



Journal Homepage: - www.journalijar.com
**INTERNATIONAL JOURNAL OF
 ADVANCED RESEARCH (IJAR)**

Article DOI: 10.21474/IJAR01/5359
 DOI URL: <http://dx.doi.org/10.21474/IJAR01/5359>



RESEARCH ARTICLE

CONSTRAINTS THAT AFFECT THE PRODUCTIVITY OF INDIGENOUS CHICKEN IN KIKUMINI/MUVAU AND KITHUNGO/KITUNDU WARDS OF MAKUENI COUNTY, KENYA.

Mutua Benson Musyoka¹, Aphaxard J N Ndathi² and Erick O Mungube³.

1. Ministry of Agriculture Livestock and Fisheries. P.O Box 42-90300 Makueni. Kenya.
2. Department of Range and Wildlife sciences, South Eastern Kenya University, P.O Box 170-90200 Kitui. Kenya.
3. Kenya Agriculture & Livestock Research Organization (KALRO), Muguga North Veterinary Research Centre, P.O. Box 32-00902. Kikuyu, Kenya.

Manuscript Info

Manuscript History

Received: 08 July 2017
 Final Accepted: 10 August 2017
 Published: September 2017

Key words:-

Biosecurity, Chicken productivity, Challenges, Diseases and parasites, Free-range.

Abstract

The study sought to assess the Constraints that affect the productivity of indigenous chicken in Kikumini/Muvau and Kithungo/Kitundu wards of Makueni County Kenya. The study location is 87% Arid and Semi-arid and very marginal to successful crop production. Poultry production is the most widespread subsistence agricultural activity where about 75-80% of all farm families practice this enterprise. Extensive (scavenging) system of production which subjects chicken to risk of disease outbreaks and high infestation by parasites dominates indigenous chicken production in the county. A total of 158 households (72 in Kikumini/Muvau ward and 86 in Kithungo/Kitundu ward) were randomly sampled for collection of primary data using semi structured questionnaires. Results revealed that indigenous chicken productivity is negatively affected mainly by diseases and parasites, and high cost of feeds, low adoption of biosecurity measures and inadequate extension services. The study recommends that; the county government and private service providers ought to improve on service delivery to the chicken producers in terms of quality and coverage, disseminating seasonal messages when due and targeting the major decision makers in the chicken enterprise at household level. It further recommends financial empowerment to farmers in order to deal with many challenges facing indigenous chicken production in Makueni County.

Copy Right, IJAR, 2017,. All rights reserved.

Introduction:-

Agriculture plays a significant role in Kenya's economy. The sector directly contributes 24% of the GDP and another 26% indirectly (ASDSP 2013). Agriculture is the second largest industry after the service sector, accounting for approximately \$58 billion earnings annually. The sector accounts for 65% of Kenya's total exports, 18% and 60% of formal and total employment respectively (KIPPRA 2013). Small-scale farmers dominate Kenya's agriculture, accounting for 75% of the total agricultural output. This sector supplies the manufacturing industries with raw materials and generates tax revenue and foreign exchange that support the rest of the economy. The sector employs over 40% of the total population (ASDSP 2013) and is the main source of livelihood to almost 80% of Kenyan population living in the rural areas (KIPPRA 2013). The Kenya's Vision 2030 development plan has

Corresponding Author:- Mutua Benson Musyoka.

Address:- Ministry of Agriculture Livestock and Fisheries. P.O Box 42-90300 Makueni. Kenya.

identified agriculture as one of the key sectors to deliver the 10% annual economic growth rate envisaged under the economic pillar (ASDSP 2013).

Livestock plays important economic and socio-cultural roles among many Kenyan communities. It is used as a measure of wealth and insurance against drought in pastoral communities, payment of penalties, dowry and settling of disputes amongst families in many regions of Kenya. The livestock sub-sector contributes to the food and cash needs of the farmers, and provides employment to about 10 million people, contributes 7 per cent to the GDP and 17 per cent to the Agricultural GDP. It also provides 50% of the agricultural labour (GoK 2010). Kenya had an estimated 11,479,414 tropical livestock units (TLU) comprising cattle, sheep, goats, donkeys, camels, pigs, poultry (including ostrich) and rabbits valued at Ksh. 264.8 billion (equivalent to US\$4.4 billion) in 2006 (Omiti and Okuthe 2010). The sub-sector accounts for about 30 per cent of total agricultural products, which earn the country foreign exchange through the export of live animals, dairy products, hides and skins. Livestock has poverty-reducing potential (KIPPRA, 2013).

