Original Research Article

Determination of ~~nts~~of Knowledge based on Aflatoxin Poisoning Among Poultry ~~Broiler~~ Farmers in Nairobi City County, Kenya

ABSTRACT

Background: There is scarcity of information concerning knowledge of aflatoxin contamination of feeds among farmers even in aflatoxin prone regions in Kenya. Thus, knowledge of aflatoxins in feeds among poultry farmers is of paramount importance in designing plans to minimize risks of aflatoxin exposure. Therefore, this study sought to assess the Determinants of Knowledge on Aflatoxin Among Broiler farmers in Nairobi City County, Kenya.
Methodology: The study utilized an analytical cross sectional study design. A total of 240 farmers were sampled from a population of 600 farmers within Nairobi City County. A structured questionnaire was administered to farmers within Nairobi City County. SPSS version 26 was used to analyze the data descriptively. Results were presented in tables and figures. Ethical approval was sought from relevant authorities and parties before commencement of the study**.**
Results: Results from the study show that majority of the farmers (58.2%) had knowledge on aflatoxin. There was a significant association ($p<0.05$) between socio demographic characteristics of farmers and knowledge on aflatoxin.
Conclusion: The study concludes that the farmers had adequate knowledge on aflatoxin occurrence in feeds and methods to reduce the contamination. There is need for continuous sensitization of farmers on aflatoxin particularly on feed management practices by the Ministry of Agriculture and Ministry of Health Division of Public Health in Kenya.

Keywords: Aflatoxin, contamination, detoxification

1. INTRODUCTION

Aflatoxins are a group of ~~extremely lethal, carcinogenic~~ fungal metabolites produced mainly by *Aspergillus flavus* and *Aspergillus parasiticus*(1). The United States Food and Drug Administration (FDA) terms aflatoxins as an inevitable food contaminant that regularly contaminates agricultural products worldwide and largely in developing countries (2). About 600 million (1 in 10 people globally) suffer from food borne diseases ~~infections~~ leading to about 420, 000 deaths annually resulting in the loss of 33 million Disability Adjusted Life Years (DALYs) (Ref)~~.~~ A considerable fraction of this burden is heavily felt in the African continent where unsafe food is responsible for about 91 million cases of food borne illnesses yearly and out of these 137,000 die prematurely (3).
In Kenya since 2004, aflatoxin epidemics among subsistence farmers have recurred yearly in the Eastern Province and the enormity of exposure to Afs(define before you use) could be higher than reported due to the lack of robust surveillance systems (4)(5).
Aflatoxin adulteration of poultry feed and raw feed ingredients is a serious concern globally (6). Close to 5 billion people in developing countries are at risk of chronic exposure to aflatoxins (7).
The main key players i.e. farmers that could have a substantial role in the control of aflatoxins have inadequate knowledge on the causes, effects and control measures of aflatoxins (8). Consequently, they are not keen on incurring the costs of controlling aflatoxin adulteration owing to that fact that most of their dealings are in informal markets without strict regulations (8). This is attributed to the lack of knowledge and alternatives for disposal of contaminated cereal at the household level and ultimately it is fed to domestic animals (9).
Nairobi unlike other towns in Kenya has been found to be the largest ultimate destination for poultry countrywide, and is also the main entry and transfer point for poultry within the East African Community

(10). In Nairobi City no data or information is readily available ~~County, little is known or documented~~ about the knowledge of aflatoxin among broiler farmers and ~~besides, little is known~~ whether the farmers' have sufficient knowledge on proper feed management practices. Therefore, this study aimed at assessing the knowledge of broiler farmers on Aflatoxin within Nairobi City County on aflatoxin.

Comment [JK1]: This statement seems to be factual. I think it should revised. If no data or information is readily available on the famers knowledge on the occurrence of aflatoxin it should be clear.

2. METHODOLOGY

2.1 Study area

The study was conducted in Nairobi City County. Nairobi is the capital city of Kenya and is one of Africa's strategic financial, business, transport, communications, non-governmental organizations and diplomatic capital. Nairobi city county population is about 4.397 million according to the 2019 census (11) therefore chicken production is expected to rise to meet this growing population.

