extension experts from abroad will be invited to train beekeepers and help to carry on the project. At the same time 3-4 persons will be trained in Poland. Main subject planned for the training is queen rearing, breeding and instrumental insemination.

One of the most important objectives of this training program is to establish the background for modern management and also for standardizing the evaluation of the selected characters in bee colonies kept by different beekeepers. To obtain any selection gains, it is critical to create proper conditions for the objectively comparable evaluation of the productivity performed by different beekeepers. Data should be collected and recording very accurate

Absconding and Migration

This is a problem of improper management. Isolators will be used to restrict the queen to the brood. Colonies should not be so strong and should not be disturbed. Different plants should be planted to prolong blooming period as much as possible. It is well known phenomenon in Poland that birds, which are fed well during autumn, do not migrate during winter. Mother queen and father queen will be kept at centers. Daughter queens will be tested in the satellite farms (may be also in the centers). An attempt will be made to use small nuclei, when colonies will be disturbed and suffer food shortage. A mother queen will be evaluated based on daughter behavior. We shall determine

the genetic variation. In order not to lose the selection gains (migration, absconding) we plan to maintain queen semen (glass capillary) kept in the centers. The same grade scales as used in defensive behavior evaluation will be applied.

Honey yield and colony build up.

Honey extracted from each colony will be weighted. Colony build up will be evaluated as a number of frames with brood and with bees (counted several times per year depending on the pattern of a colony development). These two traits attain a high level in the native population of *A.m scutellata*. Therefore during the first period of the selection, the only border selection against minus variants will be performed and only the very weak mother queens will be eliminated (excluding these, which obtained the maximum level of point for defensive behavior). Selection for honey yield and colony build up will not be performed within father queens (maternal pattern of inheritance) during this period. It will be important only if it doesn't cause regression of these traits.

Swarming

This phenomenon is observed in May / June period of honey flow peak. Selection will be done on queen mother.

Cleaning behavior

Selection of this trait is performed after obtaining selection gains in defensive behavior (needle test). Generally, selection will be performed basing on own phenotypes (particularly at the beginning) and also mean values of the daughters. As fast as possible, instrumental insemination should be applied.

First period of selection: 2 – 5 yrs

In the first period of selection, a mother queen and a father queen population will be maintained separately because of the sex allele's variability and necessity of performing the fast selection against the defensive behavior. This procedure will be performed in each of the two centers.

The queen father population

Two traits will be selected in the queen father population. The restricted selection against defensive behavior will be performed. The only extreme minus- variants will be eliminated concerning the absconding behavior and only if this will be possible. The rotation of generations

will be carried on as quickly as possible. Drone selection is the direct selection of the queen genomes and therefore is one of the most efficient methods of selection.

The queen mother population:

The selection index consisting of (defensive behavior, absconding, migration, honey yield and swarming) will be constructed

Mating:

Drones from father queen population will be used to inseminate queens both from mother queen and father queen populations. A new material will be introduced after progeny test. After a few generations, the semen (*A.m. scutellatta*) from Colombia will be introduced (only in one of the centers at the beginning). Reciprocal crossing between bees originating from the two centers will be applied to increase variability. Reciprocal outbreed crossing will be performed within each of the population.

Bank of genes:

Closed population breeding program will be established for the native bees.

Second period of selection (after 4 – 6 years)

Queens will be evaluated basing on their daughters tested at the satellite farms. Number of the selected traits in the queen father population will be increased. Selection for cleaning behavior will be started. The next centers will be established.

Pattern of mating that will be applied during selection

CENTRE I		CENTRE II	
Mother queen	Father queen	Mother queen	Father queen
	Drones		Drones
Queens	Queens	Queens	Queens
	Drones		Drones
Queens	Queens	Queens	Queens

PROBLEMS ENCOUNTERED WHEN BREEEDING BEES

1. Reciprocal crosses are rarely identical
2. Matching gentleness does not invariably secure greater gentleness or even gentleness equal to that of parental stock; on occasions we may obtain bad temper. There are many unexpected results obtained in cross breeding that are doubtless partly responsible for the confusion of views of the value of beekeeping.
3. Crossing of the honey bee rarely gives us a position to forestall specific results with any measure of certainty. Crossing two distinct races increases hybrid vigor- results are opposite of those for inbreeding. Heterosis enhances in varying degrees the general vitality, health, growth and productivity. Indeed, mother nature avoids breeding between drones and queens from the same colony.
4. Naturally, mating randomly takes place in drone congregation areas and hence unpredictable results arise from chance and luck, and unfortunately results cannot be repeated at will. Controlled hybridization in honeybees has shown the most satisfactory economic returns and often obtained not in the first cross like in domestic livestock and plants but in subsequent hybrid generations.

Swarming

First cross increases uncontrolled swarming. However, it is greatly modified in subsequent generations. Heterosis forms new genetic combinations and new races.

CONCLUSION

This project proposal is proposed to be implemented in the Eastern Africa where A.m. scutellatta is well distributed but the bee is not extensively exploited because of its defensive, absconding and migratory behavior. If this project has got financing agents, it would contribute the following for the region:-

1. Maintenance of gentle and productive bees in the area, so easy to manage and handle and therefore become more profitable for many beekeepers. This should cause dynamic development of modern beekeeping in this very suitable environment for bees.
2. Conserve ecological balance and maintain resistance to Varroa mite
3. Capacity building (staff, extension) e.g. queen rearing and breeding.

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GROWTH AND REPRODUCTIVE PERFORMANCE OF POLLED HEREFORD AND CHAROLAIS BEEF BREEDS IN THE KENYA HIGHLANDS

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ABSTRACT

Records of 1345 polled Hereford and Charolais cattle were obtained from Chepchoina ADC farm in Trans Nzioa district and used to determine environmental factors affecting performance and obtain mean estimates for growth and reproductive performance. Growth traits included birth weight (BW) and weaning weight (WWt) while reproductive traits were calving interval (CI), age at first service (AFS) and age at first calving (AFC). Most traits were influenced by different environmental sources of variation. For instance, season and year of birth, breed and birth type significantly ($P< 0.001$) influenced BW and WWt. Year of calving significantly ($P<0.001$) affected CI but parity and breed had no influence on CI. Year of service/calving and breed had a significant ($P< 0.001$) effect on AFS and AFC. The herd mean for growth traits were 36.5kg and 195.0kg for BW and WWt, respectively. For reproductive traits, they were (days) 431.2, 938.8 and 1229.8 for CI, AFS and AFC, respectively. The means for the Hereford breed were 30.9 kg for BW and, correspondingly, 165.7, 897.8 and 1175.6 days for WWt, AFS, AFC and CI. The corresponding means for the Charolais breed were 35.6 kg, 206.3, 742.1 and 1071.6 days. The current study shows the environmental influences on both growth and reproductive performance of the Hereford and Charolais breeds. Breeding and management programmes can only be effective if environmental factors are well accounted for. The mean performance of Hereford and Charolais indicate their potential to meet the ever increasing demand for beef and beef products.

GROWTH AND REPRODUCTIVE PERFORMANCE OF POLLED HEREFORD AND CHAROLAIS BEEF BREEDS IN THE KENYA HIGHLANDS

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ABSTRACT

Records of 1,345 polled-Hereford and Charolais cattle were obtained from Chepchoina ADC farm in Trans Nzioa district and used to determine environmental factors affecting performance and obtain mean estimates for growth and reproductive traits. Growth traits included birth weight (BW) and weaning weight (WWt) while reproductive traits were calving interval (CI), age at first service (AFS) and age at first calving (AFC). Most traits were influenced by different environmental sources of variation. For instance, season and year of birth, breed and birth type significantly ($P< 0.001$) influenced BW and WWt. Year of calving significantly ($P<0.001$) affected CI but parity and breed had no influence on CI. Year of service/calving and breed had a significant ($P< 0.001$) effect on AFS and AFC. The herd mean for growth traits were 36.5 kg and 195.0 kg for BW and WWt, respectively. For reproductive traits, they were 431.2 days, 938.8 days and 1229.8 days for CI, AFS and AFC, respectively. The means for the Hereford breed were 30.9 kg, 165.7 days, 897.8 days, 1175.6 days and ??days for BW, WWt, AFS, AFC and CI, respectively. The corresponding means for the Charolais breed were 35.6 kg, 206.3 days, 742.1 days, 1071.6 days and ??days. This study shows environmental influences on both growth and reproductive performance of the Hereford and Charolais breeds. Breeding and management programmes can only be effective if environmental factors are well accounted for. The mean performance of Hereford and Charolais indicate their potential to meet the ever-increasing demand for beef and beef products.

Keywords: Growth and reproductive performance; polled Hereford, Charolais, beef, Kenya.

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INTRODUCTION

The supply of beef in Kenya is mainly from the *Bos indicus* cattle found in arid and semi-arid lands (ASALs) (MALD, 2000). However, *Bos taurus* beef breeds like the polled-Hereford (PH) and the Charolais (CH) are raised in medium - to high potential areas either as pure breeds or crossbreds. These breeds have also been used in various crossbreeding programmes in the ASALs for beef production (Gregory et al., 1984; Trail et al., 1984). In a beef production enterprise, growth and reproduction efficiency are important traits for consideration. Pre-weaning growth of calves is one of the most important parameters for evaluating beef cattle (Dillard et al., 1980). The production environment and the animal's genetic constitution influence the expression of these traits. Production environments vary as a result of different management practices and the constantly changing climatic conditions, leading to variability in animal performance. Despite this, information on environmental factors influencing performance of PH and CH in the Kenya highlands, and mean estimates for various growth and fertility traits is lacking in the literature. Knowledge of the non-genetic factors influencing growth and reproductive performance is important in facilitating unbiased performance comparison, developing sound and effective breed improvement strategies for genetic improvement (Bebber, 1997). Factors affecting growth traits of PH and CH beef cattle need to be quantified in order to determine appropriate management interventions aimed at improving performances of these breeds in the Kenya highlands The objective of the current study was to determine environmental factors affecting performance of these breeds and obtain mean estimates for some growth and fertility traits.

MATERIALS AND METHODS

Data was obtained from Chepchoina Farm owned by the Agricultural Development Corporation of Kenya. The farm is located in Endebess Division in Trans-Nzoia District of the Rift Valley Province, 60 km west of Kitale town. It lies in agro-ecological zone 4 at an altitude of 2,108 m above sea level. The area receives a bimodal rainfall with the long rains in March-June and the short rains in September-November (MoA, 2003). The cattle were extensively managed on improved pastures (Boma Rhodes) with no concentrate feed supplement was provided. Mineral supplements, mainly sodium chloride, were provided *ad libitum*. During dry periods, the animals were fed on hay. Cattle were dipped once every week to control tick-borne diseases. Helminth

control was done at the onset of the rains and at the start of the dry seasons. Routine vaccinations were carried out for endemic diseases such as Foot and Mouth, Lumpy Skin and Rinderpest.

All mating was by artificial insemination and calving was all year round. At birth, the calves were weighed and left to run with their dams. Calves were weaned at approximately seven months.

Data on growth and fertility were extracted for cows with at least a first calving during the period 1956 through 2004. Traits considered were (BW, kg), (WWt, kg), (AFS, days), (AFC, days) and (CI, days). Least squares analyses of variance were conducted for different traits in order to assess the environmental effects on growth and fertility traits. The mixed model procedures were used for the analysis of variance (SAS, 1998). The fixed effects fitted in the model included sex of calf (SX), year (YY) and season (SS) of birth, and their interaction, and dam parity (PP) for BW and WW. In addition, age at weaning was fitted as a linear covariate for WWt. The YY, SS of calving and PP were fitted for CI, while YY and SS of birth of the animal were fitted for AFS and AFC. Breed (BR) was fitted for all the traits studied.

RESULTS AND DISCUSSION

Table 1 shows the analysis of variance for environmental factors affecting growth and fertility traits. All main effects fitted (PP, YY, BT, SX, SS and BR) significantly ($p<0.001$) affected BW. The overall BW was 36.5 kg (Table 2). However, the CH was 4.7 kg heavier than PH (30.9 kg). Higher BW have been reported elsewhere; 33.4 kg for Hereford in Australia (Meyer et al. (1992), 41.2 kg for CH (Meyer et al., 1993), 37.6 k) for PH and Hereford (Meyer et al., 2004). Arthur et al. (1994) reported (33.0 kg) for Hereford on medium pasture systems while Dillard et al. (1980) reported 32.2 kg for Herefords in North Carolina. In the current study, single births and bull calves were heavier while first PP calves were lighter than subsequent parities. Probably less developed embryonic cytoplasm tissues at the first PP led to low BW. Calves born in the wet season were heavier than those born in the dry weather. Similarly, nutritional stress experienced on pregnant dams in the dry season contributed to low BW.

The main effects; BR, BT, YYB, SSB, SSW and age at weaning significantly ($p<0.05$) affected WWt (Table 1). In this study, the overall WWt was 195.0 kg (Table 2) but PH and CH recorded 165.7 kg and 206.3 kg, respectively. Dillard et al. (1980) reported lower WW (157.0 kg) and (206 kg), correspondingly, for PH and CH in North Carolina. Higher WWt (196.0 kg) were reported from Herefords fed on high energy in Canada (Fan et al., 1995), and 206.1 kg in Australia (Meyer et al. 1992),258.6 kg (Meyer, 1993), 228.4 kg (Meyer et al., 2004) reported (221.9 kg and 219.0 kg reported () for PH and Hereford, respectively, in Western Australia (Meyer et al., 1997).

Arthur et al. (1994) reported (210.5, kg) for Hereford on medium pasture systems, while Dodenhoff et al. (1999) reported, correspondingly, (kg) 183.8, 234.2, 194.7, 209.8, 209.5 and 243.9 kg for PH, CH, Angus, Limousin, Red poll and Simmental in the Meat Animal Research Centre, USA. Duangjinda et al. (2001) reported 246.7 kg and 268.4 kg PH and CH, respectively in America. This difference could be due to environmental differences, i.e., temperate verses tropical conditions.

In Table 2, calves born and weaned in the dry season were heavier than those in the wet season. Generally older calves weighed more than younger ones at weaning, an indication that decisions to select or cull animals based on performance parameter estimates from analyses where their ages were not accounted for would be biased and favour older animals. The SSB, SSW, YY x SSB and YY x SSW significantly ($p<0.05$) influenced WWt. Calves born and or weaned in the wet season were lighter at weaning than those born or weaned in the dry season. Parasite resurgence in the wet season could be a possible cause of low WW. The SX, PP and YY of weaning had no effects on WWt. Single births were born and weaned heavier than twins. As expected, single births had the advantage of having been born heavier than twins and therefore grew faster than twins.

