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ASSOCIATING BIOSECURITY TO PREFERENCES

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Abstract:-
Poultry biosecurity refers to procedures used to prevent the introduction and spread of disease carrying organisms in poultry flocks. Literature shows that indigenous chickens are not produced in biosecure conditions raising risk profiles of zoonotic infections such as Campylobacter. Prior studies do not take cognizance of this biosecurity situation and fail to focus final consumers. This paper aims at associating biosecurity principles to consumer preferences for indigenous chickens. Primary data are collected from a population of 5,738 university students aged 18 years and above enrolled in campuses located in Kisumu City in Kenya in 2013. Out of 378 questionnaires sent out 281 useful questionnaires are returned. Respondent's belief that biosecurity principles influence their behavioral intentions (preferences) is assessed using a summated scale. Spearman's rank correlation reveals that both positive and negative consumer attitudes are significantly associated with consumer preferences. Respondents' occupation, residence, marital status, and cultural inclination have significant positive association with consumer preferences. Biosecurity principles are significantly positively associated with consumer preferences, however, its magnitude is smaller than expected while its direction does not conform to literature. It is concluded that biosecurity principles are positively associated to consumer preferences. The study has managerial implications in agricultural marketing.

Key words: - *Biosecurity principles; Indigenous chickens; Consumer preferences; Kisumu City; Kenya.*

INTRODUCTION

The original definition of biosecurity started out as a set of preventive measures designed to reduce the risk of transmission of infectious diseases in crops and livestock, quarantined pests, invasive alien species and living modified organisms among agricultural and environmental communities (Koblentz, 2010). Biosecurity generally means the protection of countries against alien pests (insects, vertebrates, etc) and diseases (Waage and Mumford, 2008). FAO (2003) adopted biosecurity as a holistic term which encompassed policy and regulation to protect agriculture, food and the environment from biological risk. The rebranding of biosecurity resulted from social concerns about globalization and terrorism influencing agriculture in new ways (Waage and Mumford, 2008). Biosecurity risks are therefore seen as business risks among agribusinesses and communities interconnected with them.

Several biosecurity threats in both crops and livestock have been documented in recent years (Waage and Mumford, 2008). One threat on the poultry industry is the highly pathogenic avian influenza (HPAI) that reached unprecedented levels in 2003 in Asia and rapidly spread to the other regions of the world. According to Nyaga (2007b), poultry biosecurity became globally important at the outbreak of HPAI in Hong Kong in 1997 causing deaths of six infected workers.

HPAI subsequently spread in both poultry and human populations in South East Asia, China, Middle East, Europe and Africa principally through migrating wild birds and peaked its spread and devastation in 2003 (Permin and Detmer, 2007; Nerlich *et al*, 2009; FAO, 2008a; Waage and Mumford, 2008). This threatened human health and destabilized the poultry industry especially in the East African region (Nyaga, 2007b). As a result of these risks, Food and Agriculture Organization of the United Nations (FAO) and other developmental partners commissioned several regional studies to assess regional preparedness and to mitigate risks of HPAI (Manzella and Vapnek, 2007; Nyaga, 2007a; Nyaga, 2007b; Omiti and Okuthe, 2008; Amoki *et al*, 2009;

FAO/WB/OIE, 2009; FAO/WHO, 2009; Ndirangu *et al*, 2009; Orban, 2009; USAID, 2010; Mehta and Kaur, 2011; USAID, 2012). These impact studies revealed that the regions were not prepared not only for HPAI, but for other poultry disease outbreaks such as Newcastle Disease (NCD) especially in free range poultry production systems (Nyaga, 2007a; Nyaga, 2007b; Omiti and Okuthe, 2008; Mehta and Kaur, 2011; Muteia *et al,* 2011). However, these studies concentrated on impacts on producer households and players along the poultry value chains (Norwood and Lusk, 2008). Whereas producer households bear the burden of the biosecurity lapses, downstream agribusinesses along the poultry chain suffer losses due to lack of supply and or differing preferences as a result of the risks. However, effect of biosecurity risk on consumer choice and preference has not been previously associated.

Several writers have defined poultry biosecurity (Permin and Detmer, 2007; Nyaga, 2007b; Cunningham and Fairchild, 2012). Biosecurity refers to procedures used to prevent the introduction and spread of disease-carrying organisms in poultry flocks (Cunningham and Fairchild (2012). In the same vein, Permin and Detmer (2007) sees biosecurity as security from transmission of infectious diseases, parasites and pests either to or from a poultry production unit. Nyaga (2007b) on the other hand defines biosecurity principles as simple procedures and practices which when applied prevent entry of disease agents into a firm or the exit of the disease agents from infected premises. All three writers agree on the preventive nature of biosecurity on disease carrying agent transmission. These definitions are important in evaluating indigenous chickens products produced in free range systems. Such evaluations are seen to be indicative of both attitudes and preferences that are important to poultry marketers and researchers.

