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Impact of Community Practices on the Presence of Suspected Signs and Symptoms of Rift Valley in Khartoum State (Sudan)

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ABSTRACT

The impact of community practice on the on the presence of suspected signs and symptoms of Rift Valley Fever (RVF) in Khartoum State has been investigated using spoken questionnaires with households in two sites which thought to be at risk, namely Hellat Kuku and Soba West. The study has been conducted during the year 2009-2010. Households were asked for certain risk factors and NCSS 2007 software package has been used to determine the significant impact of these factors on the presence of suspected cases of the disease in Soba West and Hellat Kuku: Chi square test (P=0.05). Statistical analysis exhibited an indicator of the establishment of RVF Virus in Hellat Kuku for at least ten years. Contrary to insecticide spraying; usage of repellents against bites of mosquitoes in Hellat Kuku has a significant effect on the decrement of the signs and symptoms of RVF. In contrast to Hellat Kuku, presence of animals and the proximity of animal shelters to houses have significant effects on the presence of suspected signs and symptoms of the disease in Soba West. Results also indicated that RVF is newly established in Soba West so that humans have not yet progress immunity against the disease. Both insecticide spraying and the use of repellents were significantly associated with the decrement of the signs and symptoms in Soba West.

Keywords: Rift Valley, Hellat Kuku, *Bunyaviridae, Phlebovirus,* Arboviruses.

1. Introduction

Rift Valley Fever (RVF) is a viral vector borne zoonotic disease caused by Rift Valley Virus, a member of *Phlebovirus* genus in the family *Bunyaviridae* [1]. It is caused by a single serotype of a mosquito–borne bunyavirus of the genus phelovirus. The disease occurs in climatic conditions favoring the breeding of mosquito vectors. The animals acquire disease through bite of infected mosquitoes and from animal to human by direct contact with blood, body fluids or tissues of infected animal as well as the bite of infected mosquitoes. Currently there is no evidence of person to person transmission of Rift Valley Fever disease [2]. Humans are susceptible to infection by handling infected materials and through transmission by mosquito vectors. During the endemic cycle the virus persists during dry season/inter-epidemic periods through vertical transmission in *Aedes* mosquito eggs. Heavy rainfall and flooding provide an environment for *Aedes* mosquitoes to rapidly multiply and become the predominant mosquito population, which results in extensive livestock transmission and amplification of the virus [3]. Epidemic cycles are driven by the subsequent elevation of various *Culex* Mosquitoes and other biting insect populations, which serve as excellent secondary vectors if immature mosquito habitats remain flooded long enough [4]. The disease is self-limiting, although complications of hemorrhagic fever, retinitis, blindness and encephalitis may occur in 1 – 2 % of affected individuals with a case fatality ratio of approximately 10 – 20 % [5]. An epizootic of the disease was also reported in Kosti district, the White Nile province of the Sudan in 1973, it covered almost every single locality in the district and spread to Blue Nile province, sheep, goat, cattle and human were involved [6]. The latest RVF outbreak occurred in Sudan during 2007- 2008 [7]. A part from heavy rainfall, other factors that were responsible for the localized occurrence of RVF outbreaks in the region included high mosquito populations and high livestock populations (WHO, 1998; 2007a).

Some control measures included in many regional countries (such as Tanzania) improved safe management of infected animals and humans in order to save the lives, encouraging use of insecticide treated nets to reduce human contact to Mosquitoes, advocate behavioural changes for farmers and the general public through targeted public awareness campaigns at national and community levels as the majority of human cases were found to be due to behaviour and practices favouring transmission of the disease, coordination of activities within frontline institutions in-charge of animal and human health to prevent further RVF contaminations [8]. Depending on this information this study aimed to investigate the impact of community practices on the appearance of RVF suspected signs and symptoms in two study sites, namely: Soba West and Hellat Kuku where the virus has been detected into specimens of wild mosquitoes [9].

2. Materials and Methods

2.1 Characteristic of the questionnaire:

Cross-sectional spoken questionnaires with close- ended questions. Non-probability sampling was used to select volunteer households to be involved in the questionnaires.