Table 2 presents the least square means of fertility traits for BR, SS and BT. The means for AFS, AFC and CI were 938.8, 1229.8 and 431.2 days, respectively. BR significantly ($p<0.001$) affected AFS and AFC (Table 1). CH cows were served (155.7 days) earlier and subsequently calved (104 days) earlier than PH. van der Westhuizen et al. (2001) reported lower CI and AFC of 390.7 and 781.8 days, respectively, from multi-breed beef cattle in South Africa. The YY of service/calving significantly ($p<0.001$) affected CI and AFC, respectively, but PP, SS of service/calving, did not affect all the reproductive traits (Table 1). The reason could be that CH attained maturity earlier than PH. In a wet year, unlike a dry year, cows had better nutrition, which led to early ovarian cycling (postpartum) and better conception.

CONCLUSION

This study shows environmental influences on both growth and reproductive performances of the PH and CH breeds. Improving environmental stressors such as nutrition, especially in the dry seasons, would enhance the performances of these breeds. Therefore, breeding and management programmes can only be effective if environmental factors such as nutrition are well accounted for. Although CH performed better in most traits, the mean performances for both breeds indicated their potential to meet the ever-increasing demand for beef and beef products in Kenya.

ACKNOWLEDGEMENTS

The authors gratefully acknowledge the Management of ADC Chepchoina Farm (Trans Nzioa Kenya) for data used in this study and support. Egerton University (Njoro, Kenya) is thanked for provision of facilities and support.

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Table 1. Analysis of variance for factors affecting growth and fertility traits

Traits[a]	*Source of variation*	*df*	*Mean squares*	*F value*
BW (kg)				
	Sex	1	925.2	37.3***
	Breed	1	3993.8	160.8***
	Birth type	1	1535.2	61.8***
	Dam parity	5	52.6	2.1*
	Season of birth	1	122.7	4.9*
	Year of birth	30	639.1	25.7***
WW (kg)				

	Sex	1	1373.8	2.0^{ns}
	Breed	1	199211.0	291.8***
	Season of birth	1	2716.3	4.0*
	Year of birth	26	1516.2	2.2***
	Birth type	1	17894.6	26.2***
	Dam parity	5	1118.2	1.6^{ns}
	Season of weaning	1	4760.8	7.0**
	Year of weaning	26	957.4	1.4^{ns}
	Age at weaning (covariate)	1	41183.8	60.3***
	Year x season of birth	50	1337.0	2.0**
	Year x season of weaning	50	1180.4	1.7**
AFS (days)				
	Breed	1	1194607.8	50.0***
	Season of service	1	15134.0	0.6^{ns}
	Year of service	42	310811.2	12.9***
AFC (days)				
	Breed	1	502386.0	20.9***
	Season of Calving	1	174.2	0.1^{ns}
	Year of calving	42	313955.6	13.0***
CI (days)				
	Parity	5	13377.7	0.9^{ns}
	Breed	1	3450.0	0.23^{ns}
	Season of calving	1	68879.9	4.7*
	Year of calving	45	89991.7	6.1***
	Year x season	90	21481.5	1.5*

[a]BW, birth weight; WW, weaning weight; CI, calving interval; AFS, age at first service; AFC, age at first calving.

*P<0.05, **P<0.01, ***P<0.001, ns = not significant

Table 2. Least squares means (LSM) (±s.e.) of growth and reproductive traits[1] for season, breed and birth type

	BW		WWt		AFS		AFC	
	N	LSM	n	LSM	n	LSM	n	I
Overall LSM	1345	36.5	1048	195.0	510	938.8	471	12
Season[2]								
Dry	779	33.0[a]	578	188.0±4.5[a]				
Wet	556	33.6[b]	470	184.1±4.4[b]				
Breed								
Hereford	1075	30.9±0.7[a]	876	165.7±4.3[a]	429	897.9±12.7[a]	393	1175.6±1
Charolais	270	35.6±0.7[b]	172	206.3±4.7[b]	79	742.1±21.9[b]	77	1071.6±2
Birth type								
Single	1321	37.5±0.5[a]	1032	204.7±2.7[a]				
Twin	24	29.0±1.2[b]	16	167.4±7.5[b]				

[1]BW, birth weight; WWt, weaning weight; AFS, age at first service; AFC, age at first calving; CI, calving interval.

[2] Season of calving fitted for CI, season of birth fitted for BW and season of weaning fitted for WWt.

Within effects, means followed by the same superscripts do not differ significantly (P< 0.05).

SESSION IV

FEEDS ANDD FEEDING

THE STATUS OF LIVESTOCK FEEDS SECTOR IN KENYA

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ABSTRACT

Livestock feeding and nutrition is the major limiting factor to enhanced livestock production in Kenya since it accounts for over 40% of the cost of production. Main feed resources in the country are either concentrates, with a production of 470,000 metric tonnes per year, and natural pastures and improved fodders. To address constraints and challenges facing feedstuff production and utilization, comprehensive strategies that include legal review have been proposed in the draft livestock feedstuffs policy.

SUPPLEMENTARY FEEDING OF HONEYBEES DURING THE DEARTH PERIOD

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ABSTRACT

Honeybees depend on flowering plants for their food (nectar, pollen) and water. However, during the dry spells in the tropics that are rampant, plants do not flower and water sources dry up. These force the bees to abscond and migrate to other favourable ecological areas. Consequently, honey production becomes variable and unpredictable. To maintain bee colonies during the dearth periods, a suitable way of feeding honeybees is to provide supplementary sugar syrup in feeder boxes. This ensures bees do not migrate or abscond hives, and still produce some amount of honey, making honey production predictable. This paper discusses the results an experiment of supplementary feeding of honeybees. The results showed that a 50:50 sugar syrup concentration was the most preferred by bees, but concentration of 40:60 would be highly economical to beekeepers. The artificial feeding should be discontinued once the climate improves as bees can store the syrup as honey.

EFFECT OF FEEDING UREA SPRAYED MAIZE STOVER SUPPLEMENTED WITH GRADED LEVELS OF *TITHONIA DIVERSIFOLIA* ON INTAKE, DIGESTIBILITY AND LIVE-WEIGHT CHANGES IN DAIRY BUCKS

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ABSTRACT

A study was carried out to examine the effect of supplementing urea sprayed maize stover with incremental levels of *Tithonia diversifolia* (Tithonia) forage on dry matter (DM) intake, digestibility and live weight changes in dairy bucks. Fifteen crossbred bucks were allotted to five treatments in a completely randomized design. The goats were fed for 49 days on the following treatments: control - the basal diet (maize stover sprayed with 1% urea) plus 100g maize germ offered alone - or supplemented with 10 (T1), 20 (T2), 30 (T3) or 40% (T4) Tithonia on dry matter basis. All animals were allowed *ad libitum* access to water and mineral lick. Inclusion of Tithonia significantly increased total DM intake ($p<0.05$). Total DMI were 376.7 (control), 444.1 (T2), 533.1 (T3), 519.7 and (T4) 578.9. However, Tithonia supplementation did not significantly ($p>0.05$) influence the intake of stover. Dry matter digestibility increased with the level of supplementation up to 30% inclusion in T3 recording (66.5%). Supplementation significantly increased daily weight gains ($p<0.05$) with T4 indicating the highest ADG (43.7 g/day) even though there was no difference between T4 and T3 (35.7g/day). It was concluded that 30 % Tithonia inclusion rate in goat rations is suitable for optimum production.

SESSION V

POLICY, MARKETING AND SOCIO-ECONOMICS

NALEP

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(Abstract available later in full paper in Proceedings of the 2006 APSK Symposium)

BASELINE SURVEY, INTERVENTIONS AND IMPACT ON NVOLVEMENT OF THE POOR AND THE VULNERABLE IN SOCIETY, IN FOUR PILOT AREAS OF KENYA: NALEP 2002-2004

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ABSTRACT

A baseline survey was conducted in four (4) pilot Districts of Kenya (Gisero in Kisii, Lunyerere in Vihiga, Kigio in Thika and Maviani in Mbeere) in the Year 2002. The purpose of the survey was to develop mechanisms targeting the poor[1] and the vulnerable[2] in society and to involve them in poverty reduction programs. The survey based the vulnerability and poverty levels on: Education, food security at household level, wealth (possessions), family life (housing, sanitation), enterprise creation and marketing, credit and finance services, Livestock development/crop technologies and environmental protection. Few of the interventions suggested by the survey, such as group mobilization, counselling and enterprise development were done. Furthermore, stakeholders were identified and introduced to the groups, for possible support. Evaluation carried out in the Year 2004 revealed a positive impact as was reflected in attitude change, group formation, training and wealth creation initiatives by the poor and the vulnerable. The staff in the pilot areas have developed capacity to understand the poverty dynamics and ways of reaching the different categories of the poor and the vulnerable and areas where they need to be trained in like counseling. The perception of the poor and the vulnerable varied from District to District. This, therefore, requires tailored poverty reduction mechanisms.

DEFINITION OF TERMS

[1]**Poor:** Lack of material well being, food security and power and vice. Elsewhere, it means surviving on an income of less than a dollar per day (Thornton et al 2002). This is aggravated by a situation of helplessness, due to circumstances beyond one's control, especially vulnerability.

[2]**Vulnerable:** exposed to defenselessness, shock and stress. A clear example is HIV/Aids impact on women, especially in a polygamous situation or where culture advocates for wife inheritance.

INTRODUCTION

The SIDA supported National Agricultural and Livestock Extension Project (NALEP) had been in existence for two years when it commissioned a baseline survey in the Year 2002, to develop mechanisms for targeting the poor and the vulnerable in society and to involve them in poverty reduction programs. A lot of work had been done but it was clear that the poor were not being reached. Moreover one of the project outputs was to enhance agricultural contribution to social and economic development and poverty alleviation.

Poverty indicator parameters employed for the study included: Education level, food security at household level, wealth (possessions), family life (housing, sanitation), enterprise creation and marketing, credit and finance services, Livestock development/crop Technologies and Environmental protection.

Four pilot areas representing different agro-ecological zones of Kenya were selected (Gisero in Kisii, Lunyerere in Vihiga, Kigio in Thika and Maviani in Mbeere) for the study, in the Year 2002.

Objectives

There were several objectives to this survey but only two are pertinent to this paper:

- To collect socio-economic, cultural, environmental and other relevant data to be used to develop appropriate mechanisms to address the resource poor and the vulnerable members of the farming community.

- To establish a bench mark for monitoring and evaluating changes arising from the pilot interventions.

METHODOLOGY

Two hundred and seventy (270) questionnaires were administered in four pilot areas and one control site. The baseline survey information was collected from 250 Households and 369 individuals in the four pilot areas. The sampling methodology and quality assurance validated that the information collected was representative of the population in the four pilot areas. In order to understand the local perception of poverty, participatory focused group discussions and wealth ranking were conducted and further information gathered from opinion leaders, key informants, and key members of the communities and included in the documentation of poverty and vulnerability.

The questionnaire: This was specially designed to capture all aspects of poverty, including empowerment, health, gender, assets and access to services such as Agricultural extension.

Data collection: This was done through questionnaire and was administered by 20 trained enumerators and 6 members of the NALEP team to 250 Households. For the control site, 20 households were selected from 150 clustered Households in the control site locality.

The drawback was that the questionnaire was too long, requiring two hours or more to administer. Some issues, such as discussions on HIV/Aids were considered sensitive by the respondents, where few people were willing to state how many family members had died of the disease.

Data analysis: This was done using the Statistical Package for Social Scientists.

RESULTS/DISCUSSIONS

The perception of poverty and vulnerability differed from District to District, necessitating employment of different or tailor-made interventions, to apply to each of the unique situation.

Major difficulties of women farmers in female headed Households were: poverty, lack of credit and lack of land ownership. This ties up with sentiments found in other studies, (IFAD, 2003) women in African communities are largely responsible for Agricultural work and play important roles in Livestock production. They contribute varying but significant levels of the labour required to care for animals depending on culture and production system. Women are however subject to more production constraints than men who control a larger share of the earnings. Women spend disproportionately larger amounts of their share of income on food and health care for children while men use most of the household income for larger household expenses and for personal needs.

The coping strategies included: Renting land out at a fee and keeping Livestock for food security and income, to meet school fees obligations, health needs and others. The notion that farmers organize themselves into common interest groups to access extension easily is not always true. The impact of the study was that different categories were mobilized, counseled and other stakeholders identified for possible support.

RECOMMENDATIONS AND ALTERNATIVE INTERVENTIONS FROM THE SURVEY

1. Identification of existing groups and focus on them.
2. Stakeholder identification (expansion of common interest groups).
3. Identification of credit institutions for assistance to groups.
4. Identify common interest group training (vocational). Incorporate HIV/Aids awareness, health and sanitation.
5. Female headed households to receive special common interest group assistance.
6. Housing/home improvement (purchase of corrugated iron sheets, construction of water catchment gutters and other).
7. Consider homes with disabled (youth, elderly, widows)
8. Utilize common interest groups in technology dissemination, purchase of tools for hire.
9. Local technology expertise (identification).

ACKNOWLEDGEMENT

As acknowledged by Breldan Consultancy as follows:

·Ministry of Agriculture and Rural Development (staff at National, Provincial and District levels)

·National Agriculture and Livestock Extension Programme ((staff at National, Provincial and District levels).

·J. Kiara, Project Co-ordinator

·A. Eriksson, Project Advisor

·Dr. T. Amare, Socio-economic Advisor

·G. Mitoko

·L. Mwarasomba

·J. Mogere

·Dr. J.M Gitachu

·T. Kimani

·J. Kobe

·Local elders pilot area communities

·Women in focus group discussions and participatory rural appraisal

·Youth in focus group discussions and participatory rural appraisal

Special mention of Ms. Josphine Mogere and Mr. L. Mwarasomba, the members of the initial Gender and Socio-economic sub-core team, who under my chairmanship, spent a lot of time debating on the paradigm to be adopted and the procedure to be followed towards developing mechanisms of targeting the resource poor and vulnerable.

Special thanks to G. Asiko. Her encouragement and assistance saw the production of this paper.