The exact classification of biosecurity principles for the poultry sector is contentious in literature. For instance, Conan *et al*, (2012) indicate a lack of standardized classification to describe biosecurity principles. Permin and Detmer (2007) identify four biosecurity principles namely: management of the flock, control of incoming animals, control of in- and out-going material, and control of other animals. Pierson (2001) equally identifies four biosecurity principles but labels them differently as: isolation, good hygiene, flock health care and monitoring, and good management practices. Butcher and Yegani (2008) identify ten sources that can introduce diseases into a farm or spread infections within or between farms. Nyaga (2007b) domesticates the biosecurity principles to Kenyan situation by identifying three principles namely: isolation, controlling traffic, and sanitation. Of these three, only sanitation has direct implications for indigenous chickens' producers while the remaining two are seldom practiced by these producers (Nyaga, 2007a). He further generates ten biosecurity standards suitable for the indigenous chickens sector.

Other authors (Manzella and Vapnek, 2007; FAO, 2008a; Pagani *et al,* 2008; Meat Control Act, 2012) elevate the business case for indigenous chickens biosecurity from policy and programmatic viewpoints. Manzella and Vapnek (2007) posit that the existence of a national policy on biosecurity should necessitate widespread consumer awareness creation on the concerns and benefits of indigenous chickens' biosecurity. However, direct consumption of indigenous chickens' products is prevalent contrary to legal provisions (Meat Control Act, 2012). Pagani *et al* (2008) agrees that in order to increase the chances of effectively improving biosecurity, it is necessary to work at different levels and with different actors, show the advantages for producers who require direct benefits, involve consumers in order to constrain producers to improve their products and implement information, training and awareness campaigns. FAO (2008a) reinforces that biosecurity requires the adoption of a set of attitudes and behaviours by people to reduce risk in all activities involving domestic, captive exotic and wild birds and their products. Nevertheless, there is a growing physical and mental distance

between producers and consumers (Brom, 2000). The location of Kisumu City along the East Asia/East Africa bird migratory flyway (Bird Life International, 2013) poses a known biosecurity risk for both poultry producers and consumers in the city. However, no principle directly appeals to indigenous chickens consumers because these writers predominantly address poultry producers and government agencies. The business case of indigenous chickens' biosecurity is therefore not directly addressed by these authors. Consumer evaluations of biosecurity principles have not been estimated. Therefore, the relationships between biosecurity and consumer preferences have not been previously studied.

EMPIRICAL EVIDENCE RELATING BIOSECURITY TO PREFERENCES

Bojesen *et al* (2003) report a study aimed at estimating and comparing the prevalence proportions of haemolytic *Gallibacterium* spp. (a bacterial infection) in chickens from different chickens' production systems at different biosecurity levels in Denmark. A stratified cross sectional study consisting of four strata of biosecurity based on production system type including organic/free-range layer-, battery-cage layer-, layer parent-, broiler parent- and broiler grandparent flocks is performed to estimate the prevalence of haemolytic *Gallibacterium* spp.

Thirty (30) birds are sampled by tracheal and cloacae swabs in each flock. A flock is considered infected when just one bird was tested positive. A total of 27 flocks are included in the study. All chickens from the broiler grandparent flocks sample negative, whereas 28% of the broiler parents, 40% of the layer parents, 67% of the battery cage layers and 96% of the organic/freerange chickens sample positive. A total of 95.9% (SD ± 7.6%) of birds from infected flocks is colonized by haemolytic *Gallibacterium* species. A significantly higher number of tracheal swabs are positive compared to cloacae swabs. The probability of vertical transfer is also investigated by sampling offspring from an infected as well as a non-infected parent flock. None of the samples are found positive. It is showed that haemolytic *Gallibacterium* spp. is widely distributed within the Danish commercial chickens' production systems. Prevalence proportions are highly influenced by the production system and found to be significantly associated with the biosecurity level observed in the flocks. In general, flock infections resemble an "all or none" type of colonization as practically all of the chickens in infected flocks sample positive. There is no evidence of vertical transmission of *Gallibacterium*. The study confirms violating biosecurity to be a concern as it raises the business' risk profile. The Danish commercial layer production and is different from Kenya's indigenous chickens' production which is predominantly freerange system. Therefore, from this result, it is expected that the Kenya's indigenous chickens are at a high risk of Gallibacteria infection raising the country's biosecurity profile.
In Finland, Perko-Mäkelä *et al* (2002) aimed at determining the prevalence of campylobacter positive broiler flocks in Finland. Every flock from all three major slaughterhouses is studied during the period from 1 May to 30 September 1999. Cloacae samples are taken in the slaughterhouses from five birds per flock. A total of 1132 broiler flocks are tested and 33 (2.9 %) of those are campylobacter positive. Thirty-one isolates are *C. jejuni* and two isolates are *C. coli*.

