A survey of agricultural production, livestock disease treatment and vaccination in rural farming communities in two provinces of Kenya.

Report of a survey carried out for GALVmed by Biotechnology Trust Africa

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Abstract

A total of 558 farmers were interviewed in the districts of Kakamega and Machakos in Kenya during 2007–08 regarding their family circumstances and agricultural activities. The first part of the survey focused on demographics, agricultural production and marketing. Approximately 60% were in the age range 20 to 49 while almost 40% were more than 49 years old and 60% of respondents were female. They had spent a variable length of time in farming from <10 to more than 40 years. The average size of farm holding was between 0.4 and 2.0 hectares and almost all respondents were involved in mixed farming (crops and livestock). Livestock species discussed included poultry, cattle and small ruminants and these were kept in a range of combinations. Most poultry keepers had between 1 and 20 chickens. Crops included maize, beans and cowpeas and a range of others including horticultural activities. Most farms had to provide supplementary feed to livestock which included hay, napier grass and maize stalks for ruminants and flour residue, maize and commercial feeds for poultry. Respondents used eggs and poultry meat for domestic consumption and surpluses were sold either from the house or at market, sometimes involving an intermediate trader. Additional income from produce sales was used to purchase domestic items including food and fuel.

The second part of the study focused on livestock disease and its recognition and management. Most respondents regarded East Coast fever (ECF), contagious caprine pleuropneumonia (CCPP) and

Newcastle Disease (ND) as the most important diseases of cattle, small ruminants and chickens respectively. There was a high degree of awareness and past use of vaccines and treatments for a number of cattle diseases and these activities were most likely to be carried out by a veterinarian. There was less use of vaccines in small ruminants and chickens but disease treatments were commonly used. Poultry vaccines were purchased from veterinarians and from Agrovet shops. Less than half the respondents believed vaccines to be effective but few reported suspected ineffective vaccinations to a veterinary officer. Most respondents (Kakamega only) were willing to pay up to 5Ksh, 10Ksh and 20Ksh for chicken, small ruminant and cattle vaccines respectively. Respondents preferred the administration of poultry vaccines to be via drinking water and most preferred vaccination on an individual farm basis rather than group vaccination activities. Almost all expressed the need for training in poultry vaccination. Respondents expressed a preference for vaccine pack sizes of less than 50 doses and for the availability of thermo-tolerant vaccines.

Introduction

Kenya with a population of approximately 38.61 million (Population and Housing Census 2009), has the largest economy of the east and central African countries. Agriculture is the second largest industry after the service sector, accounting for approximately 25% of the GDP of approximately $58 billion (Omiti and Okuthe, 2009). About 80% of the Kenyan population live in rural areas and derive their livelihood from agriculture. Even in urban areas a high proportion of the population make a living from agricultural related activities. Small-scale farmers dominate Kenya's agriculture, with this sub-sector accounting for about 75% of total agricultural output. Small-scale farmers produce a range of crops including the major cash crops; coffee, tea, maize and horticultural produce and also a range of livestock including poultry, cattle, sheep and goats. The livestock sector contributes about 38% to agricultural GDP (Irungu and Kimani, 2008) and 12% to national GDP overall (FAO, 2005) of which indigenous poultry (*Gallus gallus*) are the most abundant (see Nyange, 2000).

Thus livestock are important in supporting the livelihoods of poor farmers in Kenya and the same is true throughout the developing world (McDermott *et al*., 1999; FAO, 2002; Perry and Sones, 2007). Furthermore animal disease and veterinary public-health problems constitute a major constraint to livestock production and safe utilisation of animal products worldwide (FAO, 2002; Domenech *et al*., 2006). Large sums of money have been invested by governments, non-governmental organisations (NGO's) and other donors into research and methods of control of livestock disease, however there are still major gaps in our ability to control a large number of these diseases (Perry and Grace, 2009). It is generally recognised that there is a lack of availability of and access to veterinary medicines and vaccines in many developing countries, largely because the US and European based animal health industries do not believe there is adequate potential for return on investment (Anon, 2006) and that this is often due to lack of supply chains at the local level (Delgado and Narrod, 2002).