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FARMERS MARKETING FEDERATION (FMF) ARRANGEMENT- A PRACTICAL SOLUTION TO SMALLHOLDER FARMERS MARKETING CHALLENGE

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ABSTRACT

The livestock sub sector accounts for 10% of National GDP, 42% of Agricultural GDP and 50% of the agricultural workforce in Kenya. The small-scale farmers contribute 80% to the total agricultural production in Kenya. Poor marketing structures especially for agricultural produce has led to decline on agricultural productivity as a result of poor prices, poor policies on marketing tariffs and unaffordable credit systems. FSK in its effort to establish a sustainable wealthy, prosperous and entrepreneurial small holder farming community has developed a model known as Farmer Marketing Federation (FMF) to help farmers strategically market their agricultural commodities as well as empowering women to actively participate in the decision-making process with respect to household resources. This is because women work 15 – 20 hours a day growing 80% of the food and contributing to 90% of the labour needed for family and household

maintenance (Gellen, 1994; Maina and Waiganjo, 1998). In a bid to streamline a Farmer Oriented demand driven extension approach that would be sustainable, FSK carried out several surveys among smallholder farmers. The output of this exercise revealed that, while farmers may know what they want to achieve, they are constrained by limited technical know-how, poverty, poor infrastructure, unfriendly policy set up, limited marketing information and engagement and unaffordable credit, lack of recognition of the role of women in agricultural development among others. The Curriculum Based Extension (CBE) approach was therefore developed to empower the farmers especially women to mitigate against these limitations. The approach stemmed from FSKs engagement in various extension approaches including T &V, FFS, FSR&E, Conventional Approach, Farmer to Farmer among others. The CBE approach not only provides training but also helps farmers to establish farming as a business on a Farmers Marketing Federation (FMF) model. This paradigm shift acts as a catalyst to catapult the smallholder farmers, who constitute 80% of the farming community, to take full responsibility in determining their destiny on both supply and demand side. CBE is designed on the farmer group set up with the group comprising a membership of 20-30, which serves as a production unit. These groups cluster to form a Farmers Marketing Federation with a membership of up to 20 self help groups, hence totaling to about 500 members. The District FMF is the apex at which trading is optimized due to the comparative advantage created by economies of scale. The curriculum is designed in a way that it is adaptable to different situations depending on ecological zones and enterprise(s) inclination. It is built on flexibility and continuous appraisal to maintain its relevance and usefulness to the farming communities it serves due to the dynamic nature of the smallholder agriculture and global challenges. This paper provides proven evidence that the FMF has offered a practical solution to the livestock-marketing sector. The institutional arrangement and impact of the federation on the lives of individual farmers is highlighted.

INTRODUCTION

Over the years, the agricultural sector has experienced tremendous changes. These changes have not only affected farmers who face diminishing land sizes, lack of credit facilities, lack of technical skills, low farm productivity, illiteracy, food insecurity, unfair marketing conditions and the like; but also service providers who have to grapple with

the best methodology to use to maximize the farmers productivity and returns. The main reasons for the decline in agricultural productivity have been poor governance in key agricultural institutions, particularly the cooperative sector and lack of a comprehensive legal framework to guide formulation of consistent policies (Economic Recovery Strategy for Wealth and Employment Creation document 2003 – 2007). The returns to agricultural investments have dwindled in the recent past due to sudden exposure of the smallholder farmers to the vagaries of the externally driven market led economic environment.

The mode of markets that the farmers face is too complex for them as individuals. Even though there has been liberalization of the economy, the buyers and other stakeholders have formed themselves in cartels, thus creating monopolistic competition while in other instances a few of them control huge chunks of the market (oligopoly). This has tended to expose the farmers to operate under a pure competition market structure and at the mercies of such cartels or individuals; and as such they are pure price takers.

Marketing is the powerful engine that ensures economic growth and development in any country. A well-organized marketing system has enormous effect on the country's gross domestic product (GDP) growth index. "Market is the life blood of any business" (Yoweri Museveni, Ugandan President, at the centennial celebrations of the Kenya Uganda Railway, 2001.). It is evident that farmers adopt an enterprise with sure market outlet and income.

FSK, an indigenous NGO formed in 1981 with a vision to have an established sustainable, wealthy, prosperous and entrepreneurial smallholder farming community in Kenya and beyond has identified a model for marketing agricultural produce/commodity. The model was identified after a research was carried out on strategic marketing in an effort to get a practical solution to the fragile agriculture and livestock marketing challenges.

The FMF approach is an attempt to empower the smallholder farmers to shift from subsistence farming to commercial oriented farming, a situation, which would be described as monopolistic competition on the part of the farmer. This achievement empowers them to start to enjoy economies of scale where the benefits would accrue to them through accelerated bargaining power for both producer prices and the lower cost of production. This situation would enlarge their profit margin.

Objective

The objective is to create wealth and employment by empowering smallholder farmers to enhance their productivity through training on appropriate production methods/technologies, management, leadership, agri-business and marketing skills.

METHODOLOGY

The CBE approach is a three-year extension reform program structured in four phases that seeks to revitalize the agricultural sector. Each phase focuses on specific areas of concentration in training covering specified units. Phase 1 is a preparatory phase and the expected output is cohesive groups. The second phase is intensive capacity building where farmers are trained on livestock production so that farmers can optimize production. At the end of Phase II, the groups are expected to have improved production and therefore mobilized to form &/or formalize Farmers Marketing Federations (FMF). The major objective of FMF is to link farmer groups together for the purpose of obtaining economies of scale for both input acquisition and produce trading, credit sourcing and management, commodity marketing and policy advocacy.

At the end of the second year of training, the FMFs are weaned off and become autonomous self-sustaining entities, coordinated at the district level by the District Farmers Marketing Federation (DFMF). The main objectives of the DFMF is to provide avenues for agricultural and Livestock marketing, policy advocacy, credit sourcing, agri-business management, input purchase and commodity trading through the established FMFs. District FMFs engage the services of their own employees and other business service providers. The FMFs are linked with common interest groups / associations. In particular, two livestock associations have been established in Nakuru by NDFMF in collaboration with FSK. These arms are the Nakuru Sheep and Goat Breeders Association (NS&GBA) and the Nakuru Small Scale Dairy Cattle Breeders Association. These associations undertake the management of the breeding, production and marketing aspects of the respective livestock and livestock products in the district. FSK has facilitated further training of Technical Assistants (TAs) from every farmer group represented who serve as Trainer of Trainers (TOTs).

RESULTS AND DISCUSSION

For the last two years since inauguration, the Federation has played a major role in revitalizing the agricultural and livestock sub-sectors. The FMF strategy has made the administration of the curriculum not only easy but also a mammoth multiplier effect with an overwhelming request to replicate it in other districts. The model has so far been replicated in Uasin Gishu and over 3,800 farmers have been brought together. Farmer Field Schools (FFS) members in Nakuru district have joined the district FMF network. However the process of replication has been slowed down by lack of resources.

Some of the activities that these farmer organization have done so far in Nakuru and Uasin Gishu districts include:

- Hiring of a marketing Coordinator paid by the farmers from their annual contributions
- Joint sale of dairy goats and dorper sheep worth Kshs 1.2 M and dairy cow worth 1.5 M. They have also managed to sell milk collectively to KCC and Spnit dairies.
- Pooling their resources to purchase a motorcycle for easy mobility of the marketing coordinator and to make him more effective in reaching out to them and also market research.
- Organizing for the Artificial Insemination services for the dairy farmers
- Organizing field days. Farmers have been empowered through the FMF concept to organize their own field days. During these field days, stakeholders from all the sectors are invited and a forum is provided for exchanging new ideas, new technologies and new products. In such a forum farmers are able to buy farm inputs at negotiated lower prices and meet potential buyers of agricultural produce.
- Joint credit sourcing and management. The FMF in Uasin Gishu negotiated for agricultural loan and was advanced an amount of Kshs. 10,000,000 by K-Rep Bank in 2005 and has been repaid in full.

Impact Stories:

The FMF arrangement has impacted both the agriculture and livestock sub-sectors in Nakuru and Uasin Gishu districts. A few documented cases of individual livestock farmers portray the impact (MOA, 2000-2004; The Organic Farmer, 2005, FSK 1999 –2005).

1. The FMF at Nakuru has made a great impact in food security and wealth creation. Through the FMF, farmers have managed to sell dairy goats at a cost between Kshs. 4,000 to 10,000 while before formation of FMF and the Nakuru Sheep and Goat Breeders Association (NS&GBA) they sold at Kshs 2,000- 3,000. NS&GBA helps to train on shoat husbandry and sustain the breeding programme through strategic management of breeding bucks in a pool.
2. Mrs.Margaret Wanjiru Ngigi, a widow, received the first dairy goat funding from FSK in 1998. She is one of the 25 members of belongs to Kunyotoka Self Help Group of Ngorika FMF. Her doe has since then kidded four times by 2002 in multiples of 3, 4, 5 and 3. From sale of offsprings she has earned over Kshs 100,000 in five years (the doe could not conceive for the first year).
3. Another documented case is of Zipporah Wairimu, a widow aged 55yrs of Kumenya SHG (Maili Kumi FMF) in Nakuru who generated income from dairy goat sales and used the proceeds to construct a two-roomed semi-permanent house. Her family used to live in a makeshift two roomed housed that served as a kitchen too. She is really delighted at her achievement as a benefit from her dairy goat through the FMF. She relies on the dairy goat for her domestic milk needs.
4. Grace Mukami is also from Kunyotoka SHG (Ngorika FMF) Nakuru, sold 3 appendix does for total to Ksh 18,000 through the assistance of FMF and saved a situation whereby her son was to miss being admitted to college due to lack of school fees. She was overwhelmed by the money and could not sign for it immediately.
5. Eight FMF have been trained on livestock produce value addition i.e. yoghurt production. One FMF in Mau Narok Division (Likia) is currently undertaking commercial yorghurt production with significant impact.

Dairy Goat Pricing: -

The Federation in conjunction with the associations formulated the pricing of the livestock. Below is an example of the dairy goat-pricing schedule. The dairy goats are sold according the live weight and breeding level. Farmers are therefore careful on their breeding program to ensure their does get upgraded to higher breeding levels for better incomes.

The prices are determined as follows: -

Foundation class = Ksh 120 x Live weight + Ksh 500.

Intermediate class = Ksh 150 x Live weight + Ksh 1,000.

Appendix class = Ksh 200 x Live weight + Ksh 2,000.

Pedigree class = Kshs 300 x live weight + Kshs 2,000.

For example if an appendix doe weighs 30kgs it will sell at kshs 8, 000. The buyer however will pay an additional 10% commission of the total amount to the Goat Association. Out of this, 2% is remitted to the FMF while 8% remains with the association.

CONCLUSION

The district Farmers Marketing Federation is a smallholder farmer's movement that is professionally run by the farmers themselves for the farmers own good. The farmer groups that form the base of the federation have been fully trained and empowered to carry out their group projects and enterprise management roles effectively.

Livestock farmers in Nakuru and Uasin Gishu have adopted the Curriculum Based Extension approach founded on the unique Farmers Marketing Federation concept and are selling jointly at a beneficial price. The NSGBA plays a crucial role of managing the breeding bucks for controlled breeding while dairy cattle is being done by Nakuru Small-scale Dairy Cattle Breeders Association. This farmer empowerment is a revolution in itself, which if given support and replicated across the borders yield sustainable results.

There is a need to improve livestock consortium especially to train extension officers and front-line workers. The federation has attracted interest among other farmers and this is evident by the continuous request by other districts to be facilitated to start such initiatives in their area apart from Nakuru and Uasin Gishu District where its operational. This is however constrained by lack of resources.

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HERDING AND NAMING SYSTEM OF SMALL RUMINANTS BY THE PASTORALIST RENDILLE COMMUNITY OF NORTHERN KENYA

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ABSTRACT

This study describes and analyses the pastoral Rendille small ruminants (i.e., sheep and goats) management and goat naming system. Data on the Rendille subsistence ecology, breeding practices and small ruminant management regimes was collected using a field survey for a period of four months. An open-ended questionnaire was used in the survey. Key informants and group discussions were used to validate and/ or gather additional information. It was evident that small ruminants were ubiquitous and contributed significantly to the subsistence, economic and social livelihoods of the community. These animals utilize different plants as food, and are kept in one flock. This

mixed flock herding technique is effective and well adapted to the prevailing harsh and fragile natural environments. The Rendille classify the goats by matrilineal groups and call each goat by its matrilineal group's name. In addition to its group name, each goat is given an individual descriptive name. This unique naming system facilitates the exchange of information about the goats. It is imperative to utilize indigenous knowledge when setting up community-based genetic improvement approaches if such operations are to work well for pastoral producers.

INTRODUCTION

Small ruminants (i.e., sheep and goats), and livestock in general, play many important roles in the lives of the people who own them (Kosgey et al., 2006). They contribute to food and nutritional security, generate income, and are an important means of storing wealth and an insurance against emergencies (Kosgey, 2004; Peacock, 2004). Pastoral production is mostly subsistence and is aimed at providing a regular supply of food in the form of milk, meat and blood for household members (Kimani and Packard, 1998). Pastoralists also trade in livestock and their products (e.g., hides and skins, and milk) for cash income to purchase grains, pay for education, healthcare and other services. Production is usually organized within household units consisting of a male livestock-owner, his wife/ wives, children and other dependants.

Presently, community-based genetic improvement strategies are being advocated for pastoral production (Kahi et al., 2005). These strategies would require a good understanding of the community's indigenous knowledge of their animals (Köhler-Rollefson, 2003). Among the important subjects are the management and animal identification systems. These issues, particularly for small ruminants, have hardly been studied or formally reported for the pastoral Rendille community of Northern Kenya. The present study describes and analyses the pastoral Rendille small ruminant herding techniques. Additionally, the goat naming system and its meaning to their pastoral life was analyzed.

MATERIAL AND METHODS

The Rendille pastoralists inhabit Laisamis and Loiyangalani divisions of the district administrative zones of Marsabit. This area covers about 11,000 km^2 between 2^o and 3^o north and 37^o and 38^o east. Sedimentary plains at about 350m above sea level are the prevailing landform. The Rendille utilise the foot slopes of Mount Kulal to the west and Mount Marsabit to the East. Further to the south, the Rendille co-inhabit the foot of the Ndoto Mountains with the Samburu, where intermarriages formed the mixed Ariaal tribe (Spencer, 1973; Fratkin, 1991). The northern borderline towards the Gabra area crosses the Chalbi desert, extending from Korole springs all through to North Horr. The community has adapted itself to new diets and nutrition (Fratkin et al., 1999), social organisation (Little et al., 1999), gender roles (Roth, 1991) and organization of labour time (Smith, 1998). The Rendille keep cattle, camels, donkeys for draft power and small ruminants. However, this community values the latter more than any other livestock species.

Data on the Rendille subsistence ecology, breeding practices and small ruminant management regimes was collected using a field survey for a period of four months. An open-ended questionnaire was adopted as the survey tool. The household was the unit of analysis. Key informants and group discussions were used to validate and/ or gather additional information.