This indicates a very low *Campylobacter* contamination level in chickens and that *C. jejuni* is the most prevalent. The Finnish poultry industry is well organized with a strict Salmonella control programme. Farmers are educated to understand the importance of biosecurity barriers and hygiene control in the prevention of environmental contamination. Boot dips, for instance, are widely used as a biosecurity barrier. Chickens houses are constructed in a manner that prevents environmental contamination. Due to cold winters, houses are well insulated therefore preventing the vector animals from entering. Moreover, the inside environments are standardized. Snow-covered earth in winter decreases the possible outside sources of contamination. The situation in Kenya is a stark contrast of Finnish poultry industry especially for indigenous chickens sector. Salmonella is seldom controlled while Campylobacter contamination is prevalent in retailed poultry products in Kenya. Biosecurity interventions are seldom executed among indigenous chickens' producers in Kenya.

Gibbens *et al* (2001) report a controlled intervention trial to assess whether the risk of a broiler flock becoming infected with Campylobacter can be reduced by biosecurity measures (standard method of cleansing and disinfecting the poultry house prior to stocking, and a standard hygiene protocol followed by all personnel who enter the study house during the flock's life) in the UK. Thirty-nine flocks are allocated to intervention or control groups in a ratio of 1:2. Intervention flocks are asked to follow the specified biosecurity measures; all flocks are monitored weekly for Campylobacter infection. Analysis of infection at 42 days of age and over the life of the flock shows that the risk of thermophilic Campylobacter infection of broilers is reduced by over 50% in intervention flocks. World Organization for Animal Health (2008) shows that Campylobacter jejuni and C. coli can colonize the intestinal tract of most mammals and birds and are the most frequently isolated Campylobacter species in humans with gastro-enteritis. Transmission from animals to humans is mainly through consumption and handling of animal food products. The faecal contamination of meat (especially poultry meat) during processing is considered to be a major source of human food-borne disease. Parts of their intervention identified as significant in the univariable analysis includes twice weekly replenishment of boot dip disinfectant; potential independent risk factors identified include the location of ventilation fans and daily sanitization of the water supply. The benefit of executing a biosecurity intervention is demonstrated. The danger of violating biosecurity is real especially Campylobacter jejuni and C. coli contributing to human campylobacteriosis. Moreover, Campylobacter has been evidenced to be prevalent retailed poultry in Kenya.

Nerlich *et al* (2009) reports a study aimed at investigating knowledge claims about health, hygiene and biosecurity as tools to ward off the threat from the highly pathogenic strain of avian influenza H5N1 in the poultry industry in the UK. It takes a semi-ethnographic and discourse analytic approach to analyze a small corpus of semi-structured interviews (14

in number) carried out in the wake of one of the most publicized outbreaks of H5N1 in Suffolk in 2007. It reveals that claims about what best to do to protect flocks against the risk of disease are divided along lines imposed on the one hand by the structure of the industry and on the other by more 'tribal' lines drawn by knowledge and belief systems about purity and dirt, health and hygiene. For instance, implementing biosecurity measures around entrances of big industrial poultry farms is not only effective in terms of any microbiological effect it may have, but also impresses big supermarkets and sends out the right message. It has a symbolic and in a way, a ceremonial function. Smallholder producers regarded as the weak link in the UK poultry industry and in the disease control chain are, on the other hand, keen on sending the message that they are not entirely the culprits. Smallholder producers assert that disease outbreaks are continually reported in enclosed poultry flocks. The study concludes that for communication to be optimal, it must enable people on the ground to feel they are being spoken to appropriately, so as not be tempted to regard government leaflets as mere 'chickens feed' with little value to their 'way of life.' Their study provides a good sociological evidence for the distinct perceptions of industrial and free-range poultry production systems among farming communities on the subject of biosecurity. Its small sample size does not permit its generalization to other populations.