2.2 Sample Size:

Given the workload limitations of entomological surveys, around 40 households were selected in each of the targeted two study sites: Hellat Kuku and Soba west. The sample size was determined bases on literature (when three independent variables were used, then a clear rule would be to have a minimum sample size of 30) [10], confirmed using the method mentioned in the literature [11].

2.3 Confirmation of the determined sample size:

The number of the interviewed households in Hellat Kuku within the flight range of the breeding and resting habitats of the suspected vectors of arboviruses was assumed to be 40 (out of 77 households).

$\therefore$SD = 26.2 households.

Formula for determination of the sample size:

$$\mathbf{n \geq N\sigma^2 / (N-1)\, D + \sigma^2}$$

$$D = (\text{Margin of error})\ 2 / z^2_{\alpha/2}$$

$$\therefore D = (8)^2 / (1.96)^2 = 16.7 \text{ households.}$$

The selected margin of error was assumed to represent 10% of the total households, thus the margin of error: ± 8 households (with 95% confidence limit).

$$\therefore n \geq 77 \times (26.2)^2 \ / (76 \times 16.7) + (26.2)^2 = 27 \text{ households.}$$

Therefore the selected sample size (40 households) was considered to be correct.

The same calculations were used to confirm the selected sample size of households (44 households) to be interviewed at Soba West where the number of houses in Soba West within the flight range of the breeding and resting habitats of the suspected vectors of arboviruses was 69. The selected margin of error was assumed to represent 10% of the total households, thus the margin of error: ± 7 household (with 95% confidence limit). The n value was found to be ≥ 23 households. Therefore the selected sample size was also considered to be correct.

2.4 Selection of houses:

Houses were selected on the bases of their proximity to the potential breeding sites of the suspected vectors of the three arboviruses, and interest of the households.

Certain method [12] has been adopted with slight modifications for counting and selecting the houses for the interviews at the two targeted study sites. Google earth satellite images were used to assign unique house codes to these 40 houses. The associated spatial coordinates and the total number and demographics of residents were therefore used to select 40 houses using systematic randomization.

The study protocol and consent forms were approved by the National Ministry of Health Scientific Review Committee before commencing the study. In the field verbal informed consent and signed forms were signed from all respondents.

3. Results:

The number of patients didn't represent significant proportion of residences of Hellat Kuku thus can be neglected

$[\chi^2 \text{ cal} = 0.4 \text{ (Df= 1) } \chi^2 \text{ tab (P= 0.05)} = 3.48].$

The presence of animals has no effect on the presence of signs and symptoms of the disease

$[\chi^2 \text{ cal} = 0.00403 \text{ (df=1, p= 0.05) } \chi^2 \text{ tab} = 3.48].$

Residence above ten years has no effect on the presence of signs and symptoms of RVF at Hellat Kuku

$[\chi^2 \text{ cal} = 2.127 \text{ (df=1, p= 0.05) } \chi^2 \text{ tab} = 3.48].$

Residence between 3-10 years significantly increasde the risk of presence of signs and symptoms of RVF at Hellat Kuku

$[\chi^2 \text{ cal} = 214.151 \text{ (df=1, p= 0.05) } \chi^2 \text{ tab} = 3.48].$

Residence between 1-2 years has no effect on the presence of signs and symptoms of RVF at Hellat Kuku

$[\chi^2 \text{ cal} = = 1.7327 \text{ (df=1, p= 0.05) } \chi^2 \text{ tab} = 3.48].$

Residence for less than 1 year was significantly effective in the presence of signs and symptoms of RVF at Hellat Kuku

$[\chi 2 \text{ cal} = 5.432 \text{ (df=1, p= 0.05) } \chi 2 \text{ tab} = 3.48].$

Use of preventive methods against bites of mosquitoes at Hellat Kuku has no effect on the infectivity with RVF in humans

$[\chi^2 \text{ cal} = 9.042 \text{ (df=1, p= 0.05) } \chi^2 \text{ tab} = 3.48].$