There has been controversy by the researchers that the herders will not identify their animals for ease of management and breeding. In this study, field trials were undertaken with the herders to assess the validity of this argument. In the determination of animal identification modes and reliability, a sample of 30 herders with large flocks was chosen. Five percent of the milking animals were chosen at random from each of the 30 herders, resulting in a sample of 574 milking animals. The pastoralists were asked to identify a given number of milking animals and their kids. The kids and their dams were then clearly identified by the researchers. Subsequently, before the kid was released to the mother at milking, the herder was requested to identify the same goat with its kid. This exercise was repeated three times in different days and the results recorded. The strength of this approach hinges on the fact that there is imprinting created during birth that leads to the acceptance of the kid by the mother.

RESULTS AND DISCUSSION

Management

Herding ecology: Small ruminant products occupy a major portion of the Rendille diet. It is evident that the community possesses fewer numbers of large animals (i.e., camels and cattle) compared to the small ruminants. Sheep and goats had an average life span of 7 years. They become sexually active by the end of the first or second year of age, depending on the prevailing environmental conditions. Their gestation period is about 5 months. The breeding season of the tropical small ruminants is however not clear. Twin births are observed more frequently among the goats than in sheep in this community. This corresponds to the descriptions of Njanja et al. (2003) of the Ariaal sub-tribe. Selection of the breeding buck/ ram is done at an average age of 2 years. One or two breeding males are left in the flock for multiplication purposes while others are castrated. There are certain indigenous selection criteria for the breeding males (see Mbuku (2006) for details) that have contributed to the conservation of the local gene pools. There are two methods of small stock castration; one is to cut testicles with a knife and the other is to crush different ducts above the scrota with a wooden mallet called *Tuma.* Castration is done to control inbreeding and improve meat quality for the purposes of marketing. The Rendille classify their small ruminants by age and sex (Table 1).

Milking: Many researchers have overlooked the potential of small ruminants in the provision of milk as a good source of nutrients to the most vulnerable members of the household (i.e., the women, children and the aged). Their products (i.e., meat, milk, blood and fat) occupy a major portion of the pastoralists' diet. In the pastoral systems, small ruminants are split into two flocks: the milking flock kept around the homestead, and the mobile flock kept in the satellite camps (*fora*). Small ruminants are milked twice a day, in the morning and in the evening. One sheep or goat gives about 100 ml of milk at a time for household use. Children and women mostly milk small ruminants in northern Kenya. During milking, the women or children pick out the kids/ lambs from the infant enclosure (*mona emole*) and call their mothers by clicking of the tongue for sheep. On the other hand, goats are called by their names. Unlike goats, sheep have no distinct names because they are regarded as stupid. Only newborn infants, kept all the day in a separate enclosure are individually picked out and allowed to suckle their mothers. Other kids are not allowed to suckle during milking. Kids must wait until the main flock enters the enclosure of the main camp in the evening, then their enclosure is opened and allowed to

suckle their mothers all night long. They are herded into the infant enclosure again in the next morning before the departure of the main flock.

Herding: The son or daughter of the owner usually herds the flock everyday from 6.30 a.m. to around 7.30 p.m. daily, except for watering. The pastureland of a flock is often changed to a particular area, satellite camp (*fora*), based on the availability of pasture and the distribution of other camps. One or two adult men go out to investigate new pasturelands, the concentration of other camps and livestock, and quantity of available water.

The different livestock species (i.e., camels, cattle and small ruminants) are herded separately and in different areas. Although small ruminants utilize different flora as food, the Rendille herd them in one flock (Njanja et al., 2003). This mixed flock-herding technique has been found to be effective and well adapted to their territory's natural environment (Nathan et al., 1996). This practice ensures that the vegetation can support the flocks for longer periods. Deterioration of the usable pastureland leads to the migration of the animals from the satellite camp to another area. The herder does not intervene in his flock frequently. He only flags off the flock to start the day's pasturage in the morning and receive them in the evening to confirm any missing or sick animals. Although land ownership is communal and the flocks encounter each other during grazing, they do not mix with those of neighbours at any given time, i.e., herding of animals within an area is done separately. If different flocks come too close, the herder changes his course by shaking his stick or clicking his tongue. The small ruminants react immediately, stop their feeding, and begin to advance in a different direction. In the evening, the herder drives the flocks into the enclosure one after the other from different gates and the flocks are rested in different clusters. In the morning, each flock is driven out of the same evening gate. This herding technique has been seen to control indiscriminate breeding.

Small ruminants of the same flock act in different ways. Sheep tend to group together while the goats disperse at random. At around mid-day, herders rest their animals for around an hour. During this period the goats tend to disperse and crouch to rest, while most of the sheep cluster and stand with their heads lowered. The sheep rarely crouch. Sheep and goats are herded in a mixed flock all day and do not separate completely in the pastureland. Herders do not disturb the flocks for fear of separating the two species. They have different feeding habits. Even though goats can walk faster than

sheep, the latter tend to move ahead of the goats because they spend much less time feeding at each plant. This process is reversed in the grasslands where the sheep spend much more time grazing and goats tend to move ahead. In the end, the speeds of advancement for the two species tend to balance out. This maintains a spatial unity between the two species that ensures that they are herded as a group.

Watering: Small ruminants are watered after every 4 days. This is an important characteristic as they are able to take large amounts of water but less regularly. The animals are normally watered in small wells, but at times they may be watered in large pools of water during the rainy season. On the watering day, one or two men go directly to the well before the flock departs. On arrival, they repair a livestock-watering pipe; clay is kneaded with water and plastered all over the pipe. After the flock arrives, two or three men descend onto the well and draw water that is then transferred from one person to another in queue to the watering pipe. They usually do this while singing in a slow rhythm. Herders keep their separate flocks 100 to 200 metres away from the well and water them in a pre-arranged order. Around 10 to 20 heads run at a time struggling to the well, drink water for around 2 minutes then gather under a nearby tree. Another batch is released and the same process is followed. When water is abundant, watering is once a day.

The goat naming system

Contrary to cattle whereby each individual has its own name that is called during milking, goats only have a classificatory and descriptive naming system. A goat is named after its mother. Consequently, a name is passed through generations from a female to her offspring. Each matrilineal group has one common name, i.e., all goats are recognized with the same name belonging to one matrilineal group in a flock. Each matrilineal group is called after its common name, e.g., *Dakhane* (white) group. Male goats are also called by the name of their matrilineal groups. Where the lineage group name is the same for different animals, then a second name is used for the sake of differentiating the two. Only female goats are called binomially by both their individual name and group name. The female's first name is its matrilineal group name. The second is a term for the physical characteristics, e.g., colour of fur, hornless and place of origin, and is used as a term of endearment.

There are many goats that have the same second name. An example is *Dhakane Ruma*. The first name *Dhakane*, as indicated earlier, designates a particular matrilineal

group, and can be used as the second name. *Dhakane* will refer to a white animal but the name is passed down through generations regardless of the actual colour of the individual goat. *Ruma* means hornless, and is derived from the actual physical characteristics. When the Rendille call each female goat by its name during milking, the second name is usually omitted. The second names are mainly used as means of discriminating the goats belonging to the same matrilineal group. It is depicted that information about the individual goat is delivered easily through the distinctive and descriptive second name. In general, it was evident that over 97 percent of the herders could identify the animal in question correctly (Table 2).

CONCLUSIONS AND RECOMMENDATIONS

Livestock are an important resource to the pastoralists. They play a role in every aspect of their lives and therefore are highly valued**.** In pastoral flocks, high mobility, and shared pasture and watering facilities do not reduce independence, especially with regard to breeding decisions. The management regimes in the pastoral set up are effective and well adapted to the harsh environments. In addition, animal identification systems are well defined. It is imperative to utilize indigenous knowledge when setting up community-based genetic improvement approaches if such operations are to work well for pastoral producers. It must be emphasized that setting up of community-based genetic improvement programmes should be an integrated approach that must consider several aspects such as extension, capacity building, linkages with other institutions, both local and national etc to ensure success and sustainability.

ACKNOWLEDGEMENTS

We gratefully acknowledge Egerton University (Njoro, Kenya) and ILRI-BMZ-Hohenheim-Göttingen Collaborative Project on **"**Improving the Livelihoods of Poor Livestock Keepers in Africa Through Community-Based Management of Indigenous Farm Animal Genetic Resources" for provision of facilities and support. Our gratitude is to the many pastoralist farmers who shared with us their experiences and plight.

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Table 1. Vernacular terms for sheep and goats of different age and sex classes as distinguished by the Rendille pastoralists

Animal Class	Rendille Sheep	Rendille Goats
Very young pre-weaned	Lukuo Kunini	Lukuo Kunini
Middle aged pre-weaned	Lukuo Puusi	Kotiti
Old pre-weaners	Lukuo Botoro	Lukuo Botoro
Weaners	Guus	Karat
Sub-adult female	Sipen/Leeker	Sipen/Lekinne
Mature females	Riiyo	Onno
Sub-adult males (Uncastrated)	Lepukutorege	Lepukutorege
Castrates/ Wethers	1st Grade: Loro Lentare Uni Ilarecha	Loro lentare
	2nd Grade: Lorolesipen	Lorolesipen
	3rd Grade: Loro lentare tare	Loro lentare tare
Bucks/Rams	Lmerigesh	Orgei

Table 2. Frequency of the animal identification undertaken by herders (n = 574) for the goats

Trial	Response[1]	Frequency	Percent
1	Y	570	99.3
	N	4	0.7
2	Y	559	97.4
	N	15	2.6
3	Y	565	98.4
	N	9	1.6

[1]Y = yes; N = No.

SESSION VI

LIVESTOCK IMPROVEMENT AND GENETICS

A REVIEW OF SHEEP PRODUCTION AND GENETIC IMPROVEMENT IN KENYA

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ABSTRACT

Sheep play a key role in the livestock sector in Kenya. However, little effort has been directed by the development agencies at their improvement. This paper summarizes the production of sheep, and past and present improvement initiatives in Kenya. It presents future prospects for genetic improvement. Current production is deemed sub-optimal. Failures and shortcomings of projects initiated to improve productivity of sheep in the country have been reported. Initiatives to sustainably improve sheep should concentrate on the indigenous genotypes that are mainly kept by the smallholder and pastoralist farmers, and widely distributed throughout the country. Firstly, extensive characterization of the existing genotypes is necessary. Subsequently, community-based open nucleus schemes should be encouraged and the improved genotypes disseminated by extensive use of males from the nucleus. Establishment of private professional breeding flocks either owned individually or by private groups of farmers, that would benefit from the scientific and technical assistance provided by research and extension institutions should be encouraged.

33.

ESTIMATES OF (CO) VARIANCE COMPONENTS AND GENETIC PARAMETERS FOR GROWTH AND REPRODUCTIVE TRAITS IN THE KENYA BORAN CATTLE

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ABSTRACT

Direct and maternal (co)variance components and genetic parameters were estimated for growth and reproductive traits in the Kenya Boran cattle, fitting both univariate and multivariate animal models. Data consisted of records on 4,502 animals from 81 sires and 1010 dams collected between 1989 and 2004. Direct heritability estimates from univariate analyses of growth traits were 0.34, 0.12, 0.19, 0.08 and 0.14 for birth weight (BW), weaning weight (WW), 12-month weight (12W), 18-month weight (18W) and 24-month weight (24W), respectively. Maternal heritability increased from 0.14 at weaning to 0.34 at 12 months of age but reduced to 0.11 at 24 months of age. The maternal permanent environmental effect contributed (%) 16, 4 and 10 of the total phenotypic variance for WW, 12W and 18W, respectively. Direct-maternal genetic correlations were negative ranging from –0.14 to –0.58. The heritability estimates for reproductive traits were low, i.e., 0.04, 0.00, 0.15, 0.00 and 0.00 for age at first calving (AFC), calving interval in the first parity, calving interval in the second parity, calving interval in the third parity and pooled calving interval. Direct heritability estimates from multivariate analyses were 0.36, 0.40, 0.38, 0.21 and 0.17 for BW, WW, 12W, 18W and 24W, respectively. The heritability estimates for reproductive traits from multivariate analyses were low but higher than those obtained from univariate analyses. Improvement through selection is possible for all growth traits considered in this study. The genetic correlations between growth traits were positive and ranged from 0.36 to 0.94. The genetic correlations between reproductive traits were negative and ranged from -0.18 to -0.30. The genetic correlation between AFC and WW was positive (0.72). Selection for growth traits should be practiced with caution since this may lead to a reduction in reproduction efficiency, and direct selection for reproductive traits may be hampered by their low heritability.

34.

GENETIC ASPECTS OF MILK PRODUCTION AND FERTILITY TRAITS OF THE SAHIWAL CATTLE IN SEMI-ARID KENYA

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ABSTRACT

Data comprising 7,211 records of 2,894 cows, daughters of 262 sires were used to estimate genetic and phenotypic parameters for milk production (lactation milk yield, LMY and lactation length, LL) and fertility (calving interval, CI; number of services per conception, NSC and age at first calving, AFC) traits. Variance components were estimated using univariate, bivariate and trivariate animal models based on a derivative free restricted maximum likelihood (DFREML) procedure. Univariate models were used for each trait while bivariate models were used to estimate genetic and phenotypic correlations between milk production and fertility traits and between LMY, LL, CI and NSC within each lactation. Trivariate models were used in the analysis of LMY, LL, CI and NSC in the first three lactations. Heritability estimates from the univariate model were 0.16, 0.07, 0.03, 0.04 and 0.01 for LMY, LL, CI, AFC and NSC respectively. The heritability estimates from trivariate analysis were higher for milk production traits than those from univariate analysis with ranges of 0.32 to 0.45 for LMY and 0.26 to 0.34 for LL. Genetic correlations were high and undesirable between milk production and fertility traits while phenotypic correlations were correspondingly low. Genetic correlations were essentially unity among both milk production and fertility measures in the trivariate analysis. Continued selection for increased milk yields would result in depressed reproductive performance. The existing breeding programme has to be reviewed with view of changing the management policies and including fertility traits in the selection programme.

35.