Leibler *et al* (2010) report a research study aimed at approximating the nature and frequency of contact patterns among poultry farms in the US through national sampling and modeling to estimate avian influenza exposure risk in a region of high poultry density, focusing on the business dynamics specific to industrial poultry production. Study population is a convenience sample of broiler growers who respond to an email invitation to participate in an online survey. A total of 17 broiler growers complete the online survey and is the basis for the study. Daily rates of contact are estimated using Monte Carlo analysis. Stochastic modeling techniques are used to estimate the exposure risk posed by a single infectious farm to other farms in the region and relative risk of exposure for farms under different scenarios. Mean daily rate of vehicular contact is 0.82 vehicles per day. Magnitude of exposure risk ranges from 1% to 25% under varying parameters. Risk of between-farm transmission is largely driven by company affiliation, with farms in the same company group as the index farm facing as much as a 5-fold increase in risk compared to farms contracted with different companies. Employment of part-time workers contributes to significant increases in risk in most scenarios, notably for farms who hire daylaborers. Social visits are significantly less important in determining risk. The study concludes that biosecurity interventions be based on information on industry structure and company affiliation, and include part-time workers as potentially unrecognized sources of viral transmission. However, the small sample size they use is not representative and their convenience sampling method is not probabilistic. As a result, the findings are cautiously interpreted and cannot be generalized to other populations. Moreover, the biosecurity situation is not related to consumer preferences in the research. Pierson (2001) develops a self-assessment tool to assess the level of biosecurity on poultry and fish farms. The tool has a set of questions under each biosecurity principle. It is designed to be scored using a binary true or false response scale. Moreover the tool is designed to help commercial poultry and fish operation owners and or managers and not indigenous chickens' consumers. This self-assessment tool is not empirically tested, and its subsequent use not evident. Therefore, the efficacy of the tool in measuring consumer attitudes on biosecurity principles is not known.

Yusuf (2011) explores consumer perceptions and willingness to pay for clean and safe poultry products, particularly chicken meat and eggs, in Bali, Indonesia. The study also analyses the correlation between factors associated with the consumer's purchase decision. Four high-end markets in Denpasar are chosen and 80 respondents are randomly selected in order to explore these issues. Nine attributes are used to define clean and safe poultry products, while five variables are used to explore the correlation between consumer characteristics and their purchase decision. The results show that consumers have a good understanding of clean and safe poultry products. They are aware how the product should appear physically, and they are willing to spend up to an extra Rupee 5, 0001 for whole chicken and Rupee 10, 000/kg for eggs. From the five consumer characteristic variables tested, only age and income have strong correlation with consumer purchase decisions. This information is useful for poultry producers as they seek to produce the type of product required by the supermarket consumer. Differences exist between Indonesian poultry industry and Kenyan indigenous chickens subsector as well the socioeconomic statuses. Moreover, the Indonesian study does not segregate the poultry category and therefore the result cannot be generalized to Kenya's indigenous chickens' situation without caution.

Guèye (2002) reviews literature on prospects for control of Newcastle disease (NCD) in family poultry through ethnoveterinary medicine. He avers that family poultry (FP) are still very important in low-income food-deficit countries (LIFDCs). Moreover there are usually humanized relationships between humans and poultry because humans and poultry often lived in the same house and small poultry flocks are therefore kept by producers. However, the high incidence of diseases is one of the major constraints to smallholder poultry production systems. Newcastle disease, the most serious epizootic poultry disease in most LIFDCs, occurs every year and kills on average 70 to 80% of the unvaccinated rural family poultry flocks. Ethnoveterinary medicine is widely used by resource-poor FP-keeping farmers, especially women. Natural products, especially plant products that are locally available, are generally used. Although FP-keeping farmers claim that these practices are effective, applied research should substantiate these claims. Prevalence of NCD in family poultry (indigenous chickens) is evidenced. However, consumer preferences for indigenous chickens are not Demonstrated.

Muteia *et al* (2011) investigate the livelihood impacts of avian influenza in Nigeria at a farm level and farmers' coping behaviours using questionnaire surveys conducted between May and June 2009. A multistage sampling procedure is adopted in selecting a representative sample of the population of poultry farmers in all 13 selected states. The first stage

is to choose two Local Government Areas (LGAs) from each state by using the number of poultry farms as a selection criterion. A list of all poultry farms per LGA in each state was obtained from poultry farm registers through the state HPAI desk officers. Two LGAs with the highest number of poultry farms were selected in each state. The second stage involves the selection of two communities with the highest number of poultry farms per LGA while the third stage is a random sampling of 10 poultry farms per community resulting in a total of 520 farms. The livelihood impact of avian influenza varies across regions and poultry production sectors. Results of the farm survey suggest that the severity of impact on farm income is higher among the smallholders especially in the north-east geopolitical zone. The majority of the farms surveyed lost more than 50% of their monthly poultry income at the onset of the avian influenza crisis. Most severely affected group are the smallholders, particularly in sector 4 where about 21% lost between 80 to 100% of their annual poultry income. The disease outbreak also led to a significant reduction in poultry employment across the country but this is already picking up with a lower recovery rate being observed among the smallholders in sector 4 (56%) as compared to the commercial sector 2 (103%). At the onset of the crisis, poultry farmers adopt a mix of responses involving asset divestment and even temporary closure but the proportion of farmers needing to adopt each coping strategy decreases with time. The negative impact of biosecurity risk is demonstrated for famers but not for consumers.

