

**Dog ecology, incidence of dog bites and canine rabies post-vaccination coverage in Makueni County, Kenya: A cross-sectional survey conducted following world rabies day vaccination campaign, 2014**

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## **Summary**

A study of dog ecology, dog bites and dog rabies vaccination rates was carried out in Wote Sub-county of Makueni County, following a dog vaccination campaign to commemorate the launch of the Kenya strategic plan for the elimination of rabies and the world rabies day.

The main objective of this study was to assess canine rabies vaccination coverage in the owned-dog population of the vaccination area and to describe factors associated with dog rabies vaccination. The study was a household based cross-sectional survey utilizing two stage random sampling; first stage being random selection of vaccination points and stage two being random selection of households around the vaccination point. We sampled 128 households and collected data on 282 dogs and 870 humans residing within these households.

The dog to human ratio was 1:3, we extrapolate the owned-dog population in Makueni county as approximately 300,000 assuming human population of 884,527 (2009 census). The mean number of dogs owned per household was 2.2 with the ratio of adult male to female dogs at 1.5:1. Overall, the vaccination coverage in the adult dog population was 56%. Only 23% of dogs reported having been vaccinated for rabies at any point in their lives besides the WRD campaign. Thirty seven percent of humans in surveyed households were below 15 years (most at risk of population) with human dog bite incidence level estimated at 1149 per 100,000.

Makueni County has a very high dog to human ratio consequently putting the population at greater risk of exposure to dog-mediated rabies. The risk of rabies outbreak is confounded by low annual routine vaccination of dogs and almost nonexistent dog confinement practices. The vaccination coverage in the campaign was below the 70% level that is optimum in achieving rabies elimination. A repeat in poorly covered areas coupled with greater publicity is required to improve the coverage rates. Educational efforts should focus on the importance of annual dog vaccination.

### **1. Introduction**

Rabies; a zoonotic acute viral encephalitis is a serious public health problem in Kenya, where up to 2,000 human deaths occur annually (National rabies elimination strategy, 2014). In the past, control measures have included mass dog vaccination and control of stray dogs, however most of these efforts are uncoordinated and unsustainable resulting in little or no impact on the disease burden. Although the disease was first identified in Kenya in 1912 and was successfully

suppressed in early 1970s (National rabies elimination strategy, 2014) through sustained dog vaccination campaigns, break down of vaccination efforts in the 80's, weak surveillance, poor advocacy efforts, organizational and financial challenges, resulted to a resurgence of the disease . In Kenya, the direct medical cost associated with a complete regime of PEP is estimated at \$85 per person which is expensive for a country where 46% of the country lives below a dollar (World Bank). Mass vaccination of dogs is the most cost effective method for canine rabies prevention (Zinsstag *et al.*, 2009) provided sufficient coverage of 70% is achieved(Coleman and Dye, 1996).

Currently, stakeholders have developed a national strategy for rabies elimination by 2030. Within the elimination strategy, pilot areas which include Makueni County have been chosen to demonstrate success before scaling up to the rest of the country. However, key information gap areas on the burden of rabies, dog bites in humans, lack of data on dog demographics and ecology to inform design of rabies control strategies are necessary for proper planning of elimination activities. As recognized by WHO, dog demography studies are key to addressing many of these knowledge gaps more so because changes in human and dog demographics have important implications for the dynamics and control of rabies. . This study was aimed at assessing canine rabies vaccination coverage in the owned-dog population in Makueni following a world rabies day vaccination campaign, describing factors associated with dog rabies vaccination, dog ecology and the incidence of dog bites. The information obtained will be valuable for planning dog rabies control programs and will be the first step in planning bigger ecological studies.

## **2. Methods**

### **I. Study area**

The survey was conducted in Wote division, Kathonzweni sub-county, Makueni County between 29 -30<sup>th</sup> September 2014 after a one day dog vaccination campaign that was carried out as part of World Rabies Day celebrations on 28/09/14

Makueni has an estimated population of about 884,527 people (2009 census) and covers a total land area of 8,008.9 square kilometers