Most rural families in Kenya (an estimated 75%) keep chicken. Indigenous chickens contribute 71% of the total egg and poultry meat produced in Kenya and therefore impact greatly on the rural trade, welfare and food security of smallholder farmers (Nyaga P 2007). Annually Kenya produces about 20 million tons of poultry meat worth KES 3.5 billion and 1.3 billion eggs worth KES 9.7 billion (Nyaga P 2007). Poultry meat is the fastest growing component of global meat production, consumption, and trade, with developing and transition economies contributing a leading role in the expansion. In addition to providing opportunities to increase poultry exports, rising poultry production spurs growth in global import demand for feeds and other inputs which give rise to investment opportunities in these sectors. The livestock sector, poultry included, is expected to continue to meet rising world demand for animal products cheaply, quickly and safely (Aila et al 2012). Despite increasing demand for IC products by local consumers, their low productivity, attributed to high disease incidences, inadequate nutrition, low genetic ability and poor marketing channels, reduce their contribution to rural development (Mwobobia 2015). Indigenous chicken have not attained their full production potential due to exposure to risks that militate against their survival and productivity. Challenges to production include diseases, predators and poor nutrition. Indigenous chicken can be profitable if managed well. Control of common diseases in the free-range system could improve survival rate of chicks by at least 30% while improved feeding, housing and disease control could increase survival rate to 80% (Odwaso et al 2006).

In terms of biosecurity, the backyard poultry producers use little or minimum external inputs, which include poor quality feed; mixed cereals; local breeds sometimes combined with improved breeds obtained from extension service providers or neighbouring farmers; minimal veterinary services; local labour and traditional housing systems (Aila et al 2012). Indigenous chicken are predominantly produced in village backyards with little or no biosecurity measures. This production system is characterized by unconfined birds that scavenge around the homestead and often interact with wild bird species in the process contract diseases (Aila et al 2012).

Materials And Methods:-

Study Location:-

The study was conducted in Makueni County, located in South Eastern Kenya covering an area of 8,034.7 Km² and is one of the forty seven (47) counties in Kenya. It lies between Latitude 1° 35' and 3° 00' South and Longitude 37°10' and 38° 30' East. By 2015 the population in the county had grown to 961,738, (468,298 males and 493,440 females) and is projected to rise to 1,116,136 by 2025 (Makueni County Agriculture Profile 2015). The County lies in agro-ecological zone UM3 (Marginal coffee zone) to LM5 (Livestock-millet zone) (Jaetzold et al 2006). The County terrain is generally low-lying from 600m above sea level in Tsavo at the Southern end of the county to about 1980m in Mbooni hills to the North West.

The Kikumini/Muvau ward is mainly arid and experiences prolonged droughts from time to time characterized by extreme rainfall variability in amount and distribution. Crops grown in Kikumini/Muvau ward include drought tolerant crops like sorghum, cow peas, green grams and pigeon peas. Livestock kept includes Zebu cattle, dairy crosses, meat goats, local sheep and indigenous chicken. Kithungo/Kitundu ward is situated in UM 3 and is slightly wetter than Kikumini/Muvau ward. Crops grown in Kithungo/Kitundu include maize, beans for subsistence, while in some pockets coffee is grown as cash crop. Cattle including dairy crosses and meat and dairy goats, indigenous, improved and commercial chicken are reared in Kithungo/kitundu ward. Dairy farming is slowly taking root in this ward.

Study design:-

The study sampled 158 households using the formulae: $n = Z_{\alpha}^2 p(1-p)/L^2$, Where; $Z_{\alpha} = Z_{0.05} = 1.96$; L= the precision of the estimate (allowable error or margin of error =5%). Out of 158 households, Kithungo/Kitundu ward was allocated 86 while the 72 went to Kikumini/Muvau ward. Simple random sampling was used to select farmers from each ward. Primary data was collected using semi structures questionnaires administered to chicken farmers at the household level.