The Global Alliance for Livestock Veterinary Medicines (GALVmed; www.galvmed.org) was established in 2004 as a not-for-profit organisation to develop veterinary medicines for livestock where the market is too small or fragmented for the commercial animal health industry to invest. GALVmed has prioritised livestock diseases in developing countries depending on perceived unmet need, irrespective of species.

In order to make strategic priority decisions it was important for GALVmed to understand better the identity, attitudes and needs of the potential end users of veterinary medicines i.e. the village farmer. It is well documented that small-scale farming tends to be mixed in terms of both crops and livestock. Thus target diseases for GALVmed include those of poultry, small ruminants and cattle. Whilst information is available on the identity and causes of livestock disease in these communities (e.g. Domenech *et al*., 2006), less is known about the farmers' attitudes to them and their willingness to use veterinary medicines if they are available.

For example, Newcastle Disease (ND) is the most prevalent and fatal disease of poultry in Kenya (Kingori *et al*., 2010) and thus, a major key unmet need initially identified by GALVmed was for a sustainable supply of thermo-tolerant ND vaccine. Although such vaccines have been in use in a number of countries (Bensink and Spradbrow, 1999) there is a continuing need for standardisation and sustained production together with sustained delivery to Sector 4 (village or backyard) production, as defined by FAO (2007) and ILRI (2007). Similarly information was also lacking on production practice, constraints and diseases of other species in this sector.

Therefore the overall objective of this study was to characterise the status of smallholder livestock production systems in Kenya, in order to generate information to assist in the design and targeting of veterinary medicines for rural livestock keepers. The first part of the study focused on the demographics and the contribution of different crops and livestock to household income and the second part concentrated on livestock disease recognition and its management.

Materials and methods

Two counties in different areas of Kenya were selected for the project. Firstly Kakamega is in western Kenya lying about 30 km north of the Equator. It is the provincial headquarters of Western Province. It had a population of 73,607 (2009 census) and is 52 km north of Kisumu which is the third largest city in Kenya. Secondly, Machakos is 64 kilometres southeast of Nairobi. It is the capital of the Machakos District in Eastern Province of Kenya. Machakos is a major rural centre and also a satellite town due to its proximity to Nairobi. Its population is rapidly growing and was 192,117 in 2009. Machakos has a number of financial institutions, administrative offices, good road infrastructure and town planning.

This study was conducted on behalf of GALVmed by Biotechnology Africa (BTA) in collaboration with the Ministry of Livestock Development and Fisheries and the Ministry of Agriculture between December 2007 and April 2008. Background preparation included ethical approval for the project, meeting with the stakeholders, discussing the study logistics and general planning. This included training researchers on questionnaire administration at research sites and also involved community heads and local guides. The field work began with communication and advocacy meetings conducted with the assistance of the provincial administration. It was followed by face to face interviews with a cross section of respondents in the farming community.

Results

The two counties were originally chosen to represent two distinct demographic areas. Kakamega comprises largely rural communities whereas Machakos is more urbanised and consequently differences in demographics, attitudes and practices were anticipated. However such differences did not emerge clearly from the survey and therefore no attempt has been made to analyse statistically for significant differences between the two selected districts.

The demographic background of the respondents for the two districts are summarised in Table 1. Of the total 558 respondents 56% were in Kakamega and 44% in Machakos. The vast majority of the respondents were the farm owner or the spouse of the farm owner. There were more female than male respondents and this difference was most marked in Machakos. There was a broad age range of respondents but 58 and 65% were between the ages of 20 and 49 years in Kakamega and Machakos respectively and 41 and 35% were older than 49. Around 60% of respondents had been educated at least to primary level and around 95% were married. Between 55 and 58% of the families were between 6 and 10 members in size.

Table I: Demographic characteristics of the respondents by district.