Mwanza (2009) assesses good hygienic practices in the broiler meat chain in the peri-urban areas of Nairobi and Thika of Kenya using desk studies, farmer survey and case studies. A total of 40 farmers, 23 from Nairobi and 17 from Thika peri-urban areas, are interviewed during the survey using a pre-structured questionnaire. One trader/ middlemen and two retailers are interviewed to assess their hygienic practices. An official from the Ministry of Livestock Development is also interviewed. The study reveals that smallholders rear broilers in small batches of between 100 500 batches in cycles ranging from 3- 6 times per year. Using the a combination of chain and HACCP models the study focuses on each level and determines current practices and how they pose a safety risk, and level of compliance with existing good hygienic practice. The study indicates that, with regard to broiler house conditions, farm observations show tidiness outside the broiler house for a large majority of farmers needed improvement in terms of bush clearing and sealing of wall cracks. Earthen floors are observed to be the most common floor type in both Nairobi and Thika while litter condition is found to be in average condition. Only a handful of surveyed farmers, for instance, have footbaths. This study concludes that awareness of hygienic practices by chain actors exists but compliance is low. The study however focuses on broiler producers who have commercialized their production as opposed to indigenous chickens' producers largely seen as subsistence farmers. Moreover, the low compliance of hygienic practices among commercialized farmers is problematic. It raises the risk profiles of indigenous chickens' producers who are largely subsistent producers.

Njue *et al* (2002) report a study aimed at assessing the impact of Newcastle disease vaccination and commercial chickens feed supplementation on productivity of village chickens. The study is carried out from October 1999 for a period of one year using semi-structured interviews in six villages in agro-ecological zones (AEZs) II and III involving both village and commercial chickens. A total of 24 village chickens farms and another 47 commercial broiler chickens are included in the study. All the farmers vaccinate their birds against Newcastle disease and only 8 supplement with commercial chickens feed. At each visit, semi-structured interviews are conducted and birds are weighed. Blood is collected and subjected to indirect ELISA test. There is significant ($p = 0.0379$) change in flock size by the time of the third visit. The mean percent positive values of Newcastle disease antibodies (30%) are required to resist a challenge by a virulent virus by the time of the third visit. The net benefits accrued from vaccination with supplementation are much higher ($421.92) compared to those of vaccination without ($99.21). They conclude that productivity of village chickens is likely to improve through better feeding regime and vaccination against Newcastle disease. The study's focus is poultry producer as opposed to poultry consumers.

Okello *et al* (2010) report a study aimed at characterizing the structure of poultry value chain; assessing the relative importance of specific flows of poultry and poultry products; identifying the various actors involved in the poultry trade and their linkages; and providing insights on potential pathways of HPAI introduction in the value chain in Kenya. These study areas are selected based on their relative density of poultry populations. A value chain approach is employed entailing use of semi-structured interviews and focus group discussions with various stakeholders including hatcheries, farmers, input sellers, processors, retailers and other intermediaries in four different value chains: commercial broilers, commercial layers/eggs, indigenous chickens, and guinea fowl/ducks. The study finds that feed stockists undertake some biosecurity practices such as using feed bags only once, keeping free-ranged chickens away from stores, and not allowing customers to touch or handle opened bags of feeds they are buying. These stockists also provide regular feedback to the millers regarding demand-supply conditions and consumer preferences. This feedback is usually in terms of customer complaints and satisfaction about feeds. The study does not assess a complete value chain because consumer or end user feedback is not sought. Moreover, the nature of qualitative research design chosen in the study does not allow for generalizing the results.

Bett *et al* (2011) report a study aimed at estimating consumers' responsiveness to a premium price and how much they are willing to pay for indigenous chickens products in the market in Kenya. A total of 930 respondents are interviewed both in the urban and rural areas in the contingent valuation experiment. The two-step Heckmann selection model is used to analyze consumers' decisions and the amount they are willing to pay. The study results reveal that consumers are willing to pay 23.26% per kg more for indigenous chicken meat and 41.53% for eggs. Socioeconomic factors like age,

income, education and family size significantly determine consumers' willingness to pay for the chicken meat. Preferences for indigenous chickens' products are therefore found to be high. This study however does not consider indigenous chickens' biosecurity situation as it determines these consumer preferences.