Collection of data:-

Primary data was collected at the grassroot (community) level through focussed group discussions (FGDs) and household survey using questionnaires. The semi-structured questionnaire which was developed and pretested, was administered to collect data on ; i) general information of the respondent and the household status, ii) constraints that affect the productivity of indigenous chicken in the study area, iii) biosecurity measures practised in the study area and iv) the socio-economic and ecological factors that hinder the adoption of biosecurity measures in the study area. The questionnaire was administered to the household head or his/her representative of sound mind. Two focussed group discussions were conducted within the proximity of the selected households in both Kikumini/Muvau and Kithungo/Kitundu wards. Participants in the FGDs were farmers from the households that fall under the category of small holder, and had not been interviewed during household surveys. In Kikumini/Muvau 17 farmers (9 males and 8 females) participated in FGD while, in Kithungo/Kitundu 16 farmers (11 males and 5 females) participated. The FGDs were to check the possible socio-economic and ecological factors that could be hindering adoption of biosecurity measures that have been disseminated to the IC producers and their suggested solution.

Statistical analysis:-

Primary data collected was cleaned, coded and analysed using both MS Excel 2010 and Statistical Package for Social Sciences (SPSS) version 20.0 data analysis software. The analysis focused on the specific variables that touched on constraints that affect the productivity of indigenous chicken in Kikumini/Muvau and Kithungo/Kitundu wards.

Descriptive statistics for frequencies, percentages, means, dispersion, distribution and cross tabulation were used during analysis. Correlation analysis and linear regression analysis was also conducted to test statistical difference of means of age of respondents, household size and land size. The data findings were interpreted with support of other documented research reports available in hard and soft documents. A composite score was computed to aid in discussing the analyses. The composite score was derived by adding strongly agree and agree to form one score (Has affected) while strongly disagree and disagree formed another score (Has not affected) this is in response to questions seeking committal answers from respondents. The non-committal responses were not factored in the composite score and hence were ignore

Results:-

From the study findings, the major challenges facing chicken rearing in the two study wards were diseases, parasites, predators, and inadequate feeds (Table 1). Other constraints noted were lack of proper chicken housing, conflict with neighbours, low chicken husbandry skills, small returns from chickens, theft and rat menace.

Table 1:- Challenges faced when rearing indigenous chicken in both study wards

Challenges	Kikumini/Muvau		Kithungo/Kitundu	
	N	%	N	%
Predators attacks	124	28.3	93	21.6
Diseases	112	25.6	120	27.9
High cost of feeds	60	13.7	79	18.4
Parasites	35	8.0	39	9.1
Lack of proper chicken housing	30	6.8	24	5.6
Lack of chicken husbandry skills	30	6.8	20	4.6
Small returns	18	4.1	7	1.6
Theft	17	3.9	21	4.9
Conflict with neighbours	9	2.1	25	5.8
Rats menace	3	0.7	2	0.5

Total	438	100.0	430	100.0
--------------	------------	--------------	------------	--------------

New castle disease (NCD) was identified as the main disease condition that affect chicken productivity, closely followed by Infectious Bursal Disease (Gumboro), fowl pox, Coccidiosis and respiratory diseases (Fig 1). The other disease conditions were leg paralysis (Mareks) and a host of undefined disease conditions.

