Socio-economic Aspects of Brucellosis in Kuku Dairy Scheme
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Introduction
Animal diseases are important biophysical variable that influence animal health decisions (Chilonda & Huylenbroeck, 2001). They have considerable impact on socio-economic development and continue to be a major public and animal health problem in many regions of the world (Robinson, 2003). The Agriculture Organization of the United Nations (FAO) and the Office International des Epizooties, (OIE) emphasize the importance of brucellosis as not has only direct public health implications but also poses a potential barrier to international trade of animals and animal products. Such a barrier could seriously impair socio-economic development, especially for a vulnerable sector in many rural populations - the livestock owner (WHO, 1997). The disease has considerable impact on the economy through loss of milk, meat and by diminished animal working power (Unger, 2003).

Kuku Dairy Scheme located in Khartoum State contains 60% of cross-bred dairy cattle raised in Sudan. Although the project achieved successful results in upgrading the local Butana breed and consequently milk yield, yet animal health and veterinary extension services lag far behind the fruitful efforts of upgrading local breed. Brucellosis is prevailing in the scheme, in some herds the prevalence rate amounted to more than 50% (Angara, 2005). This paper aims to quantify the losses due to animal as well as human brucellosis over 11 years period (2004-2010). Veterinary epidemiology and economics hold a unique role in the analysis of this case.

Materials and Methods
Both primary and secondary data were utilized in the analysis. Sample survey was conducted to collect data for estimating the cost of the disease in both dairy and health sectors. For dairy sector seroprevalence and economic surveys were conducted simultaneously during the period July 2003 – August 2004. Based on (Robinson, 2003) the number of holdings was calculated using multistage cluster sample. Administered questionnaire was used to collect economic and production data for bovine brucellosis. Master sheet for each holding was used to collect information of each surveyed cow. For health sector 176 Volunteers including owners, milkers, veterinarians & vet. technicians and others including supervisors, agricultural and cleaning workers were tested. Another master sheet was used to collect data from each volunteer. Secondary sources includes: Text books, journals, relevant studies, WHO, FAO, OIE, CDC, e-Medicine and other web sites beside data from General Administration of Planning and Livestock Economics (GAPLE).

Based on the results on prevalence rates (Angara et al., 2009; Angara, 2005) evolution of the disease was projected using KUKU model (Angara, 2005) a modified Ecozoo Model (Zinsstage et al., 2005). The necessary epidemiological data for the evolution of the disease in both cattle and human were provided in the deterministic-transmission part. Data on herd composition, production parameters, and economic data needed to compute the cost of the dairy; health sector and the burden of the disease on human population were included in the model.

Two scenarios were used in keeping first one evolution of the disease was projected assuming that the total animal population will grow according to the following rates: birth rate 0.275 (field data estimate), animal mortality rate of 0.06 (Adapted from GAPLE, 2004) and 0.05 (GAPLE, 2004) for susceptible and seropositive animals respectively, extraction rate of 0.184 (GAPLE, 2004), irrespective to resource endowment available considering the very nature of the traditional producers in large herd size animal population. Cattle to cattle contact rate of 7.2780 × 10-05 (estimated based on carpenter et al., 1987) and
and follow US$. For the second scenario the total animal population will remain constant over the whole period under consideration with zero growth rate.

Losses due to reduction of milk production were based on production parameters obtained from secondary data. Losses due to infertility were estimated based on infertility rate of 0.15 (Zinsstage et al., 2005). For the health sector cost components include: transport cost, doctor fees, laboratory fees and drugs cost. Discount rate of 6% was used to compute the present value (PV) of the cost.

For The burden of the disease: disability adjusted life years (DALYS) were calculated following (Foxy-Rushby, 2002)

Microsoft excel was used in computations

Result and Discussion

The following results were obtained in the baseline year: The total number of animals was 10306 head, animal prevalence rate was found to be 24.9% based on c-Elisa as a confirmatory test, the number of seropositive animals was 1508 adult cow. The number of seropositive aborter was found to be 17 cows out of 143 (0.12). The total number of humans was 649 person, the investigated in contact people account to 176 (27.1%) of the total population. A part from four she vets and vet technicians all of them are males. The mean age of the study population was 28.5±9.7 years (Angara, 2005).

The majority of the investigated in contact people (72%) are resident in the farms. The main risk factors for brucellosis were intake of untreated milk (43.2% of the investigated people used to consume untreated milk), direct contact with placenta & aborted foet (96% of the investigated people) and consumption of uncooked meat (45.5% of the investigated people). Twenty persons (11.3%) of the investigated people were seropositive, while five (2.8%) of them were actively infected.