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2.2 Study design, Sampling and Sample Size Determination

The study utilized a cross sectional study design through administering structured questionnaires. The study used a multistage cluster random sampling technique (two stage) to select the sub counties and wards where the questionnaires were administered to 240 respondents from a population of 600 as shown in Table 1. Systematic random sampling was used to select the farms where the questionnaires were administered and every 3rd (as shown in equation 2) farm was sampled until the desired sample size was attained. Proportionate distribution of sample was employed where by 40, 80, 30, 40, 30 and 20 respondents were interviewed in Westlands, Kasarani, Embakasi Central, Embakasi East, Dagoreti South and Dagoreti North respectively.

Table 1: Sampling frame: Number of farms sampled per sub-county

Sub county	Total number of farms	Number of farms sampled
Westlands	100	40
Kasarani	200	80
Embakasi Central	75	30
Embakasi East	100	40
Dagoreti South	75	30
Dagoreti North	50	20
Total	**600**	**240**

2.2.1 Sample size determination for Cross sectional design

Since the population is less than 10,000, Yamane *et al* formula (Yamane *et al.*, 2002) was used to determine the sample size as shown below.

$$n = \frac{N}{1 + Ne^2}$$

Equation 1

Where n- estimated sample size N- Estimated population size e- Margin of error (0.05)

$$n = \frac{N}{1 + Ne^2} = \frac{600}{1 + 600x0.05^2} = 240$$

240 was the number of farmers sampled from each ward in the six sampled sub counties within Nairobi City County.

Systematic random sampling formula; $K = N/n$ 600÷240= 2.5 rounded off to 3 Equation 2

2.3 Data analysis and ethical consideration

Statistical Package for Social Sciences (SPSS) version 26 was used to analyze the quantitative data from questionnaires. The data was subjected to descriptive analysis to determine proportions and chi square test was used to determine association between variables. Consent was sought from each participant on voluntary basis before participating in the study. The scope, purpose, risks and benefits of the study was explained in detail to the respondents before collecting data.

3. RESULTS

3.1 Knowledge on Aflatoxin

Figure 1 shows that the farmers who had knowledge on aflatoxin were (58.2%). The knowledge of aflatoxin was the mean of responses from the respondents based on various knowledge parameters asked.

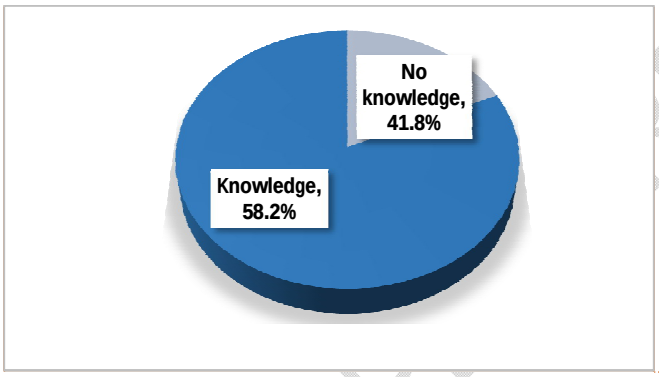

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Figure 1: Proportion of farmers with knowledge on aflatoxin in the study area

3.2 Factors associated with knowledge on Aflatoxins

Statistical analysis revealed that there was a significant association ($p<0.05$) between age and level of education with knowledge of aflatoxins as shown in Table 2.

Table 2: Association between sociodemographic characteristics and knowledge of aflatoxin

Variable	Category	Yes	No	Chi square (X^2)	P value	Remark
Sex	Male Female	67 (28.8%) 123(52.8%)	20(8.6%) 23(9.9%)	**1.896**	**0.169**	Not significant

Marital status	Married	165(70.8%)	40(17.2%)			
	Divorced	4(1.7%)	1(0.4%)		**0.446**	Not significant
	Single	21(9%)	2(0.9%)	**1.616**		
Education level	Primary	17(7.3%)	9(3.9%)			
	Secondary	133(57.1%)	27(11.6%)		**0.035**	Significant
	Tertiary	40(17.2%)	7(3%)	**5.174**		
Age	21-24	3(1.3%)	4(1.7%)			
	25-29	6(2.6%)	2(0.9%)			
	30-34	11(4.7%)	2(0.9%)			
	35-39	35(15%)	5(2.1%)		**0.047**	Significant
	40-44	31(13.3%)	11(4.7%)			
	45-49	36(15.5%)	5(2.1%)			
	≥50	68(29.2%)	14(6%)	**11.055**		

Table 3shows that there was a significant association (p<0.05) between level of education and knowledge on signs to suspect aflatoxin contamination in broiler feed.