Osano and Arimi (1999) report a study aimed at investigating the level of contamination with C. jejuni of raw chicken and beef meats sold in Nairobi and to assess their potential as sources of campylobacter infections to man. Dressed chicken and beef meat samples are randomly sourced from butcheries, markets and supermarkets in various parts of Nairobi over a period of two months. One hundred chicken and 50 beef samples are bacteriologically examined by selective enrichment and culture under microaerophilic environment. Thermophilic campylobacters are identified and characterized using standard physical and biochemical tests. Thermophilic campylobacters are isolated from 77 (77%) poultry samples and one (2%) beef sample. Isolation rate (85.3%) is higher from chickens < 24 hours old since slaughter than those > 24 hours old. The beef isolate is 2% C. jejuni. Poultry samples yield C. jejuni (59%), C. coli (39%) and C. laridis (2%). These findings show that poultry meat sold at the counter is a major source of C. jejuni and C. coli, and that it is an important potential source of campylobacter infection. Proper cooking and hygienic handling before consumption is therefore essential. This study evidences biosecurity breakdown but fails to relate biosecurity to consumer preferences.

Olwande *et al* (2010) report a study aimed at assessing performance of indigenous chickens under extensive system in southern Nyanza, Kenya. The study is carried out in two phases in Komolorume and Kawere villages in Rongo and Rachuonyo districts, respectively. The first phase is a cross-sectional study in 81 farms selected by cluster sampling to get the overview of the indigenous chickens' production. A four-month prospective longitudinal study in 60 farms randomly selected from the previous 81 farms is followed. Mean flock sizes per household are 20 and 18 birds in Komolorume and Kawere, respectively. Overall mean flock size is 19 birds ranging from 1 to 64. The mean clutch size, egg weight and hatchability are 12 eggs, 48 g and 81% respectively in Komolorume and 10 eggs, 45 g and 70%, respectively, in Kawere. The chick survival rates to the age of eight weeks are 13 % and 10% in Komolorume and Kawere, respectively. Mean live weights for cocks and hens are 2096 g and 1599 g in Komolorume and 2071 g and 1482 g in Kawere, respectively. The mean household cock to hen ratio is 2:5 and 2:4 for Komolorume and Kawere, respectively. The mean chick to grower to adult ratio per household is 8:6:6 in Komolorume and 8:4:6 in Kawere, Clutch sizes and hatchability rates are significantly higher in Komolorume village ($P<0.5$). The productivity of the indigenous chickens is shown to be low compared to that of the improved chickens in other parts of the world. This low productivity points to possible biosecurity issues. The study however fails to relate biosecurity to consumer preferences. Okeno *et al* (2012) report a study to characterize indigenous chickens (IC) and their production systems. A survey involving 594 households is conducted in six counties with the highest population of IC in Kenya using structured questionnaires. Data on IC farmers' management practices are collected and analyzed and inbreeding levels calculated based on the effective population size. Indigenous chickens are ranked highest as a source of livestock income by households in medium- to high-potential agricultural areas, but trail goats in arid and semi-arid areas. The production system practiced is mainly low-input and small-scale free range, with mean flock size of 22.40 chickens per household. The mean effective population size is 16.02, translating to high levels of inbreeding (3.12%). Provision for food and cash income are the main reasons for raising IC, whilst high mortality due to diseases, poor nutrition, housing and marketing channels are the major constraints faced by farmers. The study identifies biosecurity issues especially high inbreeding and mortality that are risks. It focuses on indigenous chickens households as opposed to consumers and fails to relate indigenous chickens' biosecurity to consumer preferences.

Reviewed literatures show that indigenous chickens are not produced in biosecure conditions. This raises the risk profiles of zoonotic infections such as Campylobacter due to human health concerns. Prior researches on indigenous chickens' preferences do not take cognizance of their biosecurity situation. Moreover most reviewed studies focus on poultry producers and traders and not final consumers. Therefore, no researches relate biosecurity principles to consumer preferences for indigenous chickens.

METHODOLOGY

Spearman's rank correlation analysis is performed to establish association between variables. Spearman's rank correlation is a non-parametric measure of strength of association between two ranked variables (Churchill and Iacobucci, 2004). The measure is appropriate because consumer preferences variable is measured in a categorical scale (Domencich and McFadden, 1996; Mazzocchi, 2008). Jamieson (2004) and Norman (2010) show that Likert scales such as the one used to measure biosecurity principles are ordinal therefore ranked. Consumer characteristics has categorical, interval and ratio scaled data. The assumption on consumer attitudes is that it is measured on an interval scale. Therefore Spearman's rank correlation is an appropriate measure of strength of association. Correlation coefficients represent associations of two variables at a time (Usoro, 2000).

Correlation coefficients are used to determine the magnitude and direction of associations. Their values range from –1 (perfect negative correlation) to + 1 (perfect positive correlation). The nearer the coefficients are to these two values, the stronger the relationship. The more the coefficients are close to 0, the less the relationship; at 0, there is no relationship (Carlson and Thorne, 1997). Spearman's rho (ρ) is the best known and used in social and behavioural science to measure correlation from ordinal-level data such as are produced by the Likert scale (Usoro, 2000). Table 1 presents the

correlational analysis results. The result presents how the three independent variables: consumer attitudes, consumer characteristics and biosecurity principles are associates with the dependent variable, consumer preferences.