Use of repellents of mosquitoes at Hellat Kuku has no effect on the infectivity with RVF

$[\chi^2 \text{ cal} = 0.461 \text{ (df=1, p= 0.05) } \chi^2 \text{ tab} = 3.48].$

Use of impregnated bed nets at Hellat Kuku has no effect on the infectivity with RVF in humans

$[\chi^2 \text{ cal} = 0.1005 \text{ (df=1, p= 0.05) } \chi^2 \text{ tab} = 3.48].$

Use of insecticides spraying at Hellat Kuku has no effect on the infectivity with RVF in humans

$[\chi^2 \text{ cal} = 0.0013 \text{ (df=1, p= 0.05) } \chi^2 \text{ tab} = 3.48].$

The number of patients represents significant proportion of residences of Soba West

$[\chi^2 \text{ cal} = 9.1 \text{ (df=1, p= 0.05) } \chi^2 \text{ tab} = 3.48]$.

The presence of animals has a significant effect on the presence of signs and symptoms of RVF at Soba West

$[\chi^2 \text{ cal} = 3.7 \text{ (df=1, p= 0.05) } \chi^2 \text{ tab} = 3.48]$.

The proximity of animals' shelters to houses in Soba West increased the risk of infectivity with RVF in humans: Residents who didn't have animals were not involved in this analysis

$[\chi^2 \text{ cal} = 5.52 \text{ (df=1, p= 0.05) } \chi^2 \text{ tab} = 3.48]$.

Residence above ten years has no effect on the presence of signs and symptoms of RVF at Soba West

$[\chi^2 \text{ cal} = 2.8 \text{ (df=1, p= 0.05) } \chi^2 \text{ tab} = 3.48]$.

Residence between 3-10 years has no effect on the presence of signs and symptoms of RVF at Soba West

$[\chi^2 \text{ cal} = 0.062 \text{ (df=1, p= 0.05) } \chi^2 \text{ tab} = 3.48]$.

Residence between 1-2 years has no effect on the presence of signs and symptoms of RVF in humans at Soba West

$[\chi^2 \text{ cal} = 0.14 \text{ (df=1, p= 0.05) } \chi^2 \text{ tab} = 3.48]$.

Use of repellents of mosquitoes at Soba West has a significant effect on decreasing signs and symptoms of RVF at Soba West

$[\chi^2 \text{ cal} = 6.55 \text{ (df=1, p= 0.05) } \chi^2 \text{ tab} = 3.48]$.

Use of impregnated bed nets at Soba West has no effect on the presence of RVF signs and symptoms

$[\chi^2 \text{ cal} = 0.017 \text{ (df=1, p= 0.05) } \chi^2 \text{ tab} = 3.48]$.

Use of insecticides spraying at Soba West has a significant effect on decreasing the signs and symptoms of RVF in humans

$[\chi^2 \text{ cal} = 6.18 \text{ (df=1, p= 0.05) } \chi^2 \text{ tab} = 3.48]$.

4. Discussion:

Spoken questionnaires were carried out at Hellat Kuku. Forty households were involved in this questionnaire. Patients who exhibited suspected signs and symptoms of RVF constituted insignificant proportion of the residences of Hellat Kuku. Patients with suspected signs and symptoms were considered as positive cases. Presence of animals has been found to have no effect on the infectivity of the disease. This was assumed to be due to the transmission of RVF virus from human to human by the endogenous vector: *Cx. quinquefasciatus*. This assumption was based on the findings of a previous study revealed that females of *Cx. quinquefasciatus* were screened for the presence of RVFV and the results were positive [9]. Detection of the virus inside this species gave a cue that the virus is amplifying inside livestock thus transmission of the virus to humans is possible at this stage. This assumption was also based on what has been mentioned in the literature [10]. Furthermore, *Cx. quinquefasciatus* has been suggested to have a role in human to human transmission of the virus [13].