Table 3: Association between sociodemographic characteristics and knowledge on signs to suspect aflatoxin contamination

Variable	**Category**	**Yes**	**No**	X^2	**P value**	**Remark**
Sex	Male	71(31.8%)	12(5.4%)			
	Female	115(51.6%)	25(11.2%)	**0.435**	**0.510**	Not significant
Marital status	Married	164(73.5%)	32(14.3%)			
	Divorced	2(0.9%)	2(0.9%)		**0.179**	Not
	Single	20(9%)	3(1.3%)	**3.445**		significant
Education level	Primary	19(8.5%)	8(3.6%)			
	Secondary	126(56.5%)	25(11.2%)		**0.043**	Significant
	Tertiary	41(18.4)	4(1.8%)	**5.246**		
Age	21-24	7(3.1%)	1(0.4%)			
	25-29	7(3.1%)	1(0.4%)			
	30-34	8(3.6%)	4(1.8%)			Not
	35-39	33(14.8%)	7(3.1%)		**0.697**	significant
	40-44	33(14.8%)	4(1.4%)			
	45-49	33(14.8%)	8(3.6%)	**3.850**		
	≥50	65(29.1%)	12(5.4%)			

There was a significant association (p<0.05) between knowledge of aflatoxins among farmers and source of information through which farmers heard about aflatoxin as reading and seminars were significant as shown in Table 4.

Table 4: Association between knowledge and sources of information on Aflatoxin

Variable	**Not Aware**	**Aware**	X^2	**P value**	**Remark**
Reading	28(12.1%)	203(87.9%)	**2.768**	**0.046**	Significant
Mass media	140(60.6%)	91(39.4%)	**1.121**	**0.290**	Not significant
Seminars	52(22.5%)	179(77.5%)	**9.661**	**0.002**	Highly Significant
Friends &neighbors	69(29.9%)	162(70.1%)	**0.182**	**0.669**	Not significant

Table 5 shows that majority of the farmers were knowledgeable on the signs used to suspect fungal contamination in feed as (85.1%) of the farmers were able to identify abnormal consistency, (79.6%) bad odor, (43.5%) presence of insect/larva and (54.6%) impaired animal health /deaths. However, majority of the farmers (77.7%) did not know how to identify abnormal color in feed.

Table 5: Knowledge on signs to suspect presence of fungal toxins in feed

Response	Abnormal color	Abnormal consistency	Bad odor	Insect/larva presence	Impaired animal health/death
Yes	53 (22.3%)	195 (85.1%)	187 (79.6%)	101(43.5%)	124 (54.6%)
No	185 (77.7%)	34 (14.9%)	48 (20.4%)	131(56.5%)	98 (45.4%)

4. DISCUSSION

Studies have reported that farmers' in developing countries know little about aflatoxin (12) however in the present study, the proportion of farmers who had knowledge on aflatoxin was relatively high. The proportion of farmers who had knowledge on aflatoxin in the current study was (58.2%), this was slightly higher than the value reported by Nakavuma*et al* (2020) (52.9%) (13). Makau *et al* (2016)(14) reported 38.5% of farmers had knowledge on aflatoxin while Marechera and Ndwiga (2014) reported (92.5%) of farmers had knowledge on aflatoxin in the lower eastern part of Kenya (15).This high level in Eastern Kenya was because the region has suffered numerous aflatoxin epidemics in humans in earlier years and the area is categorized as an aflatoxin hot spot. Studies have reported that the knowledge of aflatoxins and the other mycotoxins vary with several socio demographic characteristics (9).