Characteristics	Kakamega	Machakos
Total numbers of respondents	313 (56%)	245 (44%)
	Percentage of respondents	
Sex of respondents		
Male	45.0	30.0
Female	55.0	70.0
Age of respondents		
<20	1.0	0
20–29	9.5	11.1
30–39	28.0	30.9
40–49	20.4	23.0
>49	41.0	34.9
Educated to primary level	58.0	63.0
Married respondents	97.0	93.0
Number of members in respondent's family		
1–5	31.1	39.4
6–10	58.5	54.8
>10	10.4	5.8
Number of males per family unit		
1–3	62.5	63.8
4–6	31.1	31.9
>9	6.4	3.8
Number of females per family unit		
1–3	64.3	64.1
4–6	32.3	32.0
>9	3.4	3.9

An analysis of the farming employment of the respondents and their families is shown in Table 2. The vast majority of the respondents were the farm owner (68–77%) or the spouse (22–24%) of the farm owner and around 95% were in full-time farming. The length of time that the respondents had been in farming varied from 1–10 years (around 30%) to more than 40 years (17–19%). In 71–77% of households between 1 and 3 family members worked full time, but most of the family members (69 and 87%) were not permanently employed on the farm.

Table 2: Analysis of farming employment pattern of respondents' families

Characteristics	Percentage of respondents	
	Kakamega	**Machakos**
Farm owners	77.0	68.0
Spouse	22.0	24.0
In full time farming	95.0	94.0
Length of time in farming (years)		
1–10	32.1	26.1
11–20	25.6	29.8
21–40	23.1	27.3
>40	19.2	16.8
Number of family working full time		
0	17.9	10.7
1–3	70.7	76.9
4–6	10.7	10.7
7–9	0.7	1.7
Number of family permanently employed		
0	86.7	69.0
1–3	13.3	29.3
4–6	0	1.7

The main agricultural activities of the respondent farmers are summarised in Table 3. The most common size of holding was between 0.4 and 2.0 hectares (50 and 58%). Almost all respondents (>97%) were engaged in mixed farming i.e. production of crops and livestock.

Of those who kept cattle, around 76% kept between 1 and 5 head. Similarly of those who kept small ruminants approximately 75% kept between 1 and 10 animals. Most farmers (around 90–95%) who kept chickens had between 1 and 20 birds. In terms of combinations of livestock species, 60.1% of farms in Kakamega kept cattle, small ruminants and poultry compared to 73.6% in Machakos.

In terms of crops, almost all respondents grew a combination of maize, beans and cowpeas. However a wide variety of additional crops were also grown; the most common combinations are shown in Table 3.

Table 3: Agricultural activities of the two districts

Characteristics	Percentage of respondents	
	Kakamega	**Machakos**
Size of holding		
<0.4ha	11.4	15.3
0.4–2ha	57.5	50.0
2–4ha	15.7	18.6
>4ha	15.4	15.7
Involved in mixed farming	99.0	97.0
Of those keeping animals:		
Number of cattle		
1–5	75.7	76.1
6–10	22.7	20.9
>10	1.6	3.0
Small ruminants		
1–5	47.5	39.0
6–10	27.9	34.5
11–15	17.5	16.1
>15	7.1	10.4
Poultry		
1–5	18.7	19.1
6–10	24.9	24.4
11–15	19.7	16.0
16–20	20.3	18.7
>20	16.4	21.8
Combinations of Livestock species kept by individual households		
Poultry only	7.3	5.4
Small ruminants only	2.0	0.8
Small ruminants and poultry	11.6	11.7
Cattle, small ruminants and poultry	60.1	73.6
Combinations of crops grown by individual households (In addition to Beans, Cowpea and Maize)		
Pigeon peas, mangoes, green grams	40.3	60.7
Vegetables, pigeon peas	4.2	10.7
Bananas, vegetables, horticulture (flowers and fresh fruit)	41.0	13.9

The major reported difficulty in livestock management was in providing sufficient feed (Table 4) and consequently a wide variety of household and crop residues were utilised as feed supplements.