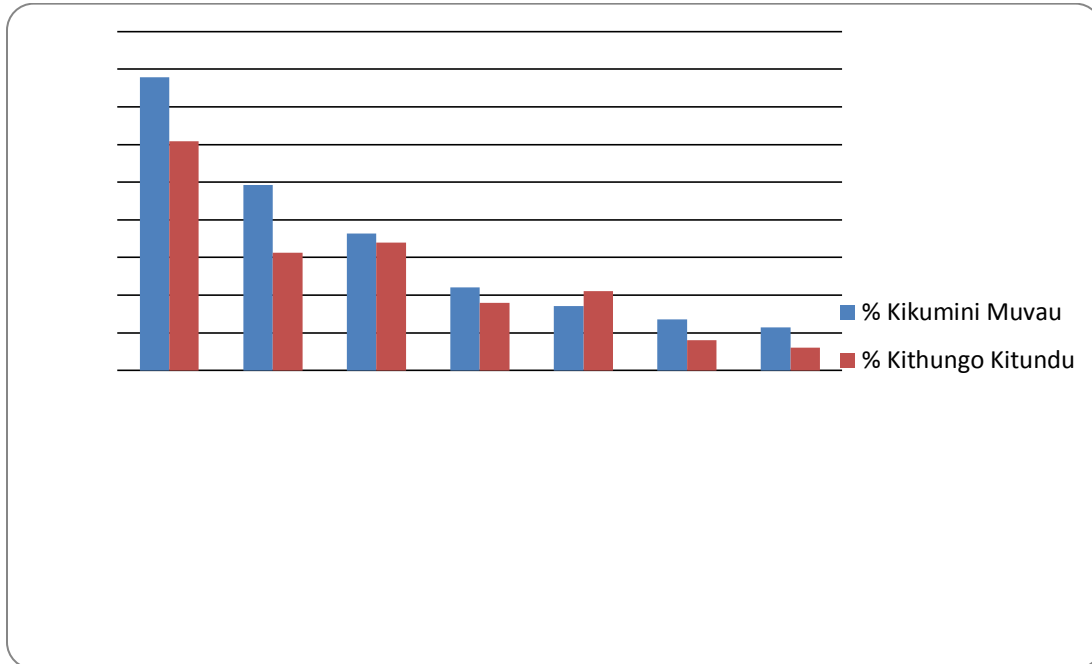


Figure 1:- Chicken diseases experienced

On disease management, farmers interviewed in the two wards used numerous methods such as treatment using ethno-veterinary and conventional veterinary drugs, vaccination and selling the flocks to evade disease outbreaks (Table 2). Treatment was the most preferred method of responding to disease outbreaks followed by vaccination. Some respondents did self treatments, while others called veterinary professionals. Other methods of responding to disease outbreaks included slaughtering the birds for home consumption.

Table 2:- Management of chicken diseases

Disease management practice	Kikumini/Muvau % x/n		Kithungo/Kitundu %x/n	
	N	Per cent	N	Percent
Treatment using herbs	65	43.3	42	28.4
Self-treatment using veterinary drugs	29	19.3	54	36.5
Vaccination	27	19	30	20.2
Call veterinary officer	20	13.3	17	11.5
Selling affected chicken	4	2.7	2	1.4
Slaughtering affected chicken	4	2.7	1	0.7
Do nothing	1	0.7	2	1.3
Total	150	100.0	148	100.0

Discussions:-

Indigenous chicken farmers in the study wards are faced with wide range of challenges. These challenges included diseases and parasites, and high cost of feeds and inadequate extension services as the major ones. Since the freeze of mass employment by government of Kenya over the past two decades, farmers receive limited extension services from the few workers available per ward. However non-governmental staff, faith based organizations and private professionals do supplement government services. Other challenges faced were inadequate skills in chicken management, chicken theft and conflict with neighbours especially where chicken are kept on free range system of

production. Predator attack was indicated as a constraint of lesser impact. This echoes the findings of Ondwasy, Wesonga and Okitoi 2006, who reported that Indigenous chicken have not attained their full production potential due to exposure to risks that militate against their survival and productivity, with major constraints being diseases, predators and poor nutrition.

New castle disease still remain a menace in both study wards (at 77.9%), followed by Gumboro (Infectious Bursal disease), Fowl pox, Coccidiosis and respiratory diseases. These diseases have remained a threat to the chicken farmers. However the farmers have not embraced vaccination as the recommended approach to control diseases before outbreaks. Poor chicken housing with less frequency of cleaning and limited disinfection can also be singled out as the reason why Coccidiosis is experienced in the two wards. These findings are in agreement with findings of King'ori, Wachira and Tuitoek (2010) in their study on indigenous chicken production in Kenya. Study by Okwor and Eze (2011) found Newcastle disease being the most significant diseases for poultry producers around the world. This poultry disease is influenced directly or indirectly by weather and climate. The limited use of modern methods of managing indigenous chicken diseases was found to be another constraints facing chicken production in the study area.