In Ethiopia, farmers were found to be less knowledgeable compared to persons in other professions (16). Most respondents interviewed in the present study (67.8%) had attained secondary level of education with only a few who had attained tertiary education level. However, this was inconsistent with study by Nyangaga whereby the larger proportion of the farmers had attained tertiary level of education (17). Studies from various countries have reported that the level of education has an impact on aflatoxin awareness. In Tanzania, studies have revealed that education level has a positive effect on knowledge of aflatoxin (18)(19).

The present study reports that most of the farmers heard about aflatoxin through mass media and seminars. This suggests that mass media and seminars are currently the best channels to convey information regarding aflatoxin to farmers and the general population. On the contrary, the percentage of farmers who heard about aflatoxin through reading were the least and this suggests that there could be inadequacy of written materials on aflatoxins, low reading drive by farmers, or the materials are too advanced for the farmers. This was in agreement with the findings reported by Ayo et al (2018)(20).

The current study reported that a higher proportion of the farmers were knowledgeable on the occurrence of fungal toxins in feed this was consistent with the findings reported by Ayo *et al* (2018) in Tanzania (20). However, this was inconsistent from studies from various settings that reported that farmers have low awareness on the concept of aflatoxins (21)(22)(23). Most farmers from the present study had knowledge on the possibility of mycotoxins in feed affecting poultry/ animal health and experimental results from various studies support this phenomenon (24)(25). Acute levels (high) of mycotoxins are lethal within a short period of time while chronic levels (low) lead to death after a relatively long period of time causing immunosuppression, increase in susceptibility and opportunistic diseases. Mycotoxin adulteration of feeds is also linked to impaired health and consequently leads to low production performance and may lead to animal death(26).

Comment [JK5]: Where little means? Since you are comparing that to the present study in percentages it should be uniformed

Comment [JK6]: This cannot account to the high knowledge. Have they gone through some knowledge based training to increase awareness? Please be clear

Comment [JK7]: What is the implication with the other studies and studies in Ethiopia (what percentage of famers) and why the difference compared to the present study if any

Comment [JK8]: Does the level of education in the present study differs from the other studies in response to aflatoxin awareness? If yes please discuss

Additionally, majority of the farmers from the present study reported that there is likelihood of mycotoxins to be transferred (carried over) from feed to the tissues of poultry / animals, however this disagrees with a study done in Tanzania where majority of the farmers mentioned~~reported~~ that the transfer of mycotoxins from feed to poultry/animal is not possible (20). The results of the study in Tanzania were consistent with a report by Kiama *et al*(2016) (9) on the perception of dairy farmers in Kenya, which revealed that consumption of moldy food by humans is unsafe but consuming products from animals fed on moldy feeds is harmless. Other reports by Grace and Okoth disagree with this perception (26)(27). Their findings proved that mycotoxins ingested with feeds by animals are assimilated into body tissues and subsequently transferred to humans in the food chain.

The findings of this study illustrate that farmers were knowledgeable on the signs of feed contamination with mycotoxins and are able to identify various signs that indicate contamination such as abnormal consistency, bad odor, presence of insects/larvae and impaired animal health/ death. These indicators and signs were also found in an on-farm study by Golob on approaches to control mold and mycotoxin development in feeds (28). Golob reported that these suggestive signs are instrumental in identifying moldy feeds that are suspected to be contaminated with aflatoxins. Nonetheless, it is important to note that lack of these signs does not warrant that the feeds are safe. Numerous studies have reported that it is impossible to have mycotoxin free feeds under normal conditions. Results from these studies have shown that feed discoloration and off-smell are useful indicative factors to suspect feed adulteration and probably presence of aflatoxins and other fungal toxins. Furthermore, majority of the farmers from the current study reported that they did not know any indicator to suggest presence of these toxins in feeds. Studies have reported that the lack of ability to suspect and identify feed degeneration and adulteration using fast rapid tests, could lead to exposure to aflatoxin adulteration of feeds thus posing a risk to human consumers (28).

Most farmers from the present study had knowledge on mycotoxin prevention strategies for instance good storage practices as this was evident in the following areas; majority of the famers stored their feeds in well ventilated stores and majority of them placed the poultry feed on raised ground. Studies have shown that improper storage practices for instance stack piling of feeds and storing feeds on bare floor and other poor bulk management practices of feeds, including extended time in storage, predisposes feeds to adulteration with aflatoxin forming fungi (29)(14).