Table 4: Supplementary feed usage by livestock farmers

Characteristics	Percentage of respondents	
	Kakamega	**Machakos**
Respondents reporting problems with feeding livestock		
Ruminants	88.4	77.8
Poultry	89.0	61.6
Supplementary feeds used		
Ruminants:		
Hay	8.8	21.5
Napier grass	34.4	13.7
Maize stalks	45.1	34.7
Poultry		
Flour remnants	54.3	20.5
Maize germ	34.6	44.9
Commercial feeds	0	6.3

Table 5 shows marketing data on farm products in the two districts. Respondents used their eggs for home consumption and for sale (data not quantified). About 50% of respondents preferred to sell their eggs at market rather than from home (47–56%), and about 46% of respondents preferred to sell their poultry at market rather than from home. Around 32–36% kept eggs for home consumption as well as selling them. Respondents (85%) believed that low prices/exploitation by traders were the major problems encountered by farmers in marketing their farm products. The vast majority (approximately 90%) of respondents used income from sale of surplus produce for domestic purchases including oil and food items.

Cattle are by far the most lucrative in terms of sales with a potential annual income value of 11,000 to 20,000Ksh. However this applied to relatively few farmers (approximately 28%) compared to those

earning income from small ruminant, poultry and crop production. In contrast, both poultry keeping and crop production are estimated to provide 1,000–10,000Ksh in annual income but for a larger proportion (approximately 57–83%) of respondents. Approximately 60% of respondents claimed that the individual value of their medium and large chicken was 100–300Ksh.

Table 5: Some sale and income characteristics for farm produce

Characteristics	**Percentage of respondents**	
	Kakamega	**Machakos**
Respondents' utilisation of eggs		
Home consumption	36.4	31.8
Sale from home	6.2	4.1
Sale at market	56.1	46.7
Sale from home and at market	1.3	10.7
Respondents' preferred places for sales of poultry		
Home	27.9	13.6
Market	45.9	46.5
Sale from home and at market	26.2	39.9
Problems reported in selling farm products		
Low prices/exploitation by traders	88.7	82.5
Annual income in Ksh by species		
Cattle (11,000–20,000)	28.1	27.8
Small ruminants (1000–10,000)	66.5	67.8
Poultry (1000–10,000)	87.5	65.6
Crops (1000–10,000)	80.7	49.3
Average cost of chickens sold in terms of size (Ksh)		
Small (50–100)	43.4	62.1
Medium (101–200)	58.2	72.5
Large (201–300)	64.2	58.8
Use of income from sale of chickens		
Domestic purposes e.g. oil, food, sugar, tea	94.6	94.9

The respondents' perceptions of the most important livestock diseases are shown in Table 6. For cattle approximately 60% reported East Coast Fever (ECF) to be the most important with anaplasmosis, foot

and mouth disease, contagious bovine pleuropneumonia (CBPP), black quarter and gastro-intestinal parasites also being regarded as important. For small ruminants contagious caprine pleuropneumonia (CCPP) was reported as the most important by 64–73% of respondents, with anaplasmosis also being reported as important. For poultry Newcastle Disease (ND) was reported by around 95% of respondents as being most important with coccidiosis, fowl pox and fowl typhoid also being regarded as important.

Table 6: Farmers' perception of the most important livestock diseases

Characteristics	**Percentage of respondents**	
	Kakamega	**Machakos**
Farmers' perception of the most important single disease in cattle		
East Coast fever (ECF)	56.7	66.3
Farmers' perception of the most important single disease in small ruminants		
Contagious caprine pleuropneumonia (CCPP)	73.3	63.8
Farmers' perception of the most important single disease in chicken		
Newcastle Disease (ND)	95.8	94.5

Aspects of the management of cattle disease by respondent farmers are shown in Table 7. This shows that most farmers use vaccines and treatments for cattle disease. Vaccines are used against several cattle diseases but only by a minority of farmers for each specific disease. A number of diseases are treated as they occur, including ECF, anaplasmosis and parasites. Cattle vaccination is largely carried out by veterinarians. Cattle treatments for disease are mostly administered by veteriarians or by para-veterinarians.