This study revealed that in the year 2004 the total amount of milk lost due to brucellosis was 392.5 tons. Infertility acted to reduce the calves’ harvest by 226 calve. The total losses of the dairy sector due to brucellosis account to 66,910,503.8 SD equivalents to US$267,642. (92.4%) of the losses were attributed to reduction of milk yield and 7.6% to reduced fertility. With regard to human brucellosis, the infected people were further subjected to clinical examination by a physician. A combined therapy of doxycycline capsules100 mg daily/ 6 wks and streptomycin 1g/day IM for 2 weeks was applied to each patient. A follow up over the entire year was done after which there was no complaint by the patient. Cost to the health sector consists of cost of transport, clinical examination, diagnosis and treatment in addition to the burden on the infected individuals. The total costs account to 12,025 SD equivalents to US$ 48.1 (12, 20, 6 and 10.1 for transport, doctor fees, lab fees and medication for each patient) respectively. Accordingly the estimated total financial cost to health sector for the 18 confirmed patient was 216,450 SD equivalent to US$ 865.8. The total cost of the disease in both dairy and health sectors was found to be 67,126,953.8 SD equivalent to US$ 268,507.8. The dairy sector shouldered 99.67% of the cost of the disease while the health sector shouldered 0.33% of brucellosis cost in the base line year. In non monitory term every infected person will loose 0.39 year of his healthy life as a result of the infection if we considered brucellosis not to be a serious disease and associated with level 0.1-disability weight and duration of disability of 3 years (Roth et al., 2003). The burden to the scheme was 7.067862 years loss. If the disease is considered as a serious and associated with level 0.2-disability weight, every infected person will loose 0.785318 years. The burden to the scheme would be 14.1 years loss.

The projection of the cost of the disease based on it’s evolution over 11 years period according to the first scenario revealed that: The losses evolve with disease evolution to reach 135,950,783 SD
74,448,912.42 (in PV) in the final year. The over all cost to dairy sector in the eleven years will be 1,020,296,428 SD, 744,209,552 (in PV) equivalent to US$ 4,081,185.712. This is distributed as 92.39% due to reduction in milk yield and 7.61% due to infertility in both actual value and when discounted at 6%.

The estimated costs for health sector will evolve with time to reach 271,359 SD, 151,526.9 (in PV) and 1,085,436 US$ in the final year. The total cost to the health sector over the eleven years was estimated to be 1,826,592 SD, 1,337,734 (in PV), equivalent to US$ 7,306.368.

The total cost of the disease in both dairy and health sectors was found to be 1,022,123,020 SD; 745,547,286 (in PV), equivalent to US$ 4,088,492.08 over the 11 years, 99.8% was the cost of the dairy sector and 0.2% was the cost of the health sector.

Loss of healthy years of scheme population (with 0.1 disability weight) will increase as a result of disease evolution to reach 9.0 DALYs in the final year. The total loss of healthy years over the eleven years will account to 59.7 years.

If we considered the disease as a serious (with 0.2 disability weigh), the loss of healthy year will increase as a result of disease evolution to reach 18.1 years in the last year. The total loss of healthy years over the eleven years will account to 119.4 years.

In the second scenario: The losses to dairy sector will evolve with disease evolution to reach 239,599,944 SD 133,792,608.7 (in PV). Equivalent to US$ 958,399.776 in the final year. The over all loss in the eleven years accounts to 1412086707 SD equivalents to US$ 5648346.83.

For the health sector the estimated total costs evolve with time to be 507,541 SD ,283,410.9 (in PV) equivalent to US$ 1,133.64 in the final year. The total cost to the health sector over the eleven years was estimated to be 2,740,863 SD (1,922,278 in (PV) equivalent to US$ 6,823.312.

The total cost of brucellosis in both dairy and health sectors was found to be 1,414,827,570 SD over the eleven years, equivalent to US$ 5,655,170.142. The present value of the total cost was found to be101.505, 075 SD out of which 99.8 % was the cost of the dairy sector and 0.2% was the cost of health sector.

In this scenario DALYs loss (with 0.1 disability weight) will increase as a result of disease evolution to reach 16.49 years in the last year. The total loss of healthy years over the eleven years will account to 89.13 years if we considered the disease as a serious (with 0.2 disability weight), the loss of health years will increase as a result of disease evolution to reach 32.98 years in the last year. The total loss of healthy years over the 11 years will account to 178.27 years.

**Conclusion**

The study proved that brucellosis causes financial losses to both the dairy and public health sectors in addition to the burden on human health. The financial cost of the disease in health sector lags far behind that of dairy sector. This fact beside the steady growth of the cost parallel to the evolution of the disease in the scheme and consequently all over the country implies that a control strategy should be adopted. Producers’ attitude together with the capacity of vaccine production should be considered. Although the cost and the burden of the disease in heath sector is so high, yet the zoonotic nature justify it control and eradication. Bottom up participatory approach including producers, consumers, workers and researchers besides policy makers in both livestock and health sectors will act to strengthen the decision about developing control strategy for the disease and guarantees its implementation.
References


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