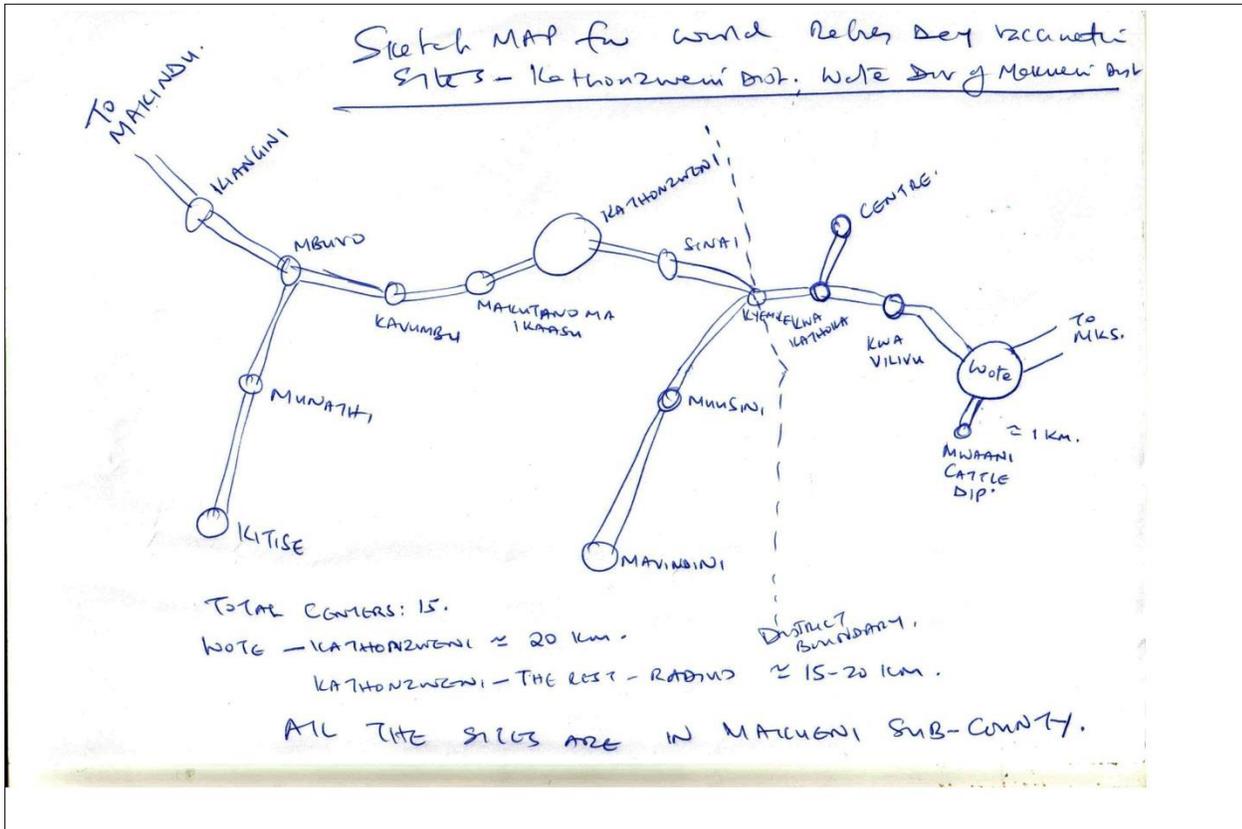


Figure 1: Map showing Makueni County (in green) in relation to Kenya

## **II. The dog vaccination campaign**

The dog vaccination campaign was carried out by the Kenya Veterinary Association on Sunday, the 28<sup>th</sup> of September 2014. Fifteen vaccination centers serving three wards (administrative units) spread out along an estimated 30km stretch of the Wote - Makindu highway were chosen by the district veterinary offices based on overall accessibility of dog owners to the site. The vaccination sites were operational from morning to late afternoon – from 8 am until 3 pm or later if there were animals waiting to be vaccinated. To publicize the vaccination sites, a vehicle mounted PA system was used to announce the campaign in the area a day prior and during the vaccinations. Every dog above three months presented for rabies vaccination was given a free shot of canine anti-rabies vaccine and marked (captured) with a green spray on the stop (area between the muzzle and frontal bones which surround the eyes). After vaccination, information on the owner and dog characteristics was recorded and the owner given a certificate of vaccination that captured information on owner and dog demographics after the dog was marked.

An attempt was made to mark all vaccinated dogs by informing dog owners they were not allowed to leave a vaccination post without their dogs being marked.



Map showing selected vaccination posts.

Source: Makueni County Veterinary Office.