ENVIRONMENTAL SOURCES OF VARIATION IN GROWTH PERFORMANCE OF SAHIWAL CATTLE IN SEMI ARID KENYA

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ABSTRACT

Growth records of 2,795 Sahiwal cattle born at the National Sahiwal Stud from 1992 to 2005 were used to determine environmental factors affecting growth performance and obtain mean estimates for these traits under semi arid conditions in Kenya. Traits considered in this study were: birth weight (BW); age at weaning (AW); age at branding (AB); pre-weaning average daily gain (PRDG); post weaning average daily gain (PODG) and average daily gain (AVDG). Sex significantly influenced all traits ($P<0.01$) except PODG while season was an important source of variation for pre-weaning traits. Year of birth was significant ($P<0.001$) for all the traits except AW and PODG. For AW and PODG, year of weaning was important. Dam age and *post-partum* weight significantly ($P<0.05$) influenced PRDG. The covariable weaning weight and branding weight had a significant ($P<0.001$) effect on AB. Mean estimates were 21kg, 156days, 476 days, 222 g, 266 g and 242 g for BW, AW, AB, PRDG, PODG and AVDG, respectively. This study shows environmental influence on growth of the Sahiwal breed. Breeding and management programmes can only be effective if environmental factors are well accounted for. This implies that satisfactory management during such periods should be able to result in satisfactory growth performance to meet the ever-increasing demand for beef and beef products.

36.

GENETIC COMPARISON OF BREEDING STRATEGIES UTILIZING LOCAL SELECTION PROGRAMMES AND THOSE BASED ON IMPORTED SEMEN FOR IMPROVEMENT OF DAIRY CATTLE IN KENYA

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ABSTRACT

A deterministic approach was used to genetically compare breeding strategies utilizing local selection programmes and those based on imported semen for improvement of dairy cattle in Kenya. The local selection programme considered was a closed progeny-testing scheme (CPT) while continuous semen importation (CSI) was the strategy based on imports. It was assumed that all semen imports are from the USA. Selection intensities and accuracies of selection were estimated according to the proportion of animals selected and using selection index methodology, respectively. The CSI ranked above CPT by 40% in terms of genetic response when the genetic correlation between Kenya and the USA was assumed to be one. At a genetic correlation of 0.6, the genetic response achieved through CSI was equal to that from the CPT. Utilization of the local selection programmes (CPT) is recommended since semen importation for the genetic improvement of dairy cattle is only genetically viable when the genotype-environment interaction level is >0.60.

37.

EVALUATION OF THE PERFORMANCE OF THE KENYA DUAL PUPOSE GOAT COMPOSITES: HETEROSIS, RECOMBINATION EFFECTS AND THE LEVELS OF INBREEDING

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ABSTRACT

Growth data from the Kenya Dual Purpose Goat (KDPG) breeding programme at the National Animal Husbandry Research Centre covering the period 1982-2004 were used to estimate effects of heterosis, recombination and the levels of inbreeding. The KDPG was developed by crossing Toggenburg (T), Anglo-Nubian (N), Small East African (E), and Galla (G) breeds in phases; 2-breed crosses were first produced by crossing exotic bucks with indigenous does, followed by a cross of 2-breed crosses to produce 4- breed crosses with equal proportions of each breed and lastly *interse* mating of the latter crosses to produce the composites. Effects of heterosis and recombination for juvenile growth traits were estimated by fitting an animal model using Derivative-Free-Restricted Maximum Likelihood (DFREML) procedures (Meyer, 1998). Pedigree analyses were done using the pedigree viewer programme while all the statistical analyses on the effects of inbreeding on performance were done using Least Squares procedures of Harvey (1990). Individual heterosis was favourable on Birth weight (0.05 kg), Yearling Weight (0.36 kg) and post-weaning daily gains (3.04 g/day) but negative in pre-weaning traits. Maternal heterosis was favourable in the traits influenced by pre-weaning maternal environment (Weaning weight and pre-weaning daily gains) Recombination losses were unfavourable and reduced performance in all traits. The mean proportion of inbred animals over the study period was 7.04 % with an average inbreeding coefficient of 3.6% and a small annual change of -0.001, which was not significantly different from zero ($P>0.05$). There was no systematic trend in the annual levels of inbreeding .A one percent increase in inbreeding caused a decrease in birth weight and pre-weaning average daily gains for all the genotypes but maintained a positive effect in weaning weights. The study establishes that the developed KDPG composites have lost the positive dominance effects; an effect due to large unfavourable recombination loses caused by lack of selection during breed development other than the effects of inbreeding. In conclusion, the KDPG composites have not stabilized into a new breed and this becomes the aim of the breeding programme.

38.

COVARIANCE ANALYSIS USING SAHIWAL CALVES DATA FROM NAIVASHA

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ABSTRACT

Analysis of covariance is a technique that combines features of analysis of variance and regression. It can be used for either observational studies or designed experiments. The basic idea is to augment the analysis of variance model containing the factor effects with one or more additional quantitative variables that are related to the dependent variables. This augmentation is intended to reduce the variance of the error term in the model, i.e., to make the analysis more precise. Therefore, covariance models are considered to be linear models containing both qualitative and quantitative independent variables. Covariance model are just a special type of regression model. In this paper, we shall consider how a covariance model can be more effective than an ordinary ANOVA model.

(SESSION VII – FEEDS AND FEEDING SYSTEMS)

39. RESPONSE OF GROWING SCAVENGING INDIGENOUS CHICKENS TO PROTEIN SUPPLEMENTATION

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ABSTRACT

An on-farm study was conducted to investigate the effect of protein supplementation on growth rate in scavenging indigenous chickens. At 14 weeks of age, 120 local chickens (60 males and 60 females) were used in this experiment. The chickens were divided into 4 groups and supplemented with either of the 4 protein levels. The supplements offered contained 0, 1.6, 3.2 and 4.8 g CP per bird per day. The birds' body weights were monitored weekly. Growth rates and chicken weight increased with increasing protein supplementation up to 3.2 g CP then plateaued. The crude protein requirement of free-range growing indigenous chickens was estimated to be around 11.7g/day. Indigenous chickens under free-range system given 11.7 g CP intake daily will have similar growth rates but higher live weight than commercial layer type pullets of the same age.

40.

RUMEN DEGRADATION AND IN VITRO GAS PRODUCTION PARAMETERS IN SELECTED FORAGES FROM KENYA

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ABSTRACT

Five browse species, *Bauhinia alba*, *Carisa edulis*, *Lantana camara*, *Sesbania sesban* and *Tithonia diversifolia*; two grass species *Chloris gayana* and *Pennisetum purpureum*

and one crop residue maize (*Zea mays*) stover were analysed for chemical composition including phenolics and rumen degradability characteristics. The rumen fermentation characteristics with and without polyethylene glycol (PEG) were studied for in vitro gas production patterns. The crude protein content was more than 200 g/kg dry matter (DM) in *S. sesban* and *T. diversifolia* but was lowest in *C. gayana* hay (55.0 g/kg DM) and maize stover (53.3 g/kg DM). The organic matter (OM) (g/kg DM) ranged between 945.3 (*C. edulis*) and 837.3 g/kg DM (*P. purpureum*). *C. gayana* hay contained the highest (741.2 g/kg DM) neutral detergent fibre (NDF). Total extractable phenolics (TEPH) and total extractable tannins (TET) were highest in *B. alba* (87.5 and 57.9 g/kg respectively). The DM disappearance after 24 h of rumen incubation ranged from 44.1 in *C. gayana* hay to 82.4 % in *T. diversifolia*. The effective degradability (ED) was higher in the browse forages than in grasses and maize stover. The gas produced after 96 h of incubation ranged from 23.9 in *B. alba* to 52.8 ml/200 mg DM in maize stover. The grasses and maize stover produced more gas than the browse forages at all incubation intervals after 24 h. The results of this study indicate that such browse forages have the potential to be used as feed supplements for ruminants, especially during the dry season when feeds such as hay and crop residues are the only feed resources available to the farmers.

41.

NUTRITIONAL EVALUATION OF SEAWEED (*ASCOPHYLUM NODOSUM*) IN BROILER DIETS

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ABSTRACT

The study was to evaluate the effects of supplementing commercial broiler diets with seaweed. Seaweed was incorporated into a broiler diet at 0, 10, 15 and 20 g seaweed per kg feed and fed to broilers from 4 – 6 weeks of age. Results showed that weight gains, feed intake and feed/gain ratios were similar between birds fed diets containing seaweed of 0 – 15 g/kg feed, but weight gains increased ($p<0.05$) beyond 15 g/kg inclusion. A 20% seaweed supplement had significant weight gains which was reflected in better final

weights (6.7% increase). It was observed that chickens fed on seaweed supplement had a deeper yellow skin pigmentation than those fed on broiler finisher only. In conclusion, supplementing broiler finisher with seaweed resulted in an increase in growth rate of broilers without affecting intake. This suggests that seaweed improved the utilization of feed consumed.

42.

EFFECT OF MINERAL SUPPLEMENTATION ON MILK YIELD AND CALF GROWTH RATE IN CAMELS OF NORTHERN KENYA

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ABSTRACT

A study was conducted in Ngurunit and Kargi locations of Marsabit district in Kenya to determine effect of mineral supplementation on milk yield and calf growth rate of settlement-based camels. No mineral mixture was available in the market that could address deficits determined in this study. Thus, two mineral supplements were formulated: one comprised of locally collected, ground bones mixed with locally available natural salt and the other of commercial ingredients. Fifty-nine and 56 camels in early lactation and their calves were recruited at Kargi and Ngurunit, respectively. Of these, 22 and 21 camels were randomly assigned the commercial mineral supplement while 12 and 11 were randomly assigned the local mineral supplement at Kargi and Ngurunit, respectively. The remaining 25 and 23 camels in Kargi and Ngurunit, respectively, served as control. Each dam was individually fed 200g of mineral supplement daily for 190 days. Milk yield measurements were taken at weekly intervals while calves were weighed on monthly basis. The supplemented camels produced higher ($p < 0.05$) amount of milk than controls in Ngurunit ($3.2ld^{-1}$ versus $2.3ld^{-1}$). In Kargi, the mean milk yield for supplemented and control camels were similar ($p> 0.05$) at $2.6ld^{-1}$. Calves from the supplemented dams grew significantly faster ($p < 0.05$) than those in control, gaining $441.3gd^{-1}$ and $424.8gd^{-1}$ compared with $275.7gd^{-1}$ and $307.7gd^{-1}$ for

controls in Kargi and Ngurunit, respectively. The overall results suggested that specific mineral deficiency existed among the Rendille camels and that this problem could be reduced by judicial use of locally available raw material. The commercial supplement may also be required by those whose circumstances cannot allow preparation of the local supplement, both in the short and long run.

43.

EFFECT OF INTERCROPPING HERBACEOUS LEGUMES WITH NAPIER AND PANICUM ON DRY MATTER YIELD AND NUTRITIVE VALUE

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ABSTRACT

Inadequate quantity and low quality of livestock feeds are the major constraints to livestock production in the semi-arid region of Kenya. The contribution of two legumes, Seca (*Stylosanthes scabra* cv. Seca) and Siratro (*Macroptilium atropurpureum* cv. Siratro) to seasonal total fodder productivity when intercropped with Napier grass (*Pennisetum purpureum* cv. Bana) and giant Panicum (*Panicum maximum* K52-129) was investigated in the semi arid region of eastern Kenya. The treatments consisted of the Napier and giant Panicum planted as pure stand and intercropped with legumes. During the production phase, both the grasses and legumes were harvested for dry matter yield after every 8 weeks for a period of 4 wet seasons and 2 dry seasons between April 2002 and September 2004. Overall total herbage yield of the mixtures was higher than those of sole fodder grasses with the grasses constituting the major component of the yield. Seca was more productive and had a relatively stable yield than Siratro in both grasses. It accounted for higher proportion of total DM yield (15 - 34% in Napier grass and 11 - 25% in Panicum) compared to Siratro (<5%) except in the drier season when yield failed. Total DM yield was highest during short rains 2002 and declined thereafter in subsequent seasons and was lowest during the dry seasons. Unlike Panicum, crude protein of Napier was significantly enhanced by inclusion of the legume in the intercrop (CP 9.64 - 9.96%

of DM) compared to sole Napier (CP 8.14% of DM). It can be concluded that Seca formed a better association with fodder grasses than Siratro and is recommended for intercropping in the semi-arid region of eastern Kenya.

44.

NAPIER GRASS DISEASE VECTOR IDENTIFICATION AND CONTAINMENT OF THE DISEASE ON-FARM

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ABSTRACT

Dairy farming, which largely depends on napier grass, is gradually becoming very popular with smallholder farmers in western Kenya. It enables farmers to produce a number of readily marketable products to maximize their income. However, Napier grass stunt, a new disease caused by a Pytoplasma, seriously affects napier production in western Kenya. Pytoplasma are mainly transmitted through use of infected planting materials and insect vectors. The objectives of this study was to identify potential vectors of Napier stunting disease and use them in transmission experiments to identify resistant germplasm that can be exploited by plant breeders, in addition to sensitization of farmers on the methods that can be used to contain the disease on-farm. During the surveys conducted in 4 districts in western Kenya in 2004-2005, insects were collected using a sweep net and suction trap, sorted using aspirators and preserved in 70% ethanol for identification using taxonomic keys. Pytoplasma detection in insects was by polymerase chain reaction (PCR) assays. The severity of the disease and baseline data on farmers' Napier production practices was also recorded. Mobile clinics and going public meetings were conducted to sensitize farmers on the mode of Napier disease transmission and containment on-farm. Over 30 leafhopper and plant hoppers were collected and identified. The most common ones were from the families Cicadelidae, Delphacidae, Fulgoridae, Derbidae and Cercopidae. From the PCR assays, three species were found to be Pytoplasma positive. Over 1000 farmers attended the going public sessions in 4 days. Most of them were not aware of the disease and more than 28 were asked questions related to Napier stunting

disease. The same studies will continue before initiating studies on transmission mechanisms to select efficient vectors for germplasm resistance screening.

45.