The Data

Primary data are collected from a population of 5,738 university students aged 18 years and above enrolled in campuses located in Kisumu City in Kenya in 2013. Out of 378 questionnaires sent out 281 useful questionnaires are returned. Respondent's belief that biosecurity principles influence their behavioral intentions (preferences) is assessed using a summated scale.

RESULTS AND DISCUSSIONS

From Table 1 the association between consumer attitudes and consumer preferences is presented by two variables: perceived benefits of biosecurity principles (PBBP) and perceived concerns of biosecurity principles (PCBP). The association between PBBP and consumer preferences $\rho = .123\ (p = .021)$ is weak though significant at 95% confidence level. The association between PCBP and consumer preferences $\rho = -.103\ (p = .045)$ is equally weak though significant. The 1-tailed tests allot all alpha to testing the statistical significance in one direction of interest (Zikmund *et al,* 2010). Therefore, PBBP is positively correlated to consumer preferences. At the same time PCBP is negatively correlated consumer preferences.

Given, that PBBP represents positive evaluations (attitudes) and PCBP negative evaluations (attitudes) based on Fishbein and Ajzen (2010), the directions of association are consistent with literature (Usoro, 2000; Weerahewa, 2004; Kim, 2009; Okello *et al*, 2010; Bett *et al*, 2011; Muthiani *et al*, 2011; Antwi-Boateng *et al*, 2013). These studies propose that the direction of both positive and negative attitudes associations with consumer preferences is feasible and therefore acceptable. The correlation coefficients of these associations however, are small $(\rho < .30)$ indicating that some other variables might be influencing the associations between the variables (Zikmund *et al,* 2010). As a result, further multivariate analysis permitting all variables to influence consumer preferences at once is necessary.

The association between consumer characteristics and consumer preferences is demonstrated by 10 variables. The associations between income $\rho = .090\ (p = .066)$, age $\rho = .020\ (p = .369)$, terminal education age $\rho = -.038\ (p = .261)$, gender $\rho = .070\ (p = .120)$, media seen read and heard $\rho = .031\ (p = .305)$ and purchase location $\rho = .031\ (p = .305)$ and consumer preferences are very low and statistically insignificant. Huang *et al* (2014) concur with the insignificant finding on age, gender and income to influence intention to take precautions by avoiding consuming broiler chickens meat and products in Malaysia. They also report that bird flu news similarly does not influence intention to take precautions consistent with media seen read and heard influence on consumer preferences for indigenous chickens. Huang *et al* (2014) target preference variable is however an exact opposite of consumer preferences and the product categories are dissimilar. Antwi-Boateng *et al* (2013) on the contrary, assert that age, gender and income influence poultry consumption. However, they use descriptive statistics in their analysis that is limited to mere description. Teng *et al* (2011) have however argued that external variables such as age, income and gender have strong relationships with consumer preferences to purchase green foods. The preferred purchase location, which is predominantly live bird markets (FAO, 2008a), is equally insignificantly associated with consumer preferences. Live bird market conditions in Kenya (Nyaga, 2007a) are not hygienically kept lowering this association. The negative sign on terminal education age (TEA) variable connotes respondent's lack of interest in indigenous chickens given that majority are below 16 years of formal education. This result corroborates Usoro (2000) in predicting use of information and communication technology for global planning. Therefore, the negative association of TEA to consumer preferences is sustained.

The remaining variables: occupation $\rho = .206\ (p = .000)$, residence $\rho = .145\ (p = .008)$, marital status $\rho = .287\ (p = .000)$ and cultural inclination $\rho = .340\ (p = .000)$ indicate highly significant associations between consumer attitudes and consumer preferences at 99% confidence level. All these variables have low correlation coefficient magnitudes $(\rho < .30)$ except cultural inclination signifying a weak association between them and consumer preferences (Zikmund *et al,* 2010). Occupation has been construed to influence preferences for indigenous chickens (GoK, 2009b; Emuron *et al,* 2010; USAID, 2010). Occupation is seen as a source of income especially for urban consumers' that increases ability to purchase indigenous chickens. Given high indigenous chickens product prices (Emuron *et al,* 2010; Bett *et al,* 2011) occupation increases the opportunity to demand these products. Residence in urban centers tends to increase consumer impetus to consume indigenous chickens (FAO, 2008b; GoK, 2009b; USAID, 2010; Caracciolo *et al,* 2011). Majority of urban households in developing countries rely on food purchases for most of their food while 97% of these urban dwellers are net food buyers (FAO, 2008b) further justifying the positive association. In terms of marital status, it seems that being married in positively associated with preferring indigenous chickens. It can be argued that owing to live bird markets being the predominant market channel for indigenous chickens (FAO, 2008a) married couples and not singles are more likely to consider buying and preparing indigenous chickens products for consumption. Indigenous chickens' preparation is tedious and often messy. Therefore singles are not likely to consider it. Cultural inclination has been showed to greatly influence consumer preferences for indigenous chickens (Sonaiya and Swan, 2004; Njenga, 2005; Kimani *et al,* 2006; Muthiani *et al,* 2011; Antwi-Boateng *et al,* 2013). The authors aver that cultural factors such as ceremonial and traditional aspects, traditional taste values and choice of carcass parts and organ meats influence consumption of indigenous chickens. Antwi-Boateng *et al* (2013) reports peak demands for chickens' products during religious and cultural festivities