### III. Post-vaccination survey (PVS)

#### a) Design

The PVS was conducted within 72 hours of the vaccination campaign to minimize mark loss, dog movement and mortality effects. We conducted a household based cross-sectional survey utilizing two stage random sampling; first stage being random selection of vaccination points and stage two being random selection of households along roads and footpaths leading from the vaccination points.

Six vaccination posts out of 15 were chosen randomly (the selection of six vaccination points was because of logistical reasons). Households were then sampled by selecting a direction to follow from the vaccination points by spinning a bottle on the ground and sampling all accessible households along the chosen direction. The direction was changed after every two kilometers to cover a wide geographical area as possible. Houses without dogs were skipped for the next house possessing dog(s). On getting to a household we recaptured all vaccinated dogs by doing a direct count of all dogs with the green mark on the forehead.



Figure 2: Image showing the marking of dogs on the forehead

#### **b) Sample size calculation**

A sample size for a cross-sectional study was calculated using the open-Epi version 2 open source calculator (Dean *et al.*, 2011). A minimum of 97 households was the required sample size.

**Table 2.1: variables used in the calculation of sample size.**

<b>Two sided confidence level (1-<math>\alpha</math>)</b>	<b>95%</b>
<b>Power</b>	<b>80%</b>
<b>Precision</b>	<b>10%</b>

<b>Estimated proportion of households with vaccinated dogs</b>	<b>50%</b>
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### **c) The survey team**

A team of six divided into two groups constituted the survey team: three FELTP (Field Epidemiology and Laboratory Training Program) residents, a ZDU data analyst and intern and the Wote sub-county veterinary officer. On each day, the two groups chose a vaccination post to start from randomly after which a vehicle moved round and dropped off the teams.

### **d) Data collection**

A structured questionnaire based on World Health Organizations standard (WHO/WSPA 1990) was designed to collect information. The questionnaires were designed to cover three thematic areas:

- (1) Dog characteristics (e.g. sex, age, dog handling/keeping practices, vaccination status), annual recruitment into the dog population and level of supervision and accessibility.
- (2) Household characteristics including determinants of dog ownership (e.g. socio-economic status, livestock ownership, religion and sex of the head of households.
- (3) Knowledge of rabies in the household,

Once the team got to a household, a questionnaire was administered to the household head or any other adult (above 18 years) in the local Kikamba language.

## **3. Results**

### **I. Owned dog demographics**

In 128 households in the study area, a total of 282 dogs and 870 humans were recorded during the census by direct count. The mean number of dogs per household (hh) in the study area was 2.1 with the dog to human ratio at 1:3. Based on the dog to human ratio and total number of households in Makueni (2009 census), we extrapolate the owned-dog population in Makueni county to be approximately 300,000 to 392,000.

Of the 282 adult dogs 82 (39%) were female and 60% (126/282) were male, resulting in an overall 1:1.5 female: male ratio. The female to male sex ratio from the household survey was similar to the sex ratios from a sample of 1055 dogs selected randomly from vaccination manifest (1:1.4). The sex ratios for adults were also not significantly different to those of puppies (the female to male ratio for puppies was 1:1.4) meaning the survival rates for female and male puppies are the same (table 3.1). Half of the dogs in surveyed households were reported to have whelped at least once in the past 12 months with four as the average number of puppies per litter. Household respondents were questioned about the fate of the last batch of puppies born in the past 12 months. On average 26% of the puppies born in a house hold are reportedly kept, 42% of the puppies were given away to while 33% of the puppies died.

**Table 3.1: Table showing number of surveyed households, number of humans and age distribution of dogs in surveyed households**

<b>Total number of households - 128</b>			
<b>Total number of humans -870</b>			
<b>Dog age distribution</b>			
<b>Female</b>		<b>Male</b>	<b>Total</b>
<b>Adults</b>	82	126	208
<b>Puppies</b>	31	43	74
<b>Total</b>	113	169	282