6. CONCLUSION

The study concludes that the farmers' knowledge on aflatoxin was average~~fair.~~ Reports from FGD show that farmers did not have knowledge on carry over, measures taken with feeds found contaminated with ~~fungal toxins/~~aflatoxins, detoxification of contaminated feed and knowledge on signs to show that a broiler has been infected with aflatoxin. The study also revealed that there was a significant association ($p<0.05$) between age and level of education with knowledge on aflatoxins. The study also revealed that there was a significant association ($p<0.05$) between level of education and knowledge on signs to suspect aflatoxin contamination in broiler feed. There was a significant association ($p<0.05$) between knowledge on aflatoxins among farmers and means through which farmers heard about aflatoxin and ~~the study~~ further revealed that, obtaining information about aflatoxin through reading and from seminars were significant.

There is need for continuous sensitization of farmers on aflatoxins particularly in feed management through extension services by the Ministry of Agriculture and Ministry of Health Division of Public Health both at the county and national levels, to safeguard the public from exposure to aflatoxin contamination.

ETHICAL APPROVAL

Approval to carry out the study was obtained from Kenyatta University graduate school. Ethical approval was obtained from Kenyatta University Ethical and review committee Approval number (PKU/2163/II307). A research permit to carry out the study was obtained from National commission for Science, Technology and innovation (NACOSTI) license number (NACOSTI/P/20/8037. Authorization was also obtained from

Comment [JK9]: What is the meaning?

the Ministry of Agriculture, Division of Veterinary Services before commencement of the study. Consent was sought from each participant on voluntary basis before participating in the study.

REFERENCES

1. Sana S. Molecular Approaches for Characterization of Aflatoxin Producing Aspergillus flavus Isolates from Poultry Feed. Pak Vet J. 2019;39(02):169–74.
2. JECFA. Evaluation of certain contaminants in food, Prepared by the Eighty-third report of the Joint FAO/WHO Expert Committee on Food Additives (JECFA) [Internet]. WHO Technical Report Series. 2017. 90–106 p. Available from: http://www.ncbi.nlm.nih.gov/pubmed/29144071
3. WHO. Programme Budget 2018–2019: Implementation and mid-term review [Internet]. 2019. Available from: https://apps.who.int/iris/handle/10665/327904
4. Obonyo MA, Salano EN. Perennial and seasonal contamination of maize by aflatoxins in eastern kenya. Int J Food Contam [Internet]. 2018 Aug 31 [cited 2023 Feb 23];5(1):1–5. Available from: https://foodsafetyandrisk.biomedcentral.com/articles/10.1186/s40550-018-0069-y
5. Kilonzo RM, Imungi JK, Muiru WM, Lamuka PO, Njage PMK. Household dietary exposure to aflatoxins from maize and maize products in Kenya. Food Addit Contam Part A Chem Anal Control Expo Risk Assess [Internet]. 2014 Dec 2 [cited 2023 Feb 23];31(12):2055–62. Available from: https://pubmed.ncbi.nlm.nih.gov/25325777/
6. Lubna MA, Debnath M, Hossaini F. Detection of Aflatoxin in Poultry Feed and Feed Materials through Immuno Based Assay from Different Poultry Farms and Feed Factories in Bangladesh. Bangladesh J Microbiol. 2019;35(1):75–8.
7. Udomkun P, Wossen T, Nabahungu NL, Mutegi C, Vanlauwe B, Bandyopadhyay R. Incidence and farmers' knowledge of aflatoxin contamination and control in Eastern Democratic Republic of Congo. Food Sci Nutr. 2018;6(6):1607–20.
8. Sirma AJ, Ouko EO, Murithi G, Mburugu C, Mapenay I, Ombui J, et al. Prevalence of aflatoxin contamination in cereals from Nandi county, Kenya. Int J Agric Sci Vet Med [Internet]. 2015;3(3):1–9. Available from: www.ijasvm.com
9. Kiama TN, Lindahl JF, Sirma AJ, Senerwa DM, Waithanji EM, Ochungo PA, et al. Kenya dairy farmer perception of moulds and mycotoxins and implications for exposure to aflatoxins: A

gendered analysis. African J Food, Agric Nutr Dev. 2016;16(3):11106–25.