indicating a strong association. The mixed results of consumer characteristics variable effect on consumer preferences needs a further multivariate analysis to ascertain its true influence.

The association between biosecurity principles and consumer preferences $\rho = .117\ (p = .027)$ is statistically significant at 95% confidence level. The direction of this association is consistent with Bett *et al* (2011) because consumers' willingness to pay premium prices for indigenous chickens is indicative of their strong preferences. Bett *et al* (2011) however do not include biosecurity principles in their analysis. The magnitude of this association is however not as strong as expected. The direction of this association does not reflect the indigenous chickens' biosecurity situation reported by Nyaga (2007a) in Kenya which should be in the opposite direction. Whereas Manzella and Vapnek (2007) report existence of a national policy on biosecurity in Kenya, the policy seemingly has not translated into widespread consumer awareness on biosecurity principles.

The spatial engagement between producers and consumers (Pagani *et al,* 2008) might explain the weak positive association because one party is only partially aware of the other's actions. Brom (2000) decries the growing physical and mental distance between producers and consumers. Trewin (2001) asserts trade-offs between utility from biosecurity principles and those from consumer preferences for indigenous chickens. These trade-offs cannot not be left for market forces alone. In this regard, willingness to pay a premium price for indigenous chickens (Bett *et al,* 2011) is only a situation where value is revealed in market transaction through hedonic pricing. This price incorporates other aspects such as biosecurity in its evaluation. Considering Trewin (2001) arguments, the premium price (Bett *et al,* 2011) might reflect just the opportunity cost to consumers, that is, what they are paying, and not their greater willingness to pay. Furthermore, less efficient production systems with low productivity (Teketel, 1986) require the buyer to cover its production costs for survival. Bett *et al* (2011) willingness to pay premium prices for indigenous chickens might not necessarily result in intentions to consume (consumer preferences), further confirming the weak association. Due to the bivariate nature of this analysis, a multivariate analysis might reveal how this association plays out in the presence of other explanatory variables.

CONCLUSION

Bivariate results between consumer attitudes and consumer preferences show that positive attitudes (perceived benefits) have significant positive association with consumer preferences. At the same time negative attitudes (perceived concerns) have significant negative association with consumer preferences. This result is consistent with literature. The magnitudes of association are however smaller than expected. Occupation, residence, marital status, and cultural inclination have significant positive association with consumer preferences. Income, age, gender, preferred purchase location and media seen read and heard have insignificant positive association with consumer preferences. Terminal education age and gender have insignificant negative association with consumer preferences. The magnitudes of these associations are however smaller than expected except for cultural inclination. A significant positive association exists between biosecurity principles and consumer preferences. This association's magnitude is smaller than expected and its direction does not conform to literature. The study offers fresh evidence associating biosecurity principles to consumer preferences to be a positive association. The study has managerial implications in agricultural marketing. Further multivariate analyses is however desirable in this regard.

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Table 1: Correlations of Variables with Preferences for Indigenous Chickens

Variable	*N*	Correlation with Preference (Spearman's rho, ρ)	$p-value$
1. Consumer Attitudes:			
Perceived Benefits of Biosecurity Principles (PBBP)	274	.123*	.021
Perceived Concerns Biosecurity Principles (PCBP)	274	-.103*	.045
2. Consumer Characteristics:			
Income	281	.090	.066
Age	281	.020	.369
Terminal Education Age	281	-.038	.261
Gender	281	.070	.120
Occupation	281	.206**	.000
Residence	281	.145**	.008
Preferred Purchase Location	241	.001	.499
Marital Status	281	.287**	.000
Media Seen Read and Heard (MSRH)	277	.031	.305
Cultural Inclination	281	.340**	.000
3. Biosecurity Principles:			
Biosecurity Principles	271	.117*	.027

**. Correlation is significant at the 0.01 level (1-tailed)
*. Correlation is significant at the 0.05 level (1-tailed).
Source: Main survey data, 2013.