Table 7: Vaccination and treatment of cattle

Activity	Percentage of respondents	
	Kakamega	**Machakos**
Farmers use of:		
Vaccines to prevent diseases in cattle	67.0	69.0
Treatments for diseases in cattle	74.0	79.0
Farmers who have vaccinated against:		
ECF	28.1	13.4
Blackquarter	17.5	10.0
Foot and mouth disease	7.5	12.4
Lumpy skin disease	6.2	8.6
Rift Valley fever	5.5	5.3
Anthrax	4.8	20.1
Farmers who have treated for these diseases:		
ECF	10.0	27.4
Anaplasmosis	33.1	29.8
Parasites	31.9	23.3
Persons vaccinating cattle against disease		
Veterinarian	72.0	86.0
Persons treating cattle for disease		
Veterinarian	53.0	70.0
Para-veterinarian	15.0	4.0

Aspects of the management of small ruminant disease by respondent farmers are shown in Table 8. This shows that less than half of the farmers used vaccines for small ruminants. CCPP was the most common vaccine used reflecting its perceived status as the most important small ruminant disease. Most farmers used treatments for small ruminant disease and parasite infestation was the most common reason for treatment. Vaccination is commonly carried out by veterinarians; this was especially marked in Machakos. Disease treatments for small ruminants are administered by veterinarians and by para-veterinarians but also about 1/4 are given by the farmer.

Table 8: Vaccination and treatment of small ruminants

Activity	Percentage of respondents	
	Kakamega	**Machakos**
Farmers' use of:		
Vaccines to prevent disease in small ruminants	23.0	46.0
Treatments for disease in small ruminants	72.0	91.0
Farmers who have vaccinated against:		
CCPP	24.0	51.0
Farmers who have treated for these diseases:		
CCPP	13.0	15.0
Parasites	37.0	39.0
Respiratory disease	2.0	11.0
Persons vaccinating small ruminants against disease		
Veterinarian	41.0	80.0
Persons treating small ruminants for disease		
Farmer	24.0	20.0
Veterinarian	33.0	63.0
Para-veterinarian	14.0	5.0

Activities related to the management of poultry disease are shown in Table 9. Both regions actively treat their poultry for disease (64–84%) but less carry out vaccinations (18–39%). Where farmers do vaccinate they obtain the vaccines mainly from veterinarians or from Agrovet shops. The majority of drugs for the treatment of livestock are obtained from Agrovet shops (45–54%). Where vaccines are used, about 25% farmers vaccinate their own poultry, with others having the services of veterinarians and paravets. A small proportion (reportedly in Machakos only) vaccinate on a farmer-group basis. A much larger proportion (64–72%) of farmers carry out their own disease treatments in poultry.

Table 9: Vaccination and treatment of poultry

Activity	Percentage of respondents	
	Kakamega	**Machakos**
Farmers' use of:		
Vaccines to prevent disease in chickens	39.3	17.5
Treatment for disease in chickens	63.5	84.2
Source of vaccine for those using vaccinations		
Veterinarians	27.3	4.6
Agrovet shops	9.5	11.2
Source of treatments for disease		
Agrovet shops	44.5	54.1
Persons vaccinating poultry		
Farmer	26.5	25.6
Veterinarian	14.6	24.4
Paravet	37.1	6.7
Person treating poultry		
Farmer	63.9	71.6
Veterinarian	7.8	13.5
Paravet	3.5	2.4

Responses to questions concerning vaccination and treatment of disease indicated a general awareness of the services offered by veterinarians and paravets. However there was specific interest in the awareness of local Agrovet shops and the products and services available. The survey showed that there was a high level of awareness of Agrovet shops (Kakamega 77.9% and Machakos 71.2%) and that they sold products such as veterinary drugs, vaccines, fertilizers and feeds (Kakamega 86.9% and Machakos 82.9%).

Respondents were asked about their perception of general effectiveness of vaccination (Table 10). Only 40.2% in Kakamega and 25.0% in Machakos perceived vaccination to be effective yet only about 7-8% claimed to report perceived vaccination failure to local veterinary officers. Respondents were also asked about their willingness to pay for vaccines for the various species and the results are shown in Table 5.

Generally the vast majority of respondents were willing to pay up to 5Ksh, 10Ksh and 20Ksh for poultry, small ruminant and cattle vaccines respectively.