Statistical analysis for the results obtained from this questionnaire showed significant dependence of the presence of signs and symptoms and the residence at Hellat Kuku. Residences who inhabited Hellat Kuku for 1-2 years and for less than an year were undergoing the signs and symptoms of RVF while those signs were not significantly obvious between residences who were settled for 3-10 years and for more than ten years. This can be referred to the immune status of the residences because recent inhabitors are mostly less immuned to RVF. On the other hands residences who were settled in the area for more than ten years were assumed to improve an immunity against RFV from past infections. Depending on these findings, RVF virus was assumed to be established in Hellat Kuku for at least ten years.

Societal practice of using prevention methods against bites of mosquitoes; (particularly repellents) was found to has a significant effect on the decrement of the signs and symptoms of RVF. Another prevention method such as using of bed nets was found to have no effect on the appearance of the symptoms of the disease. Societal practice was assumed to have a role in this phenomenon where people in Khartoum State at late hours after the mid night thus people don´t sleep under bed nets. This time synchronizes the peak of activity of the suspected vector of RVF at Hellat Kuku (*Cx. quinquefasciatus*).

The use of insecticide spraying was also found to have no significant effect on the appearance of signs and symptoms of RVF. This result may be due to the insecticides resistance of the vectors. Susceptibility tests are crucial to clarify the effect of using these insecticides as a valid intervention for the control of mosquitoes at Hellat Kuku. Furthermore, monitoring and evaluating control measures against mosquitoes (particularly *Cx. quinquefasciatus*) are essential.

In Soba West the questionnaire of households revealed that the total number of patients exhibiting signs and symptoms similar to RVF constituted a significant proportion of the interviewed households (72.7%). In contrast to Hellat Kuku, presence of animals (recorded in literature as susceptible hosts of RVF) was found to have a significant effect on the presence of suspected signs and symptoms of the disease at Soba West. Proximity of shelters of these animals to houses was also related to the presence of the signs and symptoms. Statistical analysis showed that shelters inside or proximal to houses increased the risk of presence of the signs and symptoms of the disease. All households at Soba West who have animals were used to graze them between 6:00am- 12:00 pm. Only 4 households (out of the 36 households who had animals) used to take their animals to grazing at a time not synchronized with the peak of activity of *Aedes* mosquitoes. In addition to the evening grazing period, the 4 households also used to graze their animals during the day time. Due to this, no obvious variations were observed in the grazing time of animals. This gave the justification that the effect of grazing time was neglected in the statistical analysis of the results.

Only two of the interviewed households were residents in Soba West for less than one year, so the impact residence for less than one year on the appearance of signs and symptoms of haemorrhagic fevers was neglected in the analysis of the results. Statistical analysis showed that residence period in Soba West has no effect on the presence of the suspected signs and symptoms of RVF. This led to the assumption that RVF is newly established in Soba West so that humans have not yet progress immunity against the disease. Findings of [9] supported this hypothesis

where *Culex spp* of Soba West were not harbouring RVF virus. This indicated that the virus is not circulating between the secondary vectors and therefore not established in the area.

All the interviewed households at Soba West were found to use at least one of the prevention methods against mosquito bites. Statistical analysis showed that the use of repellents and insecticides spraying had a significant impact on decreasing the signs and symptoms of the disease. This indicated that potential mosquito vectors were susceptible to the insecticides used for vector control at Soba West. Susceptibility tests are also recommended for confirmation of this assumption. In contrast to repellents and insecticides spraying, the use of impregnated bed nets were found to have no significant impact on the presence of the suspected signs and symptoms of the disease of the disease. This gave a cue that the responsible vector (which assumed to be *Aedes vexans*) reachs its peak of activity in a time not matched with the time of sleeping under bed nets.