High use of herbs by 43.3% of chicken farmers in Kikumini/Muvau and 28.4% in Kithungo/Kitundu is indicative of how conventional chicken drugs have not been embraced in the both study wards either due to their costs, inaccessibility or merely lack of awareness of their availability or/and perceived ineffectiveness due to previous misuse of the antibiotic. Most farmers in Kithungo/Kitundu buy drugs and vaccinate their birds as indicated by 36.5% and 20.2% respectively. On the contrary in Kikumini/ Muvau vaccination is very low (18%). This is a low percentage bearing in mind that the area is normally affected by four killer diseases (New castle disease, Fowl pox, Fowl typhoid and Gumboro) which annually combined claim over 70% of chicken in Makueni County. Low usage of veterinary officers in the study area (13.3% in Kikumini/Muvau and 11.5% in Kithungo/Kitundu) is attributed to the low number of public extension staff including veterinary officers in the county where extension staff : farmers ratio is 1:1800 (Makueni County Agriculture profile 2013).

Cleaning of chicken houses though practised by higher number of the farmers (86.8% in Kikumini/Muvau ward and 74.9% in Kithungo/Kitundu), on its own is not a very effective strategy in controlling of parasites. Use of vermin dust is better approach but practised by few farmers. The above two measures of controlling parasites is laudable but use of wood ash, splashing of water and detergents as indicated by over 33% of respondents are methods with unknown effectiveness pose a great constraints of ensuring indigenous chicken biosecurity is maintained. Related results were reported by Khandait et al 2011 and Mfaume (2008) in their studies in India and Tanzania respectively.

The study established that 74.1% of farmers use free range method of indigenous chicken production. This method coupled with poor housing and mixing with neighbours chicken pose great danger of spread of diseases and parasites across farms. The lack of appropriate shelter to house birds exposes them to vagaries of the weather which tends to affect productivity. These observations are supported by the findings by Onuekwusi (2001) in a survey on commercial poultry production in Nigeria which showed that more than half of the surveyed poultry farms did not provide adequate housing or shelter for their chickens. Majority (90.2%) of the farmers supplement their chicken. However the supplement feeds given are mostly from whole grains produced at their farms, leftovers, green vegetables which may not provide balanced diet. The lack of balance diet given indigenous chicken does not catalyse their growth or faster weight gain but contributes to low production of meat and eggs. This state of affair is supported by Ali 2012 who argues that in most cases farmers don't offer balanced or standard feeds instead they provide supplements of grains and food residues. Best practices recommend commercial feeds with proper formulation (balanced diet) should be used to supplement free range indigenous chicken production. Use of low quality feeds materials to supplement indigenous chicken is attributed to high cost of commercial feeds. This fact is supported by King'ori, Wachira & Tuitoek (2010) who found out that the prices of feed have been constantly increasing. Due to recent global changes in the price structure of the cereal grains and other feed stuffs, the poultry industry at present is handicapped on account of high feed cost which has gone over to more than 60% of the total cost of production King'ori, Wachira & Tuitoek (2010). Obtaining quality poultry feed also presents a challenge to poultry famers.

Majority (85.3%) of the farmers agreed that constraints facing production of indigenous chicken have negatively affected productivity in both study wards these included; diseases, parasites, high cost of feeds, costly construction materials and predation. Similar studies (Mapiye et al 2008, Fisseha et al 2010, Magothe et al 2012, Oosthuyen

2013, Gwala 2014 and Butler 2016) also indicate these as production constraints faced by chicken farmers. Other researchers (Adebayo and Adeola, 2005, Mapiye et al 2008, Bongani and Masuku 2013, Ndathi et al 2012 and Kyule et al 2015) found socio-economic factors as crucial constraints in chicken production in their studies. Ownership of chicken at household level and land ownership are also other socio-cultural challenges facing indigenous chicken in the study area. Different studies (FAO, 2004, FAO 2008, Fisseha et al 2010 and Ndathi et al 2012) also found socio-cultural aspect in different communities as constraints that affect indigenous chicken productivity.

Conclusion:-

- Lack of adequate biosecurity measures to protect their chicken from diseases infections and parasites infestation have led to low productivity of indigenous chick
- Diseases and parasites, New castle disease, Gumboro (Infectious Bursal disease) and Fowl Pox also lower productivity of indigenous chick.
- Inadequate resources and inadequate knowledge on chicken management have led to low practices of vaccination and as a result farmers use herbs to treat chicken diseases as an alternative.
- High cost of feeds and feed ingredients are also a hindrance to productivity of indigenous chicken.
- Environmental variability (especially cold seasons when chicken diseases outbreaks mostly occur) has also negatively affect productivity of indigenous chicken

Recommendations:-

The study recommends that; the county government of Makueni and private service providers ought to improve on service delivery to the chicken producers in terms of quality and coverage, disseminating seasonal messages when due and targeting the major decision makers in the chicken enterprise at household level. It further recommends financial empowerment to farmers in order to deal with many challenges facing indigenous chicken production in Makueni County.