Table 10: Vaccination effectiveness and cost

Activity	Percentage of respondents	
	Kakamega	**Machakos**
Respondents perceiving vaccination to be effective	40.2	25.0
Ineffective vaccines reported to vet officer	7.8	7.1
Amount respondents willing to pay for vaccine (Ksh)		
Poultry ≤5	100.0	ND
Small ruminants ≤10	100.0	ND
Cattle ≤20	94.9	ND

ND = No data

Questions were asked concerning the administration of poultry vaccines and the results are shown in Table 11. Most respondents regarded vaccination as being simple or only moderately difficult. Very few regarded it as complicated. By far the most common method of administration was via the drinking water (67–71%) and 18–25% by eye or nasal drop. About 33% vaccinated their poultry on a group basis with neighbours whilst about 60% typically carried out vaccination on an individual basis. There was an overwhelming need for training in vaccination and many respondents felt there was a need for training in various aspects of poultry husbandry including management and feeding. Few felt the need for training in recognition of disease symptoms.

Table 11: Administration of vaccines to poultry

Activity	Percentage of respondents	
	Kakamega	**Machakos**
Ease of vaccination		
Simple	24.2	10.7
Moderately difficult	26.8	28.3
Complicated	1.3	5.3
Administration of poultry vaccine		
Drop in eye or nostrils	25.4	17.7
In drinking water	66.9	70.7
In food	7.7	8.6
Group vaccination		
Yes	33.4	33.2
No	61.3	59.1
Preference for Group or Individual vaccination		
Prefer Group vaccination	37.0	43.0
Prefer Individual vaccination	63.0	57.0
A need for training in chicken vaccination		
Yes	98.3	99.6
No	1.7	0.4
A need for training in poultry husbandry		
Feeding and nutrition	50.2	53.0
Management	14.8	8.6
Disease symptoms and diagnosis	2.0	1.3
For improved independence of farmer	37.1	33.1

Some responses regarding vaccine formulation and packaging are summarised in Table 12. Packaging preference was for the vaccine to be in plastic with 50 doses being the maximum preferred package for optimum economy and affordability. By far the greatest preference for the characteristics of a vaccine is that it is supplied in liquid, thermo-tolerant form, compared to other available formulations.

Table 12. Vaccine formulation and packaging

Vaccine characteristic	Percentage of respondents	
	Kakamega	**Machakos**
Preference for plastic packaging	54.2	27.3
Preferred pack size ≤50 doses	90.0	82.8
Preferred formulation: Liquid thermo-tolerant	80.1	61.6

Discussion

As GALVmed is a relatively new organisation just entering the animal health sector, it was considered appropriate to collect information from potential end users as to the kind of prevalent livestock production systems, their production and marketing activities, and their attitudes and practices relating to disease diagnosis, treatment and control. The first half of the study (Tables 1 to 5) involved demographics, production and marketing issues.

The respondents interviewed in this survey were predominantly small-farm owners and their spouses in two selected areas of Kenya. Most respondents were full-time farmers whereas others combined this with other jobs. The gender distribution of respondents was about 60% female and 40% male. The prominent role of women in rural family poultry (RFP) production has been highlighted previously (Njue *et al.*, 2002; Gueye, 2000). However Okitoi *et al* (2007) indicated that the woman's role is limited to non-cash related decisions although this view is not supported by Omiti and Okuthe (2009) who suggested that women are the main decision makers in RFP production and that they control the income. Nevertheless Gueye (2000) has suggested that RFP development programs should specifically aim to facilitate women's participation and the present survey data would support the necessary inclusion of women farmers in extension and training activities related to the use of veterinary medicines.

The majority of respondents were in the age group of 30–49 years and approximately 60% of the total respondents were educated to at least primary level. Similarly, Kimani *et al.* (2006) found that 63% of chicken-keeping household heads were educated to primary or secondary level. This is highly relevant to the use of veterinary medicines in that it implies that farmers are likely to understand their role and importance in good animal husbandry and would also be able to benefit from training in these subjects.

Ndirangu *et al.* (2009) used probabilistic models to determine the factors involved in two decision making processes in relation to poultry keeping i.e. firstly engagement in poultry production as a livelihood strategy and, secondly the household's decision as to the size of flock to manage. Firstly households more likely to keep poultry have older and less educated household heads, they are also larger and have a higher adult female-to-male ratio. Their livelihood is diversified and poultry keeping is just one of several activities. On the other hand, households that manage much larger flocks tend to have older but more educated household heads and are more likely to be female. In general, households keeping above average flock size tend to be wealthier.