## **II. Dog ownership practices- Dog confinement and feeding**

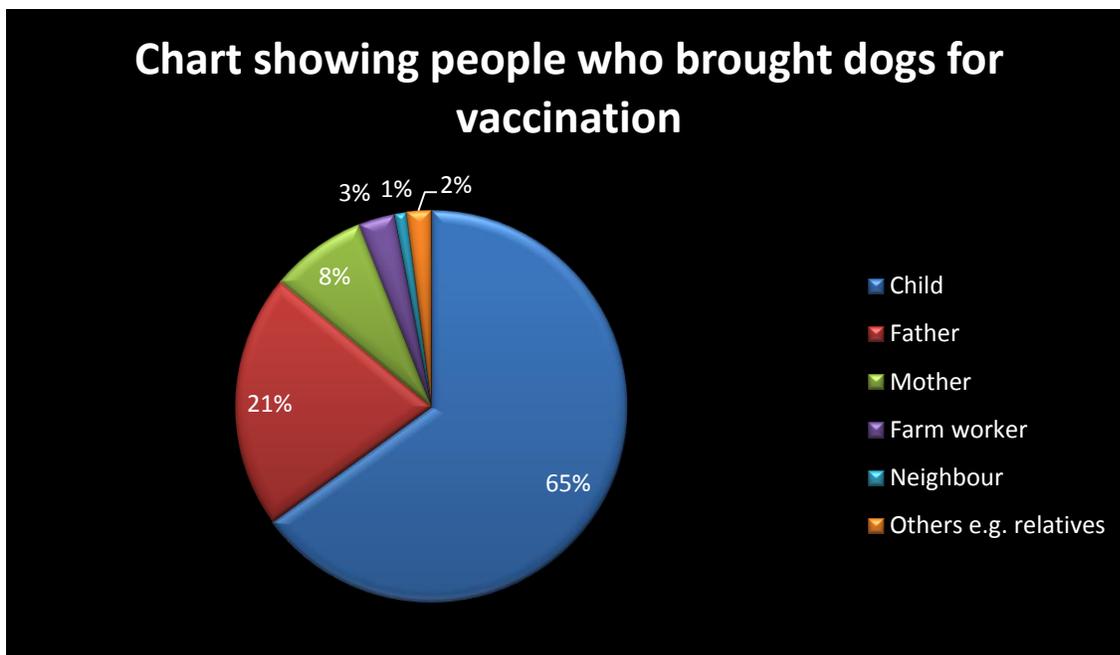
In the study area, confinement of dogs either by leashing or restricting dogs in a dog house was very rare only 3% (4/128) of hh confined their dogs within the compound at all times. Eighteen percent (23/128) of the hh partially confine their dogs either by leashing or confining them in a dog house at some point during the day but let them roam at other times with the remaining 79% of hh letting their dogs roam free at all times. Only 4% (4/127) of the hh had a lockable-specially constructed house for their dogs. Ninety-eight of the respondents (125/128) reported that they fed their dogs with kitchen left overs or household refuse, and allow them to feed on scavenge while the remaining two percent fed their dogs daily in confinement with dog food; one percent (1/128) using commercial feed and the other hh using non-commercial dog food.

Households respondents were asked where they got the last adult dog(s) they own. Majority of the households get their dogs as gifts (82%), 27% were born in the household while the rest bought the dogs.

### III. Dog vaccination coverage

A total of 282 dogs were surveyed by direct count during the study. Of these, 208 were dogs above 3 months of age (eligible for vaccination). A total of 116 dogs had the vaccination mark giving vaccination coverage of 56% for the WRD campaign. The anti-rabies vaccination coverage in the area is however higher as 23% of the dogs counted had been vaccinated (verified using vaccination cards) before the WRD by private and government vets; this shows routine annual vaccination is very far from the recommended 70% coverage. Low annual vaccination coverage is further shown by the fact that 60.6% of the surveyed households reported to have never vaccinated their dogs before the WRD. The most reported (mode) cost of vaccination was KSH100 (1\$=89.4Kshs) in households that reported vaccinating their dogs prior/before to the vaccination campaign.

Majority (65%) of the dogs were brought to the campaign by children followed by their fathers at 21%.