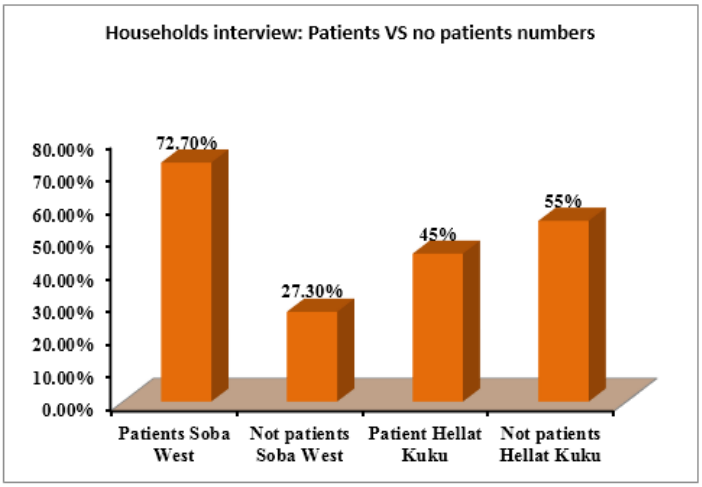

Fig 1: Households interview: Patients VS no patients numbers (Residents who didn't exhibited the signs and symptoms were considered as not patients)