In the present study, most farmers in both districts were involved in mixed farming (livestock and crops). Of the farmers that kept livestock, few kept more than 10 animals (cattle plus small ruminants) Most farmers that kept cattle had between 1 and 5 animals and the majority of livestock farmers also kept poultry (≤20 birds). Various combinations of crops were grown, the residues of which were used as supplementary feed for their livestock.

As indicated above, backyard poultry production is an important component in traditional rural farming and dominates Kenyan poultry production; the birds surviving largely by scavenging (Nyaga, 2007; Kingori *et al.*, 2010). In a study of smallholder families in Kenya, farmers ranked poultry keeping as the most important household occupation having a significant impact on their livelihoods (Kimani, *et al.*, 2006.).

Approximately one third of respondents utilised eggs as part of their household diet with the remainder being sold either from home or at markets. Similarly, chickens were also sold from both home and at markets. Chickens are regarded as an important hedge against emergency cash needs e.g. medical and school fees (Moreki *et al*., 2010). The majority of respondents described problems in selling farm produce; these were largely due to low prices and exploitation by traders. Njue *et al.* (2002) had found that marketing of poultry products was a major problem to most farmers because they either sold their birds to neighbours who offered low prices or to the nearest market where they did not have control over prices. Marketing of produce is also problematical due to the small volume of output per household at irregular times, lack of market information and high market margins (Njue *et al.* (2002). The sale value of cattle was obviously highest followed by small ruminants and poultry respectively. However larger numbers of poultry are clearly available for sale. In fact the main farm income comes from poultry and egg sales, as also reported by Kimani *et al.* (2006) amounting to more than 73% of total farm income in that report.

The second part of the study (Tables 6 to 12) focused on livestock disease, its recognition, treatment and prevention.

The respondents identified East Coast fever (ECF) as the most important disease constraining cattle production. ECF is a tick borne disease of the lymphatic system caused by the protozoan parasite *Theileria parva*. It is endemic in 11 countries in eastern, central and southern Africa, where over 40 million cattle are considered at risk (Norval *et al*., 1992; Dolan, 1999; Minjauw and McLeod, 2003). Mortality rate can be as high as 90% depending on susceptibility. ECF has been controlled largely by vector control, using acaricide dips and sprays since the early 1900's and the chemotherapeutic treatments parvaquone and buparvaquone became available in the 1980s (Muraguri *et al*., 1998). A vaccine was developed in the 1970's (Radley *et al*., 1975a; b; c) whereby a cocktail of field strains (the Muguga cocktail) of the parasite was administered to cattle simultaneously with antibiotic treatment. This became

known as the Infection and Treatment Method (ITM) and has not yet been superseded by a conventional or molecular based vaccine (Morrison and McKeever, 2006). Due to its narrow margin of safety the use of this vaccine has been controversial and until recently had not been widely disseminated or indeed registered in any country. However because of the lack of a suitable alternative, GALVmed and its partners have sponsored further production of Muguga cocktail, transfer to commercial manufacture, registration and distribution in target countries, including Kenya, Tanzania and Malawi (Peters, 2009). Other monovalent variants of ITM e.g. Marekebuni, have also been available in Kenya over the years.

A small proportion of farmers (13–28%) responded that they had vaccinated against ECF, a percentage probably consistent with limited and variable availability of ITM vaccines. Farmers also used vaccines against blackquarter, a lethal clostridial disease, foot and mouth disease, lumpy skin disease, a pox virus related to the capripox virus of small ruminants, Rift Valley fever and anthrax. Rift Valley fever and lumpy skin disease have been targeted by GALVmed as priority diseases for improved vaccine development.