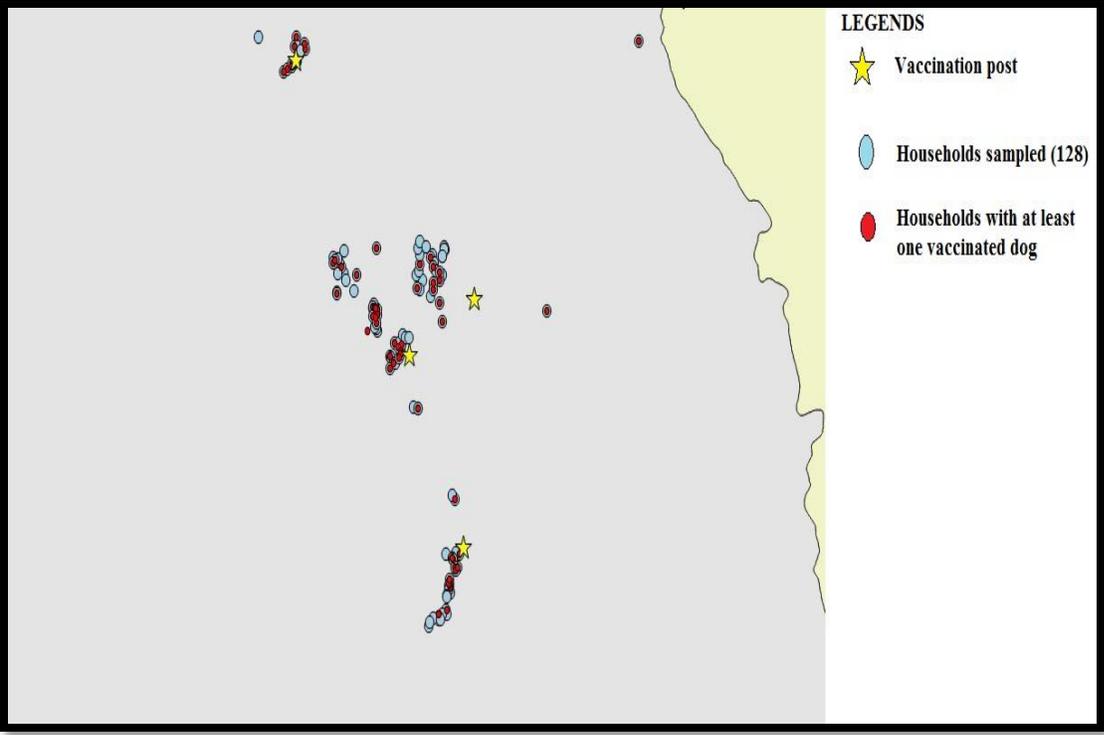
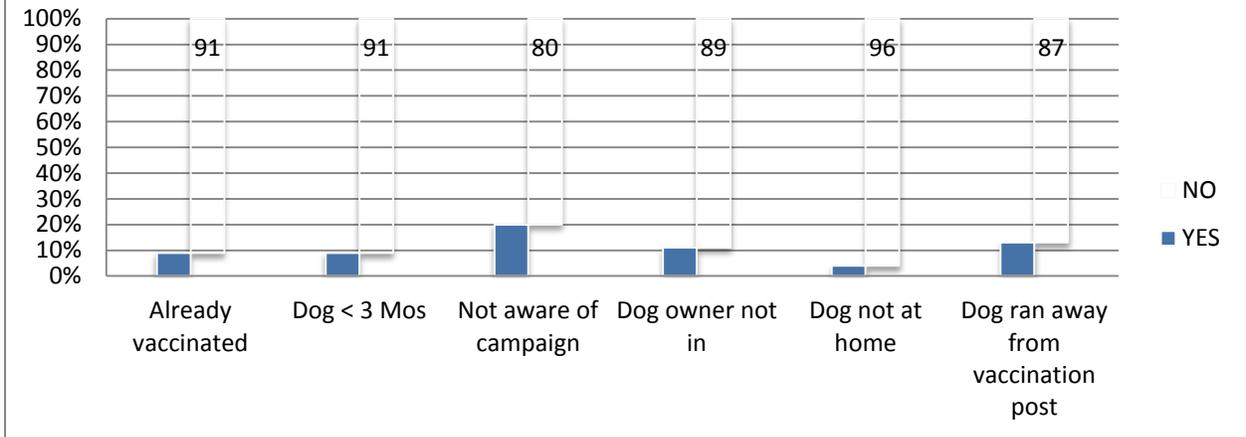