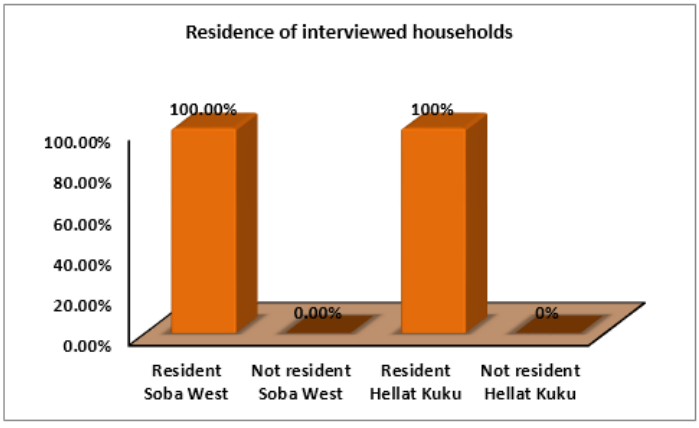

Fig 2: Residence of interviewed households

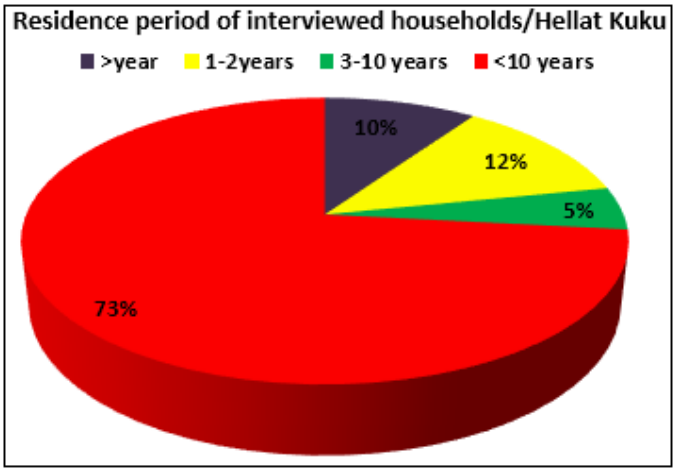

Fig 3: Residence period of interviewed households/Hellat Kuku

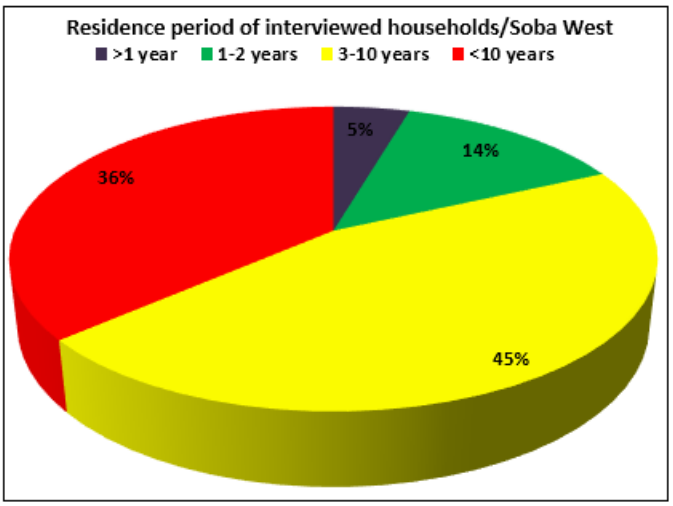

Fig 4: Residence period of interviewed households/Soba West

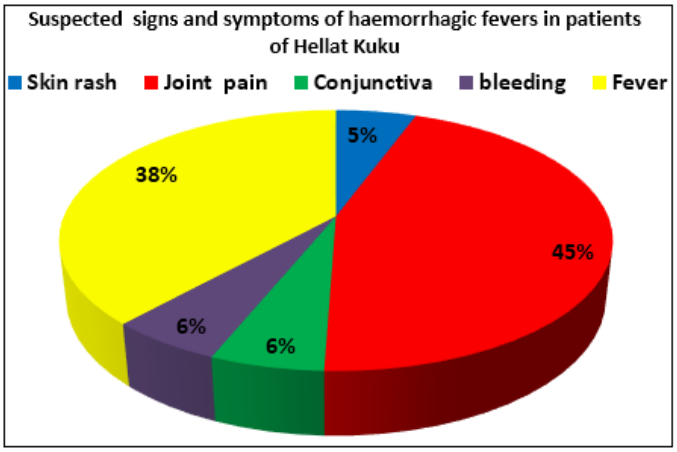

Fig 5: Suspected signs and symptoms of haemorrhagic fevers in patients of Hellat Kuku

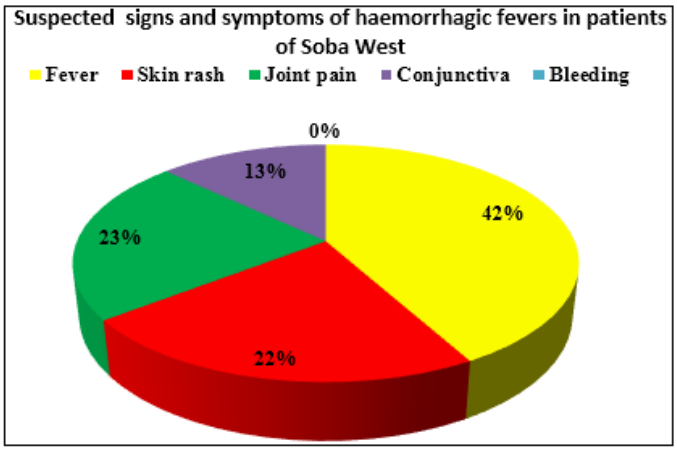

Fig 6: Suspected signs and symptoms of haemorrhagic fevers in patients of Soba West