FORAGE LEGUME TECHNOLOGY TRANSFER FOR INCREASED REPLACEMENT STOCK AND INCOME ON THE SMALLHOLDERS IN NYANDARUA DISTRICT

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ABSTRACT

An on-farm research project was carried out on 85 smallholder farms in two divisions (Ol-Kalou and Ndaragwa) of Nyandrua Districts for a period of 18 months. The aims of the study were to assess the nutritive value of the available feed resource, factors limiting young stock performance on the smallholder farms. The study also developed strategies for increasing uptake of forage legume technology for increase the number of replacement stock and rural income for sustainable dairying. The survey data indicates that inadequate feed resource (71%) and animal diseases (23%) are the two major factors responsible for low growth rates (<0.4kg/day) and high mortality (11.7-27.7%) of young stock on the smallholder farms of Nyandarua. Major animal diseases being scour pneumonia and tick borne disease that could be controlled by good nutrition and managements The main feed resources included the natural pastures composed of grass species such as the Rhodes grass (Chloris gayana), kikuyu grass (*Pennistum clandestinum*) and fodder napier grass (*Penniseturn purpureum*) of low crude protein (62-77g/kg DM) and high fibre (NDF >682 g/kg DM) which could limit intake and animal growth. However, protein rich forage species tolerant to frost such as Lucerne (*Medicago sativa*), desmodium (*Desmodum intortum*), vetch and sweet potato vines (*Ipomoea batatas*) with high Crude protein content (164-187 g/kgDM) have the potential to supplement low quality grass forages. The adoption rate of the forage legume technologies at the household level increased between 51% and 77% in both divisions through intensive farmer training, demonstration and establishing forage legume multiplication sites at the farm field schools. Farmers growing protein rich forages reported 50% reduction in feed cost and increased household income. Results indicate

that effective technology transfer to smallholders requires a strong research – extension linkage appropriate legume seed production techniques needs to be developed to make seed available for further distribution to farmers.

46.

EVALUATION OF SORGHUM(*SORGHUM BICOLOR(L)MOENCH*) ADOPTION STATUS AS A FODDER IN GILGIL DIVISION, KENYA

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ABSTRACT

Sorghum (*sorghum bicolor(L)Moench*) is a drought resistant crop. Technologies on its production and utilization as a fodder for livestock have been developed at Kari- Lanet and disseminated to farmers in Gilgil division. A survey was conducted in 2003 to establish the levels of adoption of utilization technologies for sorghum as a fodder. The studied varieties included E1291 and E6518 both of them selected at Kari- lanet. Treating households as sampling units a total of 92 households were selected, 73 of them growing sorghum and 19 not growing sorghum. Using the simple random sampling techniques. Closing and open structured questionnaires were administered. The study assumed that the households are the farmers who are the consumers, adopters of technologies and at the same time they are the owners of factors of production. The results showed that 87% of the respondents grew sorghum as a fodder and 95% fed it as green chop. Only 65% do the wilting of the sorghum forage before feeding livestock. On feed conservation technologies, only 8% who could make sorghum silage. It was also reported that 95% experienced feed shortage during dry period. As measure to this problem only 48% of the respondents could conserve forage .Out of those who did it 73% could just do normal drying of the forage in the sun as a conservation measure. As an alternative solution 59% use dry maize stovers during the dry months .The use of improved varieties of sorghum in the division reduces fodder losses in drought years ensuring feed security. Silage making technologies should be reviewed to enhance the adoption among the farm families who are rearing livestock

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47.

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(Abstract available later in full paper in Proceedings of the 2006 APSK Symposium

Genetic comparison of breeding strategies utilizing local selection programmes and those based on imported semen for improvement of dairy cattle in Kenya

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ABSTRACT

A deterministic simulation approach was used to genetically compare breeding strategy utilizing local selection programme and that based on imported semen for improvement of milk yield of dairy cattle in Kenya. The local selection programme considered was closed progeny testing scheme (CPT) while continuous semen importation (CSI) was the strategy based on imports. It was assumed that all semen imports are from USA. Selection intensities and accuracies of selection were estimated according to the proportion of animals selected and using selection index methodology, respectively. The CSI ranked above CPT by 40% in terms of genetic response when the genetic correlation between Kenya and the USA was assumed to be one. At a genetic correlation of 0.60, the genetic response achieved through CSI was equal to that from

CPT. Utilization of the CPT is recommended since semen importation for the genetic improvement of dairy cattle is only justified when the genotype-environment interaction level is >0.60. However

INTRODUCTION

Exotic dairy cattle breeds are used for commercial milk production in Kenya. Like other developing countries, breeding of dairy cattle in Kenya involves the utilization of breeding strategies using both local and imported genetic materials (Ojango, 2000; Bebe et al., 2002). The genetic progress achieved through the use of local selection programmes (i.e., progeny testing), although low, are cumulative and therefore result in improvement over time. Due to the economic and physical constraints involved in such programmes, Smith (1988) and Hodges (1990) recommended the adoption of breeding strategies based on importation or on nucleus breeding schemes using multiple ovulation and embryo transfer (MNS).

The rate of genetic progress for strategies based on imports depend on the migration rate, the initial difference in genetic mean and magnitude of genotype-environment interaction between the importing and exporting populations (Mpofu et al., 1993; Ojango and Pollott, 2002; Vargas and van Arendonk, 2004). Previous studies indicate that in tropical countries, performance of high yielding temperate breeds has often been negatively affected and the re-ranking of genotypes may be influenced by genotype-environment interactions (Smith, 1988; Bondoc et al., 1989; Rege, 1991). In Kenya, such studies are lacking, the widespread use of imported germplasm notwithstanding. There is therefore need to compare breeding strategies utilizing local selection programmes and those based on imported semen for improvement of milk yield of dairy cattle in Kenya. The objective of this study was to genetically compare breeding strategies for genetic improvement of milk yield in Kenya using deterministic simulation approach. The strategies considered include those based on local selection programme (CPT) and importation of genetic materials (CSI).

MATERIALS AND METHODS

Characteristics of the simulated breeding strategies

Two breeding strategies were compared based on genetic response per year in milk yield. The strategy based on local selection programme was assumed to be a closed

progeny testing scheme (CPT) while the strategy based on imports was continuous semen importation (CSI). In CPT, it was assumed that a progeny testing scheme (PTS) was initiated within the local population. Table 1 presents the population size and structure for the local selection scheme. It was also assumed that all cows under milk recording were sired by bulls selected from the local selection scheme. In CSI**,** it was assumed that there is no selection being done in Kenya and therefore improvement is based on imported semen from proven bulls. This strategy has been recommended in situations where the exotic stock are superior to local stock, breeding objective in the exporting and importing countries are similar and where there are no major effects of genotype-environment interactions (Smith, 1988). In this study, it was assumed that all semen imports are from the USA. The USA has along-standing PTS with a large dairy cattle population. The population parameters and breeding structure for the USA are presented in Table 1.

Method of evaluation

Deterministic simulation was used to assess the effectiveness of breeding strategies by comparing their predicted genetic responses in milk yield. The gene flow procedures (Hill, 1974) were used to estimate the population genetic mean and cumulative discounted expressions for the traits in the breeding goal over a projected period of 25 years. The genetic, phenotypic and economic parameters used were obtained from the literature based on studies in Kenya and the USA. The gene flow model used was;

$$M(t) = P[M(t-1) + \Delta G(t)] \quad (1)$$

where $M(t)$ is the vector of the average genetic merit of animals in each sex-age class at time *t, P* a gene transmission matrix, and $M(t-1)$ a vector of average genetic merit of animals at time $(t-1)$, and $\Delta G(t)$ a vector of genetic superiority of selected animals. The *P* matrix specifies the contribution of different age classes to the next generation and is different for each strategy, i.e., the contributions of the different age classes to the next generation are not the same across the years.

The standard deviation of the breeding goal and accuracy of selection were calculated using selection index methodology (Hazel, 1943) while selection intensities were calculated from the proportions of animals selected and corrected for finite populations according to the formula of Smith (1969) and Burrows (1972).

The estimates of annual genetic gains for each strategy were based on the four selection pathways; sires to breed sires (SS), sires to breed dams (SD), dams to breed sires (DS) and dams to breed dams (DD). The predicted genetic gain per year summed over all selection pathways was calculated using the Rendel and Robertson (1950) formula:

$$\Delta G = \frac{\sum_{l=1}^{L} \left(i \times r_{IH} \times \sigma_H \right)_l \times r_g}{\sum_{l=1}^{L} L_l} \qquad (2)$$

where ΔG is the predicted genetic gain per year summed over all selection pathways, i the selection intensity, r_{IH} the accuracy of selection, σ_H the genetic standard deviation, r_g the genetic correlation between importing and exporting country and $\sum_{l=1}^{L} L_l$ the summation of generation intervals in the l^{th} selection pathway. The r_g was used to adjust for the genetic gains when imports were involved. A genetic correlation of 0.58 obtained by Ojango and Pollott (2002) between Kenya and exporting countries was used as a reference point. The sensitivity of predicted genetic gain to changes in genetic correlation was also investigated.

RESULTS AND DISCUSSION

Table 2 shows the accuracies of selection, selection intensities, traits in the breeding goal and genetic responses for breeding strategies based on CPT and CSI, assuming four levels of genetic correlations (0.30, 0.60, 0.90 and 1.00) between the exporting country and Kenya. In this study the fat yield (FY) and protein yields (PY) were included in the breeding goal to access the effect of multiple trait selection on the ranking of breeding strategies. Generally the CSI strategy resulted in higher genetic response for Milk yield (MY) than the CPT when the genetic correlation between the two countries was assumed to be one. This is in agreement with the results obtained by Mpofu et al. (1993) and Vargas and van Arendonk (2004) for Zimbabwe and Costa Rica Holstein Friesian dairy cattle populations, respectively. The high genetic response in the exporting country might have been as a result of the long-standing and efficient PTS which has enabled intense selection of the sire and dam lines on milk production. Such programmes, however, are scarce in the developing countries (Smith, 1988, Mewiussen,

1990; Kahi et al., 2004; Kosgey et al., 2005). In this study, only the sire pathways (SS and SD) were compared between the two countries as only semen from the proven bulls are imported. Response obtained from sires in the exporting country was 66.7% superior in genetic gain per year to those in Kenya (Table 2). This is due to high number of daughters with complete lactations whose records could be used to evaluate these pathways in the USA leading to increased accuracies of selection and high selection intensities.

The four levels of genetic correlations simulated shows the effects of genotype-environment interactions between the two populations. The results from these four levels of genetic correlation were compared with results obtained from the CPT. When the genetic correlation is 0.30, the rate of response achieved by CPT is 44% superior to the imports. With a genetic correlation of 0.60, there was no difference in terms of rate of genetic response between the two strategies. Finally, the CSI strategy was 31% and 40% superior to CPT when a genetic correlation of 0.90 and 1.00 were assumed, respectively (Table 2). Based on these results, the importation of semen is justified from genetic point of view when the genetic correlation between Kenya and the exporting country is >0.60.

The addition FY and PY in the breeding goal of CPT strategy did not have any effect on the ranking of breeding strategies but had a positive effect on the genetic response (results not shown).This is in agreement with studies by Vargas and van Arendonk (2004), in which they observed that differences in traits in the breeding goal between Costa Rica and the USA did not affect the ranking of breeding strategies.

The effects of initial differences in genetic merit of the population in the exporting country were investigated at three different levels (1.25, 1.50 and 2.00 SD) assuming a genetic correlation of 0.60 and results were compared against CPT (Table 3). The genetic response of CSI strategy improved with increased initial differences in genetic merit (Table 3). When lower genetic correlation of 0.30 was assumed, the CPT was superior to CSI (results not shown). But if imports have to be used at this level of genetic correlation, then only semen from countries with >2.00 SD above Kenya population in MY should be imported. The use of imports from countries which are 1.25 SD above Kenya in MY are justified, since at a genetic correlation of 0.60 genetic responses from CSI was superior to CPT (Table, 3). The results of this study are consistence with those reported by Mpofu et al. (1993) and Vargas and Van Arendonk (2004) for Zimbabwe and Costa Rica dairy cattle population respectively.

It could be concluded that the use of imported semen is mainly dependent on the level of genotype-environment interaction and initial differences in genetic merits between populations. Previous studies in Kenya reported a genetic correlation of 0.49 and 0.58 using animal and sire models, respectively, between the breeding values for MY of Holstein Friesian sires in Kenya and exporting countries (Ojango and Pollott, 2002). Other studies elsewhere in the tropics reported higher genetic correlation of 0.70 (Mpofu et al., 1993) and 0.62 (Vargas and van Arendonk, 2004). Lower estimates of 0.42 and 0.50 have also been reported between USA sires used in Ecuador and Brazil, respectively (Powell et al., 1990). If genetic correlation of 0.58 obtained in Kenya (Ojango and Pollott, 2002) is close to reality then, the use of local or imported semen will be dependent on the costs involved, since there are no significant differences between 0.58 and 0.60 levels of genetic correlations in terms of genetic response.

Mpofu et al. (1993) and Vargas and van Arendonk (2004) stated that countries relying on imported genes for genetic improvement, will have to switch at some point to local selection programmes. Selection from the local population requires establishment of a PTS. In developing countries, these schemes have proved to be inefficient owing to various constraints e.g., small herd size, lack of systematic identification of animals, poor performance and pedigree recording, lack of funds and expertise for an efficient operation of improvement programmes based on artificial insemination (McGuirk, 1989; Rege and Wakhungu, 1992; Mpofu et al., 1993; Kahi et al., 2004; Vargas and van Arendonk, 2004; Kosgey et al., 2005). Nucleus breeding schemes have been recommended as they do not require expensive infrastructure because recording is only done within the nucleus (Smith, 1988). Nucleus schemes, however, require technical skills and management conditions which are scarce in developing countries (Meuwissen, 1990). Even though the results of this study suggests utilization of CPT for genetic improvement of MY since imports are only justified at a genetic correlation of >0.60, the use of imported germplasm may still play a major role in genetic improvement of dairy cattle in the developing countries. Therefore, cross country evaluation is recommended so that only semen from countries which are ≥1.25SD should be imported. An economic evaluation is also needed to ascertain the profitability of these strategies under the local production conditions.

ACKNOWLEDGEMENTS

The authors gratefully thank Egerton University (Njoro, Kenya) for provision of facilities and support.

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Table 1. Population parameters and structure for progeny testing scheme in Kenya and the USA

Population parameters	Kenya	USA
Assumed cow population	500,000	5,000,000
% of cows bred by AI and milk recorded	20	50
% of bull dams from milk recorded cows	5	5
Young bulls tested per year	500	2,000
Daughters per young bulls	50	100
Proportions selected		
SS	5/500	20/2000
SD	25/500	100/2000
DS	500/10,000	12,500/250,000
DD	90/100	117/130
Generation intervals (Yrs)		
SS	6	6
SD	6	6
DS	5	5
DD	5	5

SS= Sires to breed sons; SD= Sires to breed dam; DS= Dams to breed sires; DD= Dams to breed dam.

Table 2. Accuracies of selection, selection intensities, traits in the breeding goal, genetic responses (ΔG (σ_p)/year) for breeding strategies based on local selection programme (CPT) and continuous semen importation (CSI), assuming the genetic correlations between the two countries are 0.3, 0.6, 0.9 and 1.0.