Contagious caprine pleuropneumonia (CCPP) was identified by farmers as the most important disease in small ruminants. CCPP is a severe respiratory and systemic disease of sheep and goats caused by *Mycoplasm mycoides subsp. Capripneumoniae* (Thiacourt and Bölske, 1996). Vaccines are available on a limited scale and treatment is possible with antibiotics although expensive. It is generally accepted that the availability of better vaccines would be advantageous. The most common disease small ruminants were treated for was parasites. Parasitic disease both internal and external are known to be one of the major constraints to livestock production worldwide and a wide range of anti-parasitic agents have been available for many decades. To-date the GALVmed strategy has tended to focus on ‘neglected diseases’ but it is important to remember that many of the endemic diseases affecting livestock production in the developed world are also important in the developing world in addition to the ‘neglected diseases’.

Overall from the survey it appears that the person most likely to vaccinate cattle and small ruminants is a veterinarian. It was not specified whether this service was private or government based, but in all probability was a combination. Cheneau *et al.* (2004) have recently reviewed the provison of veterinary services in the developing world. They suggest that state veterinary services have declined since the 1970s and there has been a growth in privatisation (Chilonda and Huylenbroeck, 2001) which has to some extent improved the delivery of veterinary services but this has been limited and Cheneau *et al.* (2004) inferred that the potential for public provision of veterinary services has been underrated. Utilisation of the services of para-veterinarians, technicians trained in specific aspects of livestock disease diagnosis and treatment has assumed considerable importance in developing countries (Catley *et al*., 2004). There has been considerable resource put into the development of community animal health worker (CAHW) systems and there is evidence that these have had a significant impact on animal health in many areas (Catley *et al*., 2004). It is clear that these so-called para-professional classes of veterinary support such as para-veterinarians and community animal health workers have expanded in recent years to fill the gap in veterinary services in the more remote pastoral areas (Cheneau *et al*., 2004).

Farmers' perception of the single most important disease of poultry was Newcastle Disease (ND). ND is a severe and highly contagious disease of poultry (Alexander, 2001) and is regarded as second in impact only to avian influenza. In countries where the disease is endemic, vaccines are used to a greater or lesser extent. Whilst vaccination is considered effective, there are practical issues of vaccine delivery to remote rural areas and the major need is for a thermo-tolerant vaccine formulation (Bensink and Spradbrow, 1999) i.e. one that is stable in ambient temperatures and thus does not require refrigeration and this opinion was supported in the present study. Whilst thermo-tolerant vaccines are available, their production and use is sporadic and a major GALVmed priority is to improve the quality and reliability of supply of such vaccines. Nevertheless the I-2 vaccine (Bensink and Spradbrow, 1999) has already been used to great effect in a number of countries e.g. in Mozambique, having a significant positive impact on numbers of chickens produced (Bagnol, 2001). Respondents expressed a preference for administration of

vaccine to chickens via the drinking water similar to the results of a study carried out in S Africa (Thekisoe *et al*., 2004) using the Nobilis® ND Inkukhu vaccine. This used 3 routes of administration viz. eyedrop, drinking water or feed, and the eyedrop and drinking water routes were shown to be equally effective.

Given the lower monetary value of poultry, it is to be expected that there was less veterinary involvement in treatment and vaccination of chickens compared to ruminants. Almost 100% of respondents expressed interest in training in chicken vaccination. Furthermore approximately half of respondents expressed interest in training, feeding and nutrition of poultry.

The issue of pack size of ND vaccine is well known and respondents unsurprisingly expressed a preference for pack sizes of less than 50 doses. Pack size has a direct impact on price with smaller pack sizes being more costly per dose. It may have been a flaw in the questionnaire design that respondents did not express a preference for much smaller pack sizes e.g. 5-10 doses. Given the preference for smaller pack sizes it was surprising that around 60% of respondents preferred vaccinating individually rather than on a farmer-group basis and the reason for this was not evident from the results.

In both locations there was a high degree of awareness and usage (approximately 50%) of Agrovet shops for the purchase of animal medicines. Turkson (2009) recently carried out a similar type of survey in Ghana looking at the relative availability of veterinary medicines and care in different locations. However he found that regional differences were insufficient to recommend location specific delivery systems.

In summary the present study has revealed insights into demographics, agricultural production and local attitudes and practices relating to animal husbandry and disease. These findings will be of benefit to organisations like GALVmed in developing veterinary medicines which are focused on the preferences and needs of small rural livestock keepers in Kenya and similar countries.

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