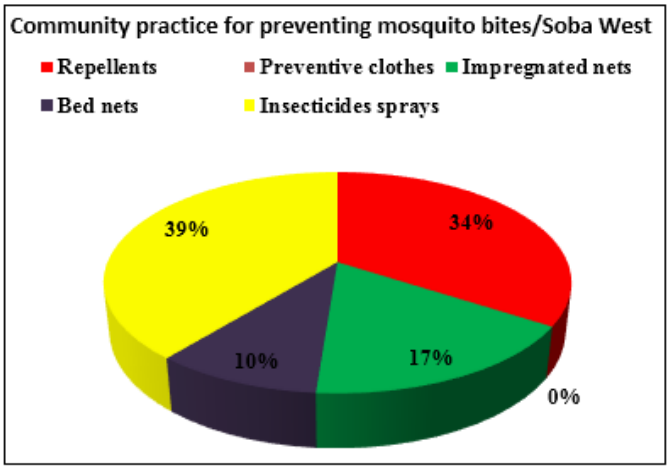

Fig 7: Community practice for preventing mosquito bites/Soba West

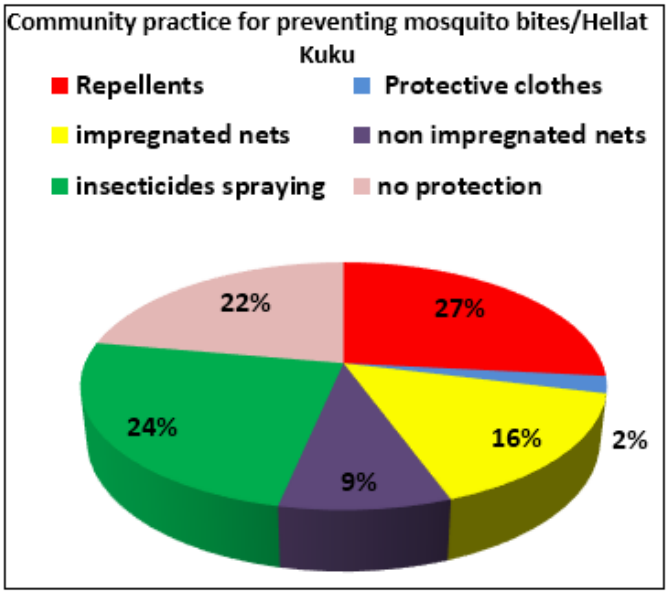

Fig 8: Community practice for preventing mosquito bites/Hellat Kuku

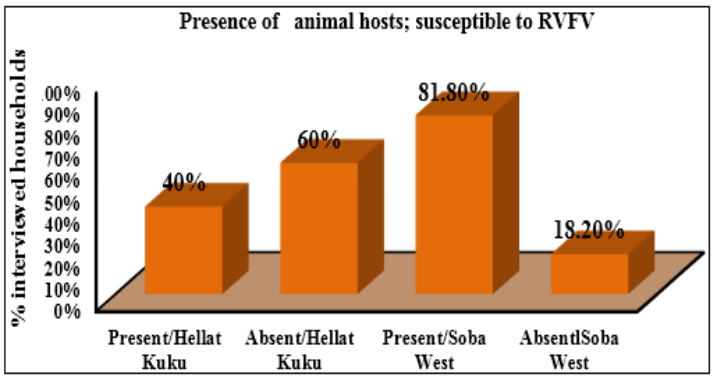

Fig 9: Presence of animal hosts; susceptible to RVFV

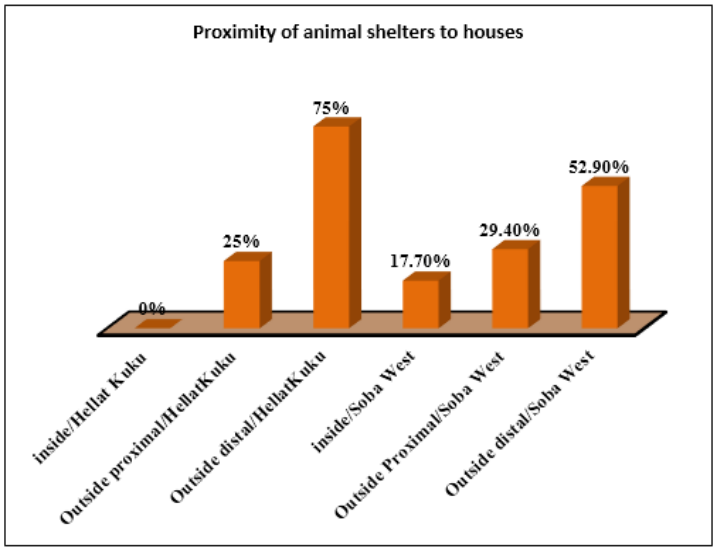

Fig 10: Proximity of animal shelters to houses