Selection paths[a]	r_{IH}[b]	I[c]	Traits in the breeding goal[d]			ΔG (σ_p)/year[e]			
			MY	FY	PY				
r_g[f]						0.30	0.60	0.90	1.00
CPT									
SS	0.66	1.60	√	√		0.18	0.18	0.18	0.18
SD	0.66	1.31	√	√		0.14	0.14	0.14	0.14
DS	0.58	1.32	√	√		0.15	0.15	0.15	0.15
DD	0.58	0.41	√	√		0.05	0.05	0.05	0.05
Total response						0.52	0.52	0.52	0.52
CSI									
SS	0.68	2.67	√	√	√	0.09	0.18	0.27	0.30
SD	0.68	2.06	√	√	√	0.07	0.14	0.21	0.23
DS	0.58	2.06	√	√	√	0.15	0.15	0.15	0.15
DD	0.58	0.20	√	√	√	0.05	0.05	0.05	0.05
Total response						0.36	0.52	0.68	0.73

[a]SS= Sires to breed sons; SD= Sires to breed dam; DS= Dams to breed sires; DD= Dams to breed dam.
[b]r_{IH} = Accuracy of selection.
[c]i= Selection intensity.
[d]MY= Milk yield; FY= Fat yield; PY= Protein yield.
[e]ΔG (σ_p)/year= Genetic response per year in standard deviation.
[f]r_g= Levels of genetic correlations.

Table 3. Genetic response in phenotypic standard deviation (ΔG (σ_p)/year) for breeding strategies assuming initial genetic differences between importing and exporting country and a genetic correlation of 0.60 between the two populations

	ΔG (σ_p)/year[a]		
Initial genetic differences	1.25	1.50	2.00
Strategy			
Closed progeny testing	0.52	0.52	0.52
Continuous semen importation	0.60	0.68	0.84

[a]ΔG (σ_p)/year= Genetic response per year in standard deviation.

SESSION VIII

SPECIAL SESSION

PRODUCING AND MARKETING CAMEL MILK –PROBLEMS AND POTENTIAL IN LAIKIPIA DISTRICT, KENYA

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ABSTRACT

Camels' milk has potential value as it can be produced in very arid environments where cows are unproductive. The objectives of the study were to investigate the economic potential of marketing camels' milk and to examine the main problems involved. It also has medicinal value and the potential to be marketed as a health food. A research herd of 77 to 200, mainly the Somali breed camels was managed along traditional lines for nine years in Laikipia District. Daily records were kept of all milk sold as well as other sources of income and expenditure. The results indicated that altogether about 134,100 litres of milk were sold worth over Kshs 4.1 million. Prices ranged from Kshs. 15 to 40 per litre. On average 59% of the total income from the herd was from the sale of milk. The overall value of the milk was equivalent to two thirds of the total expenditure on the herd. It was concluded that while milk is clearly an important component of the herd economy its production has experienced several problems. Initially, the small herd size in relation to the labour costs was uneconomical. Weather conditions, especially the El Nino rains, caused problems of disease and transport to market. Woodland and browse near Nanyuki, the primary collection point, has been depleted in the past decade and is no longer adequate for dairy camels. The launching of a Camel Dairy in Nanyuki has not been pro-poor and has favoured neither the producer nor the consumer. Only the Dairy itself appears to have benefited.

INTRODUCTION

With the rapid growth of human populations, there has been an intensification of land use in the arid and semi-arid lands (ASAL's) of the Greater Horn of Africa. The camel (*Camelus dromedarius*, Linnaeus), which had been neglected in the past, is now receiving increasing attention as a potential source of food for the people in the region (Field, 2005). Camels are able to tolerate water deprivation and so access pastures beyond the reach of more water-dependent livestock. They may continue lactating during drought, thereby providing nomadic pastoralists with a degree of food security when other livestock are unproductive. For the past thirty years the author has studied the traditional use of camels by nomads. Latterly, however, he has concentrated less on the use of camels for the provision of subsistence needs and more on demonstrating their economic value.

This paper summarizes camel milk production and its value to the producer as experienced with an experimental herd over the past nine years. It draws on these data to identify some of the problems encountered as well as the expected potential to the economy from camel milk production and marketing.

MATERIALS AND METHODS

A foundation herd of 77 camels was purchased by the author in 1996. They were principally of the Somali breed and Hoor type, although a few Turkana and Pakistan breed camels were included (Hulsebusch and Kaufmann, 2002). The latter, which had been imported for their milk potential, were used to crossbreed with the indigenous camels, so that gradually the herd composition has shifted to predominately Somali x Pakistan type. Numbers were increased by purchase during the first 18 months to about 150 camels and then by natural recruitment to a maximum of about 220 animals. Subsequently, some of these were culled or sold so that the herd now numbers about 140 animals.

For most of the time, the camels were managed in three separate herds, namely the lactating or dairy herd including a bull and suckling calves, a male herd, comprising all other males from weaning age and above, and a dry herd making up the rest. The dairy herd was usually kept within 20 km of Nanyuki so that fresh milk could be carried (either by camel back or bicycle as the volume of milk was small and did not justify the use of a vehicle) to the collecting point before being sent on by bus to Nairobi, which was the

main market. Except during wet periods, availability of browse was limited near to Nanyuki so the other two herds were kept up to 100 km away.

Monthly records of all income and expenditure were kept over the past nine years. Although there have been ten sources of income, in this paper for simplicity, only milk is considered in this study, although meat, live animals and eco-tourism comprise the other main sources of income. Likewise, there have been fifteen categories of expenditure, but it is only necessary here to summarize total expenditure with occasional reference to salaries, which were the main item. Further details are available in Field (2004a). The author is not a large land-owner and was obliged to rent browsing as and where available. During the nine years a total of 14 areas were rented, although five of these were for short periods of less than six months, usually because of drought.

RESULTS

The results of the income from and expenditure on the camel herd, are summarized in Table 1 for six eighteen-month periods commencing August 1996 and ending July 2005. The table also includes the price of the milk from which the volume marketed is estimated. Milk prices are those paid by an agent in Nanyuki who then transported it to the main market in Eastleigh, Nairobi where it was invariably sold at a considerably higher price to the consumer.

The milk was sold in raw unprocessed form although occasionally if there were delays in marketing it might be sold as fermented milk (*souza*) at a slightly reduced price since in that form it cannot be used to make tea. From the table, it can be seen that during the nine years the milk sold to Nanyuki agents was worth a total of Kshs. 4,156,745.00. The price of the milk increased from a low of Kshs.s 15.00 per litre in the beginning to a high of Kshs. 40.00 during dry seasons in the last three periods. The volume of milk sold is estimated to have totaled about 134,100 litres or about 41 litres per day, ranging from an average of 21 litres per day at the beginning to a peak of 61 litres per day in the fourth period and dropping to 36 litres per day in the last period.

When income from milk is expressed as a percentage of total income it averaged 59%, ranging from a low of 48% in the fifth period to a high of 70% in the fourth period. The extent to which milk sales can contribute to costs (expenditure) has also been calculated and averaged 67% overall with a low of 50% at the beginning and a high of 97% by the fourth quarter.

Table 1. Income and expenditure from camel milk (in KShs.) (August 1996 - July2005)

	18-month periods						
	1st	2nd	3rd	4th	5th	6th	Total
Sale of milk	180,565	352,952	893,952	1,163,345	831,656	734,275	4,156,745
Price per litre	15-17	20-25	22-35	30-40	32.50-40	35-40	
Litres sold	11,285	15,687	31,367	33,328	22,942	19,581	134,100
Litres per day	21	29	58	61	42	36	41
Total income	365,784	636,528	1,393,465	1,667,811	1,719,255	1,253,195	7,036,038
Milk as % of total of income	49.4	55.4	64.1	69.7	48.4	58.6	59
Total expenditure	361,847	627,738	1,051,871	1,197,434	1,440,551	1,494,018	6,173,459
Milk as % of expenditure	49.9	56.2	85	97.1	57.7	49.1	67.3

DISCUSSION

The production and marketing of camel milk has encountered several problems, which should be taken into account by anyone planning to enter the business. They may be illustrated by referring to the information in Table 1.

Production

Camels do not produce large volumes of milk for the market like cattle. They average about 3 litres per day, but usually continue for a year or more and are not seriously affected by dry seasons. During the first three years (periods one and two in Table 1) the camels produced less than at any other time. This is explained by the smaller herd size, with a maximum of ten being milked, compared with a maximum of 25 from the second period onwards. This was followed by exceptionally wet conditions, associated with the El Nino effect, which prevailed for much of the second period. Camels do not thrive in muddy conditions and diseases such as trypanosomosis are more prevalent. Furthermore, the latter disease was accompanied by a spate of abortions, which led to fewer animals lactating. Meanwhile, access to the market was more difficult due to flooding. During the last and most recent period there were significant times when the camels were not milked, which is explained in the marketing section.

Another important constraint to production has been the destruction of the woodlands for charcoal in the vicinity of Nanyuki town. Perennial woody vegetation comprises the main diet of camels and its destruction for charcoal and to a lesser extent firewood and browse for goats has had a negative effect on camel milk production. This

is because the dairy herd provides a peri-urban milk supply and as such must remain within 20 km of the market and it is this zone, which is being depleted most for charcoal.

Marketing

For all but the last period, milk from the herd was marketed wholesale through agents to the main outlet among mainly Somali people living in Eastleigh, Nairobi. During the first two periods, a relatively small amount of milk was retailed directly to consumers in Nanyuki and in the third, fourth and fifth periods through restaurants run by the authors wife in Nanyuki. Here it should be noted that retailers in Eastleigh may market fresh camel milk for as much as Ksh 100.00 per litre in dry seasons and thus make considerable profits for relatively little investment.

During 2002, the author was asked to evaluate a camel milk dairy in Puntland, Somalia (UNA, 2003). Major constraints in milk supply were experienced due to a prolonged drought, which had caused camels to be moved as far as 300 km. from the dairy in search of food, and much of the milk was being used for subsistence. In contrast, it was felt that in Laikipia district in Kenya, camel milk supply would be less affected by drought as there is a significant number of camels being kept by large-scale ranchers who do not depend on their milk for subsistence during drought. The author then drew up a proposal for the first Kenya Camel Dairy based on his observations in Puntland (Field, 2004b). It was presented to the Kenya Camel Association (KCA) for comment and approval and eventually one of the members found a German entrepreneur to provide initial funding. Later additional funds were obtained from German Technical Co-operation (GTZ) and United Kingdom's Department for International Development (DFID). A Memorandum of Understanding was signed between the Dairy and the KCA whose members were to be the sole suppliers of camel milk. Several training workshops were held for milk producers and KCA Committee members. After many delays, the Dairy eventually started production on a small scale in April 2005 using milk from the author and others. Production was, however, sporadic and after five months the author ceased to supply the Dairy as it was not pro-poor, prices being neither producer nor consumer friendly.

Milk was purchased from producers at a fixed price of Ksh 40.00 per litre, pasteurized and bottled. It was then available for purchase at the Nanyuki Dairy gate for Ksh 250.00 per litre, which was equivalent to an increase of 625%! After transportation

to Nairobi the same milk was being retailed at Ksh 360.00 per litre, a total increase of 900%! The purchase price of raw milk offered at the dairy gate is the same as the author was receiving in dry seasons as long ago as September 2001, yet production costs have increased by more than 25%. Meanwhile, the retail price is only affordable by the very rich in Nairobi. The only beneficiary from the dairy is therefore its operator. Furthermore, camel milk, which has special health properties, is being made unaffordable to the very people who used to depend on it, especially during drought and famine.

During the start-up phase of the Nanyuki Dairy, agents suspected that producers would supply direct to the Dairy thereby sidelining them. The majority moved away to Isiolo to continue their traditional business with other suppliers. The author then had to negotiate with the one remaining agent who in effect had a monopoly of the milk from all those not willing to supply the Dairy. This has prolonged the suppression of fair prices for the producer and explains why there were lengthy periods when camels were not milked while negotiations were underway.

CONCLUSIONS

Camel milk production and marketing may be profitable, but currently involves a significant proportion of the profits being taken by middlemen and entrepreneurs. Milk production is subject to a number of variables. The rising cost of labour accounts for 60% of the expenses while veterinary drugs, transport and grazing fees, in that order, are also important. The general decline of peri-urban forage is having a negative effect on production and should be countered if the enterprise is to flourish. Camels, however, compete very little with cattle and can be kept together, thereby boosting the overall productivity of semi-arid rangelands.

Experiences from the first camel milk dairy in Kenya suggest that if care is not taken in the planning and execution, such enterprises will alienate the producers and so eventually fail. Producers should gain the initiative by the formation of a cooperative/ society to establish fair prices and thus overcome exploitation. This should probably be one of the functions of the KCA. Future dairies planned for other parts of the camels' range (e.g., Garissa) should take note of these pitfalls if they are to succeed in a sustainable manner.

In arid rangelands it has been shown that camels produce six times more milk than cattle raised under similar conditions (Field and Simpkin, 1985). This potential is

further enhanced when the high vitamin C content and therapeutic value of camels' milk is taken into consideration. Recent studies in India (Agrawal et al., 2002) have shown that camels' milk can be beneficial in the management of type 1 diabetes. Similar trials using type 2 diabetics and cows milk as a blind control are currently being conducted by the Kenya Medical Research Institute (KEMRI) and the KCA.

ACKNOWLEDGEMENTS

I wish to thank all those Landowners who have allowed the camels used in this work to browse on their land. I also acknowledge the dedicated work of the camel herdsmen and their supervisors over the nine year reported. Many members of the Kenya Camel Association have provided advice and support over the years, for which I am most grateful.

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THE POTENTIAL OF USING STAKEHOLDERS IN TECHNOLOGY DISSEMINATION IN THE NORTH RIFT VALLEY PROVINCE OF KENYA

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ABSTRACT

The Kenya Agricultural Research Institute (KARI) formulated a new initiative, the Agricultural Technology and Information Response Initiative (ATIRI) whose main goal was to work with partners to enhance farmers' information and technology demands. The purpose of the initiative was to catalyze the dissemination process by bringing together community based organizations (CBOs), Governmental and Non-Governmental Organizations (NGOs) extension services and farmers to make demands on KARI. This study was therefore designed to identify key stakeholders, their roles and their technical and financial ability, and assess their potential contribution to ATIRI. The ultimate goal was to strengthen the link between KARI and other service providers in agricultural technology dissemination. Data from 19 willing stakeholders in the National Agricultural Research Centre (NARC), Kitale mandate region was collected using a structured questionnaire and analyzed using the SPSS analysis package. The majority of the stakeholders are local NGOs or church-based organizations with major objectives related to technology dissemination and capacity building. The stakeholders were also interested in the arresting of environmental degradation with some involved in distributing relief food and a few in provision of health. The rest of the objectives were broadly classified as poverty eradication. The main obstacles to attaining the set objectives by the stakeholders were inappropriate technologies and approaches. Major hindrances to technology dissemination were related to funds, poor administration and poor approaches to technology dissemination. Poor marketing strategies and socio-cultural barriers were also listed among the hindrances. Some linkages were indicated among various

stakeholders. Suggestions for strengthening linkages between the stakeholders included joint planning of activities with flexible plans, seeking multiple sources of funds instead of depending on one source, enhancing participation and making communication more effective. Most stakeholders suggested socio-economics as the area in which they would like to see more collaboration with KARI. Most of the information exchange was done through workshops, meetings, letters and other advertisement channels. Results from the stakeholder analysis indicated that the aims and goals of the stakeholders were in tandem with the objective of ATIRI, hence possibility of forming strong partnerships exist. Identified constraints that weaken the researcher-collaborator linkages should be addressed.