10. McCarron M, Munyua P, Cheng PY, Manga T, Wanjohi C, Moen A, et al. Understanding the poultry trade network in Kenya: Implications for regional disease prevention and control. Prev Vet Med [Internet]. 2015 Jul 1 [cited 2023 Feb 23];120(3–4):321–7. Available from: https://pubmed.ncbi.nlm.nih.gov/26002998/
11. KNBS. Kenya population and housing census volume 1: Population by County and sub-County [Internet]. Vol. I, Kenya National Bureau of Statistics. 2019. 1–38 p. Available from: https://www.knbs.or.ke/?wpdmpro=2019-kenya-population-and-housing-census-volume-i-population-by-county-and-sub-county
12. Unnevehr L, Grace D, BANDYOPADHYAY R, COTTY PJ, WALKER S, DAVIES B, et al. Aflatoxins Finding Solutions for Improved Food Safety. 2020 Vis Focus. 2013;(November):1–63.
13. Nakavuma JL, Kirabo A, Bogere P, Nabulime MM, Kaaya AN, Gnonlonfin B. Awareness of mycotoxins and occurrence of aflatoxins in poultry feeds and feed ingredients in selected regions of Uganda. Int J Food Contam [Internet]. 2020 Apr 24 [cited 2023 Feb 17];7(1):1–10. Available from: https://foodsafetyandrisk.biomedcentral.com/articles/10.1186/s40550-020-00079-2
14. Makau CM, Matofari JW, Muliro PS, Bebe BO. Aflatoxin B1 and deoxynivalenol contamination of dairy feeds and presence of aflatoxin M1 contamination in milk from smallholder dairy systems in Nakuru, Kenya. Int J Food Contam [Internet]. 2016 Jul 28 [cited 2023 Feb 17];3(1):1–10. Available from: https://foodsafetyandrisk.biomedcentral.com/articles/10.1186/s40550-016-0033-7
15. Marechera G, Ndwiga J, Agricultural A, Foundation T, Nairobi POB. Farmer perceptions of aflatoxin management strategies in lower Eastern Kenya. J Agric Ext Rural Dev. 2014;6(12):382–92.
16. Guchi E. Stakeholders' perception about aflatoxin contamination in groundnut (Arachis hypogaea L.) along the value chain actors in eastern Ethiopia. Int J Food Contam [Internet]. 2015;2(1). Available from: http://dx.doi.org/10.1186/s40550-015-0014-2
17. Nyangaga D, Kwamboka BE. Traders' awareness and level of aflatoxins in human foods and cattle feeds in selected markets and stores in Nairobi County, Kenya. 2014 [cited 2023 Feb 17]; Available from: https://ir-library.ku.ac.ke/handle/123456789/12053