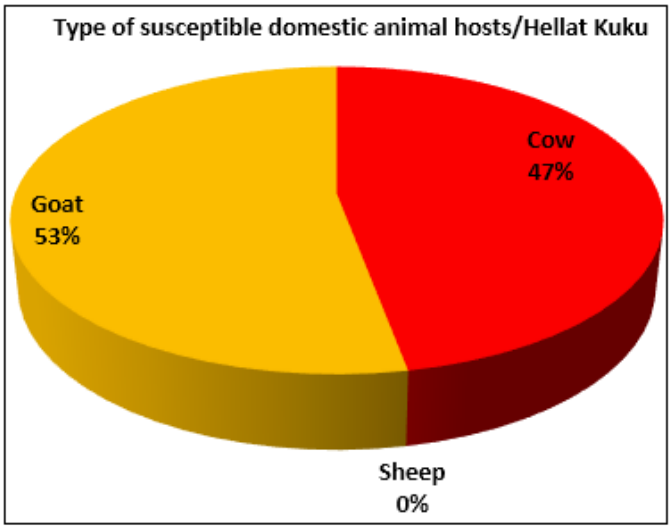

Fig 11: Type of susceptible domestic animal hosts/Hellat Kuku

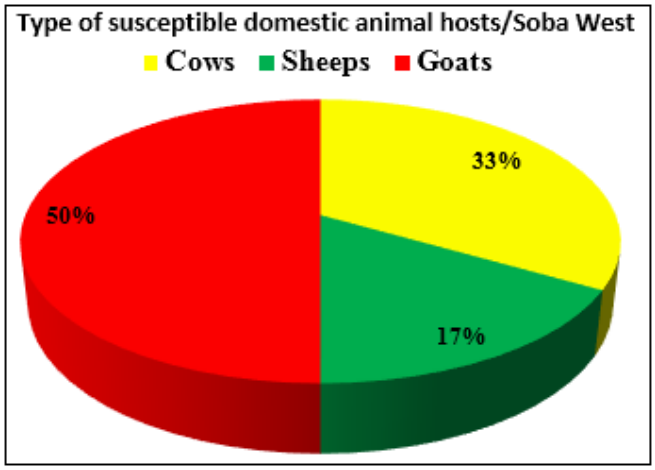

Fig 12: Type of susceptible domestic animal hosts/Soba West

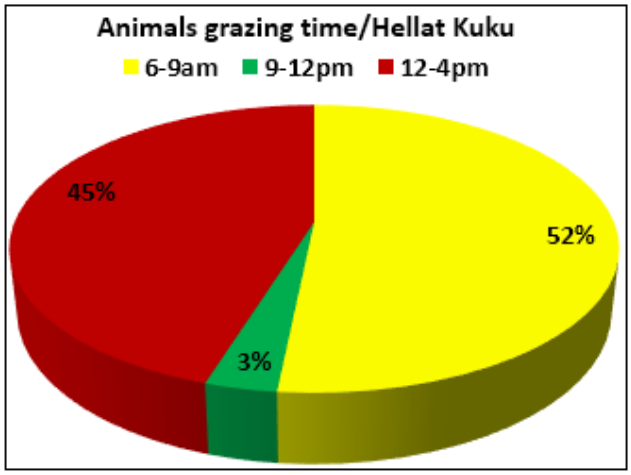

Fig 13: Animals grazing time/Hellat Kuku

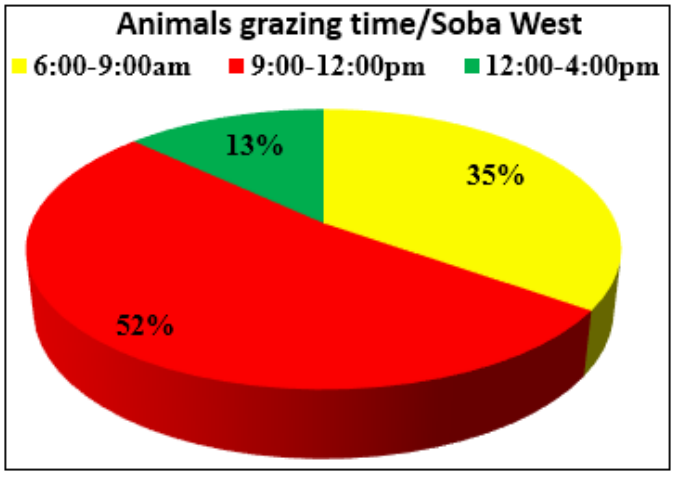

Fig 14: Animals grazing time/Soba West

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