INRODUCTION

Several technologies have been developed in KARI centers over the years with minimal adoption. In order for the developed technologies to be adopted, there is need to involve various stakeholders in technology transfer. The key stakeholders in technology dissemination have for a long time remained to be the Governmental extension services. However, the high farmer: extension staff ratios as well as reduced budgets have become constraints over the years, resulting in poor adoption of agricultural technologies.

KARI initiated the ATIRI project in 2000 to catalyze the technology dissemination process through CBOs and other stakeholders by instituting a paradigm shift from the 'supply model' to a 'demand model' (Kamau et al., 2000). At inception, it was realized that KARI had neither the mandate nor the capacity to engage in conventional extension necessitating collaboration with intermediary partners. The main collaborators so far have been extension services provided by the ministries involved in Agriculture besides a few NGOs. The response to the initiative has been overwhelming. At the time of this study, there were 13 funded ATIRI activities in the NARC Kitale mandate region. In addition, 36 proposals had been approved by the Regional Steering Committee (RSC) and a further 66 proposals were awaiting review by the RSC. This response created a more urgent need to formalize partnerships with existing stakeholders in the technology dissemination and up-scaling under ATIRI. However, information on stakeholders was not available. This study was therefore designed to identify key stakeholders, their roles, and their technical and financial abilities, in order to assess their potential involvement in ATIRI. The ultimate goal was to strengthen the linkages

between KARI and other service providers in agricultural technology dissemination (KARI, 2000; KARI, 2001).

METHODOLOGY

An inventory of stakeholders was done in October 2003 and contacts initiated through letters, telephone and personal visits to the respective stakeholders and an agreed date for interviews set. Data was collected using a structured questionnaire administered to willing stakeholders. The interviewees were single individuals or groups whenever responses needed consultation. Some of the institutions visited requested time to go through the questionnaire in advance before responding. Data was analyzed using the SPSS program and descriptive statistics of means, range and proportions obtained.

RESULTS

General Features of Stakeholders

The majority (76%) of respondents were males while 24% were females. Males interviewed held at least one of the posts in the management while 20% of the females interviewed had roles of manager. All secretaries (100%) were females. The majority of the stakeholders (65 %) were local NGOs or church-based organizations operating within their locality. Some, however, operated in several districts within the western Kenya region.

The majority of the stakeholder objectives were related to disseminating technologies (27%), capacity building (25%) and arresting environmental degradation (15%). Some stakeholders (8%), mainly NGOs, had the role of distributing relief food. Due to HIV/AIDS pandemic some of the organization objectives were geared to human health (8%). The rest of objectives were broadly classified as poverty eradication (8%). All the stakeholders covered in this study had multiple objectives covering at least one of the several areas stated above. The main obstacles to attaining the set objectives were inappropriate technologies and approaches (40%). The other obstacles were socio-cultural barriers, poor funding and poor planning on the part of the stakeholders in that order.

Constraints of stakeholders

Financial constraints were mainly as a result of inadequate funds (47%), poor cash flow (18%) poor management (6%) and input price increases (6%). In terms of knowledge, most (59%) were constrained by lack of adequately qualified technical staff. Other constraints were limited land (43%), seasonality of agricultural produce (14%) high level of illiteracy among the clients (14%), and competition among stakeholders (14%). Among the suggested solutions to the constraints were seeking for many alternative sources of funding to address financial constraints (26%) and collaborate with other institutions to access knowledge (21%).

Type of Technologies and dissemination by stakeholders

Technologies disseminated to farmers were mainly (30 %) related to livestock production (Table 1). The listed fields included up-grading of dairy cattle, bee keeping, honey processing, dairy cattle feeding, poultry production and zero-grazing. Crop related technologies were addressed by 28 % of the technologies disseminated to farmers. Components of crop technologies were vegetables, fruits, nursery management, appropriate maize varieties, bean production, groundnut production, high protein in maize, sericulture, disease control, and grain storage. Soil and water management and conservation technologies constituted 23 % of all the technologies listed by the stakeholders. These included dry land farming, soil fertility amendments, organic farming, soil testing, soil erosion control, and water catchments conservation. Other technologies were agro-forestry and socio-economic services (provision of credit). Most of the stakeholders targeted farmer groups and community based organizations (37%) as well as individual large or small scale farmers (26%). Also targeted were agro-pastoral communities including specific livestock farmers (15%), companies and government ministries (19%) as well as organizations for marketing of inputs and outputs (4%).

Stakeholders did not have adequate information about some of the technologies they disseminate to their clients (Table 2). Technologies demanded by clients but the stakeholders did not feel competent enough to deal with were crop related (58%), livestock related (23%), soil and water (15%), forages (8%), and home economics (3%). Technologies with limited information but required for wider dissemination were crop related (31%), soil related (24%), livestock related (24%) and agro forestry (3%). It was

felt too that some of the technologies in the fields of soil and water conservation (28%), crop production (25%) and livestock production (21%) needed improvements in order to be more effective and acceptable (Table 2).

The lead methods of technology dissemination used by stakeholders were group meetings (28%), tours and exchange visits (24%), demonstrations (15%) and training/visitation (15%). Other methods, but in minimal proportions, were mass media, conventional extension and agricultural shows. Individual farm visits were the least employed methods. The major hindrances to technology dissemination were related to availability of funds (27%), poor administration (27%) and poor approaches to technology dissemination (13%). Poor marketing strategies and socio-cultural barriers accounted for 13% and 7% respectively. The major constraints to scaling up of technologies after the initial contact with target groups were financial (30%), lack of sufficiently qualified technical staff (30%), poor administration (17%) poor information flow (13%) and socio-cultural barriers (10%).

Strengths and Weakness of Technology Users

Some of the strong points for technology users were willingness to change and adopt technologies (50%), ownership of the project (14%), willingness to share the cost (17%) and their ability to experiment. However, some of the weak points of users were; lack of innovativeness (26%), lack of credit to adopt in new technologies (4%) and high illiteracy levels (10%). Some of the suggested solution to the limitations included financial support (35%), community empowerment (23%), training and giving backstopping services (15%). Other suggested solutions are related to the socio-cultural values.

Collaboration of stakeholders with other institutions

Close to 30% of the respondents stated that they collaborate with the Ministries of Agriculture and Livestock Development (Table 3). For all the stakeholders, collaboration with Non-governmental Organizations (NGOs) was 19%, with Agribusiness companies 11% and with Vi Agro-forestry Project 9%. Some of the stakeholders work with the Anglican Church (4%) and others with individual farmers or farmer groups (4%). Also mentioned were different government ministries, departments and parastatal organizations.

Suggestions to strengthen the linkage between collaborators included; joint planning activities with flexible plans (35%), seeking alternative sources of funds instead of depending on one source (15%), enhanced participation (15%) and effective communication (12%). Other suggestions included were; jointly making follow-ups (4%) and good flow of funds (8%). Mechanisms for improving collaboration among stakeholders were joint meetings and field activities (55%), training NGO committees (22%), coordination of NGOs at regional level (17%) and financial support (6%). It was also felt collaboration with ATIRI could be improved by joint regular meetings (61%), effective communication (23%), provision of appropriate agricultural information (8%) and sharing of personnel and transport (8%). Potential areas for collaboration and partnership were livestock related (15%), crop related (11%), soil and water (8%) socio-economics (57%) and others (12%).

Among the collaborators most of the information exchange is done through workshops and meetings (32%) and letters and other advertisement methods (25%). Other methods included were; e-mail and telephone (21%), technical reports (7%) and field days/demonstrations (7%). The main communication medium among with the clients was meetings/workshops/seminars (21%). Others were; letters (10%), personal visits (10%) and exchange visits (10%).

Potential for collaboration with KARI/ATIRI

Stakeholders suggested some arrangements and/or mechanisms for collaboration with KARI as presented in Table 5. These included joint meetings (53%), joint training sessions for farmers (24%), and joint surveys (12%) among others. A large majority were willing to provide staff (86%) and transport (71%) for collaborative activities (Table 5). Additionally, 55% would be able to contribute towards operating expenses in working with ATIRI, though 27% said they were not able to contribute anything. A large majority (79%) of the stakeholders were in a position to provide technical backstopping for joint activities. Other contributions in working with ATIRI were listed as computer facilities, telephone and equipment (40%) and community mobilization (10%). Some of the stakeholders only stated whether contributions were available (30%) or not (20%) without being specific.

DISCUSSION

The results show that females are involved in leadership positions in the organizations of stakeholders. Generally the organization objectives covered all areas of human life. However, the extent of the impact to the community should be analyzed. A look at the technologies that stakeholders extend to farmers shows that crops and livestock are given almost the same priority and that over 90 % of the times priority is given to technologies that have a direct effect on agricultural productivity (Table 1). More emphasis is given to technology dissemination, which is in line with what ATIRI is doing. Thus the objectives of ATIRI can easily be addressed through the stakeholders. In fact the readiness of the stakeholders to work with KARI in technology transfer is proof of this. Since the key players in the agricultural technology development and transfer already collaborate, there is need to strengthen the collaborative links for the befit of the farmers.

CONCLUSIONS

From this stakeholder analysis, it is obvious that the aims and goals of the stakeholder institutions are in tandem with the objective of ATIRI. Therefore there is potential for the formation of strong partnerships between stakeholders and KARI/ATIRI in the implementation of ATIRI activities. This in turn creates potential for enhanced technology dissemination and subsequent adoption. The stakeholders are willing and ready to provide and/or share their resources in the implementation of ATIRI activities. This will relieve the already overburdened extension staff and allow KARI scientists to concentrate on addressing problems encountered during technology implementation. The stakeholder assessment of clients shows strong points which ATIRI should exploit, and weak points which need to be addressed if technology adoption will be enhanced.

RECOMMENDATIONS

- The Constraints that weaken the Research-collaborator links should be addressed if aims/objectives of ATIRI are to be achieved.
- Joint planning and implementation of activities with stakeholders should be able to resolve some of the suspicions and conflicts among stakeholder/users.
- Technical backstopping, alternative sources of funding and timely and efficient commutation among the ATIRI clients will be good for the project.

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Table 1: Technologies the stakeholders are utilizing for extension

Technologies	% of Respondents
Soil and water (dry land farming, soil amendment, organic farming, soil testing, soil erosion, water catchments)	23.3
Crops (vegetables, fruits, nursery management, maize varieties, bean production, high protein in maize, ground nut production, sericulture, disease, storage)	27.9
Livestock production (up grading, bee keeping, honey processing, dairy feeding, poultry production, zero-grazing)	30.2
Socio-economic services (e.g. Credit)	2.3
Agro-forestry	7.0
Others (Home economics -kitchen garden, solar energy)	9.3
Total	100

Table 2: Demanded technologies but lack enough information

Category	Technologies with limited information (n=17)		
	Demanded	For wider coverage	For improvement
Soil and water (dry land farming, soil amendment, organic farming, soil testing, soil erosion, water catchments)	15.0	24.1	28.1
Livestock production (up grading, bee keeping, honey processing, dairy feeding, poultry production, zero-grazing, ground nut production)	22.5	24.1	21.8
Forages (high altitude forage types	7.5	3.4	12.5
Crops (vegetables, fruits, nursery management, maize varieties, bean production, high protein in maize, sericulture, disease, storage)	57.5	31.0	25.0
Agro-forestry	0	3.4	6.3
Home economics (kitchen garden, solar energy)	2.5	3.4	3.1

Table 3: Collaborations of stakeholders with other institutions

Collaborator	% of respondent
Churches (ACK, Catholic)	4.3
Ministries of Agriculture and livestock development	29.8
Individual farmer plus Farmer groups	4.3
Ministry of Water and Natural Resources	2.1
VI Agro-forestry	8.5
Ministry of Culture and Social Services	2.1
Ministry of Health	2.1
Co-operative Bank	2.1
Agri- Business Companies (eg seed companies)	10.6
Kenya Wildlife Service (KWS)	2.1
Local Administration	4.3
CIAT	2.1
Non Governmental Organization (NGOs) and CBOs	19.1
Agricultural Finance Cooperation (AFC)	2.1
Others	4.3

Table 4: Areas for Collaboration and partnership with other institutions

Area	% of Respondents (n=17)
LIVESTOCK	
Pasture	3.5
Breeding (A I, Bull scheme)	8.8
Disease control	0
Bee keeping	1.8

Area	% of Respondents (n=17)
CROP	
Horticulture	3.5
Crop diversity	5.3
Pest/Disease control	1.8
SOIL AND WATER	
Dry land farming	1.8
Soil sampling and testing	1.8
Irrigation	1.8
Soil amendments	1.8
SOCIO-ECONOMICS	
Technology dissemination	24.6
Capacity building	5.3
Input and output markets	3.5
Credit/financial assistance	8.8
Trainings	14.0
OTHERS	
Security	12.3

Table 5: Collaboration of stakeholders with ATIRI

	% of Respondents
Arrangements/mechanism (n=17)	
Joint group meetings	52.9
Joint Surveys	11.8
Joint Training of farmers	23.5
Funding of farmers groups	5.9
Others	5.9
Human Recourse contribution(n=14)	
Avail Staff	85.7
Pay Salary/ allowance for staff	7.1
Staff Not available	7.1
Transport contribution (n=14)	
Fully available transport	71.4
Cost shared transport	14.3
Not given	14.3
Operating Expenses contribution (n=11)	
Cost share	18.1
Not available	27.3
Available	54.5
Technical Backstopping contribution (n=14)	
Available	78.6
Limited	14.3
Not available	7.1
Other Contributions (n=10)	
Community mobilization	10.0
Computer, Phone & other equipment	40.0
Available	30.0
Not available	20.0