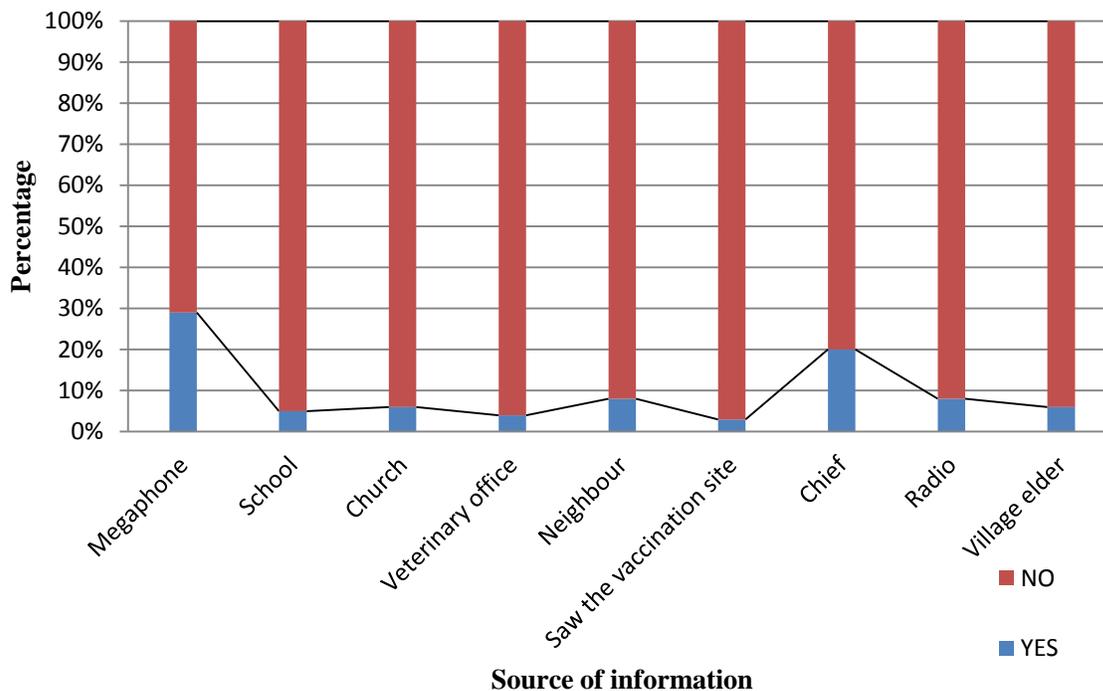
Diagram 3.1: Distribution of vaccination posts, surveyed hh and hh with at least one vaccinated dog.

### Graph showing responses to reason for non-vaccination in 128 HH



Majority of the respondents (75%) reported they did not hear about the vaccination campaign. Majority of households found out about the campaign from a megaphone and local chiefs as shown below

### Graph showing how respondents got information about the campaign



#### **IV. Incidence of rabies**

A total of 10 people from the 128 households reported to be victims of unprovoked dog bites, seven (70%) were male and three were females. This translates to an incidence level of 1149 per 100,000. Majority, 60% of the dog bite victims were below 15 years. Eighty percent of the dog bite cases received at least three doses and above of anti-rabies vaccine. The most reported cost of a single human anti-rabies vaccine shot was Ksh.1000 (1 USD=Ksh.89)

#### **Discussion**

Mass vaccination of dogs is the most cost effective method for canine rabies prevention provided sufficient coverage of 70% is achieved (Coleman and Dye, 1996; Zinsstag *et al.*, 2009). Vaccination coverage achieved in the WRD campaign was 56% which is lower than recommended 70%. There is thus the need to perform “mop-up” vaccination campaigns targeted in areas with the lowest vaccination rates until an overall 70% coverage rate is achieved to provide herd immunity against rabies. Sustained efforts should focus on improving routine annual vaccination coverage which currently stands at 23%.

Most important is the owned dog to human ratio that the study found at 1:3, which extrapolates the owned dog population to approximately 300,000 based on 2009 census. This compares to a study in 1992-1993 by Kitula (2001) that estimated the dog to human ratio as 1:8, factoring population growth in the last decade. A similar unpublished 2012 study in Kisumu County by the Kisumu East and Kisumu North District Veterinary Offices estimated the dog to human ratio in rural Kisumu between 1:5 to 1:8. This means the dog: human population as shown by our study is a very close estimate of the true dog population.

At least 50% of the dogs in surveyed households have given birth to puppies in the past 12 months with four being the average number of puppies in a litter. A third (33%) of these puppies however die before their first year. This high turnover further compounds the need to focus all efforts in rabies control in the region to sustained annual vaccination. The size of a litter born per whelping as by the study is similar to other studies in rural Africa; an average of 4.6 and 4.8 pups per litter recorded in Zimbabwe and the average litter size of 4.7 pups in rural Tanzania (Hampson *et al.*, 2009). The findings of the dog female: Male ratio; 1:1.5 are similar to several

studies across Africa. Gsell (2012), Hambolu (2014) also showed the male: female ratio to be 1:1.5 in Tanzania and Nigeria respectively.

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