18. Ngoma SJ, Kimanya M, Tiisekwa B, Mwaseba D. Perception and Attitude of Parents towards Aflatoxins Contamination in Complementary Foods and Its Management in Central Tanzania. J Middle East North Africa Sci [Internet]. 2017 Mar [cited 2023 Feb 17];10(4086):1–16. Available from: https://platform.almanhal.com/Details/Article/98674
19. Magembe KS, Mwatawala MW, Mamiro DP, Chingonikaya EE. Assessment of awareness of mycotoxins infections in stored maize (Zea mays L.) and groundnut (arachis hypogea l.) in Kilosa district, Tanzania. Int J Food Contam. 2016;3(1).
20. Ayo EM, Matemu A, Laswai GH, Kimanya ME. Socioeconomic Characteristics Influencing Level of Awareness of Aflatoxin Contamination of Feeds among Livestock Farmers in Meru District of Tanzania. Scientifica (Cairo) [Internet]. 2018 [cited 2023 Feb 17];2018. Available from: https://www.readcube.com/articles/10.1155%2F2018%2F3485967
21. Loreen D. Assessment of Aflatoxin Awareness by Players in Groundnut Value Chain : The Case of Dora in Mutare , Zimbabwe Abstract : 2015;4(10):90–100.
22. Gizachew D, Szonyi B, Tegegne A, Hanson J, Grace D. Feed storage practices and aflatoxin contamination of dairy feeds in the Greater Addis Ababa milk shed, Ethiopia. 2015 [cited 2023 Feb 17]; Available from: https://agris.fao.org/agris-search/search.do?recordID=QT2016105392
23. Kamala A, Kimanya M, Haesaert G, Tiisekwa B, Madege R, Degraeve S, et al. Local post-harvest practices associated with aflatoxin and fumonisin contamination of maize in three agro ecological zones of Tanzania. Food Addit Contam - Part A Chem Anal Control Expo Risk Assess. 2016;33(3):551–9.
24. Unnevehr L, Grace D. AFLATOXINS: FINDING SOLUTIONS FOR IMPROVED FOOD SAFETY Sources of mycotoxins in the diet of livestock Sources of mycotoxins in the diet of livestock Susceptibility of livestock Susceptibility of livestock Impacts of aflatoxins on animal health and Impacts. 2013;(November). Available from: http://cdm15738.contentdm.oclc.org/utils/getfile/collection/p15738coll2/id/127875/filename/128086.pdf
25. Umar S, Munir MT, Ali Shah M, Shahzad M, Ahmad Khan R, Sohoo M-R, et al. Outbreak of aflatoxicosis on a local cattle farm in Pakistan. Veterinaria. 2015;3(1):13–7.

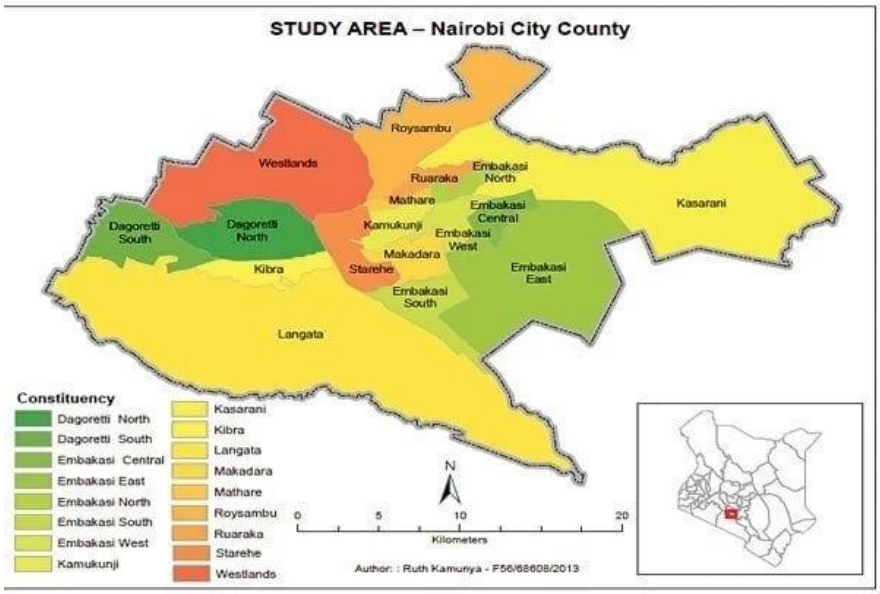
26. Grace, D., Kang'ethe, E., Lindahl, J., Atherstone, C., Nelson, F., and Wesonga T. Aflatoxin: Impact on animal health and productivity. East African Community [Internet]. 2015; Available from: https://cgspace.cgiar.org/handle/10568/75536

27. Okoth S. Improving the Evidence Base on Aflatoxin Contamination and Exposure in Africa. Paca. 2016;1–113.

28. Golob. on-Farm Mycotoxin Control in Food and Feed Grain on-Farm Mycotoxin Control in Food and Feed Grain. Vol. 1, Food and Agriculture Organization,. 2007. 38 p.

29. O'Bryan CA, Crandall PG, Ricke SC. Mycotoxin outbreak in animal feed. Foodborne Dis Case Stud Outbreaks Agri-Food Ind [Internet]. 2016 Apr 6 [cited 2023 Feb 17];411 p. Available from: https://hal.science/hal-01603991

APPENDIX



Map of Nairobi City County (Source: Ruth Kamunya, 2013)