Acknowledgement:-

The authors greatly appreciate the administration officials of the two wards for awareness creation and mobilization of the farmers, the poultry farmers of Kikumini/Muvau and Kithungo/Kitundu wards for voluntarily participating in the survey interviews. The enumerators who assisted in data collection, and the statisticians for their technical support.

References:-

1. Adebayo O. O. and Adeola R. G. (2005): Socio-Economic Factors Affecting Poultry Farmers in Ejigbo Local Government Area of Osun State. Nigeria. Agricultural Economics and Extension Department, Ladoke Akintola University of Technology, P M B 4000 Ogbomoso, Nigeria. Retrieved on 9th January 2017, from www.citeseer.ist.psu.edu/viewdoc/download
2. Aila Fredrick, David Oima, Isaac Ochieng, Odhiambo Odera (2012): Biosecurity Factors informing consumer preference for indigenous chicken: a literature review. *Business and Management Review vol.1 (12)* pp 60-71 February 2012. Retrieved on February 2016 from <http://www.businessjournal.org/bmr>
3. Ali S A M (2012): Family poultry as a tool in alleviating environmental hazards in settled areas of transhumant families in Gezira Scheme Sudan. *Asian Journal of Rural Development 2(1):1-12.*
4. ASDSP (2013) Agricultural Sector Development Support Programme, Programme document. Ministry of Agriculture, Livestock and Fisheries. Government of Kenya. May 2013.
5. Bongani J Siyaya and M B Masuku (2013): Factors Affecting Commercialisation of Indigenous Chickens in Swaziland. Department of Agricultural Economics and Management, University of Swaziland, Manzini, M200, Swaziland. *Journal of Agricultural Studies* ISSN 2166-0379 2013, Vol. 1, No. 2
6. Butler John Eden (2016) Prospects and challenges of poultry farming in the Wa Municipality of the Upper West Region of Ghana. Department of Development Studies, University for Development Studies, Wa Campus, Ghana. *African Journal of Poultry Farming* ISSN 2375-0863 vol. 4(1) pp 103-112. Retrieved on 30th January 2017 from www.internationalscholarsjournal.org
7. FAO (2004): Manual on Small scale poultry production, Agriculture and consumer production. *Research and Development for family poultry. Chapter 10.* Eds; E B Sonaya and Swan S C J-Rome 2004. ISBN 92-5-105082-1. Retrieved on April 2015 from www.fao.org/docrep/008/y5169e.

8. FAO (2008): Biosecurity for highly pathogenic Avian Influenza, Eds; Phil Harris, Issues and options paper number 165, *Animal production and health* ISSN 0254-6019, Viale delle Terme di Caracalla 00153 Rome Italy
9. Fisseha Moges, Azage Tegegne and Tadelle Dessie, (2010): Indigenous chicken production and marketing systems in Ethiopia: Characteristics and opportunities for market-oriented development. IPMS (Improving Productivity and Market Success) of Ethiopian Farmers Project Working Paper 24. Nairobi, Kenya. ILRI. Retrieved on 11 July 2016 from www.ipms-ethiopia.org
10. Government of Kenya (2010): Kenya National Poultry Improvement Programme; A baseline survey on poultry in Kenya, Conducted in 2009. Government of Kenya, 2010 agricultural sector development strategy 2010–2020
11. Gwala Mlungisi Petros (2014): *Contribution of village chickens to the resource-poor households*. A dissertation for degree of Master of Science in Agriculture (Animal Science) in Animal and Poultry Science, Faculty of Science, Agriculture and Engineering. University of Kwa Zulu-Natal. Pietermaritzburg, South Africa.
12. Khandait V N, Gawande S H, Lohakare A C, and Dhenge S A, (2011): Adoption level and constraints in backyard poultry rearing practices at Bhandara District of Maharashtra, India. *Research Journal of Agricultural Sciences* 2(1): 110-113.
13. KIPPRA (2013): Kenya's Economic Report 2013, Kenya Institute of Public Policy Research and Analysis. Nairobi- Kenya. ISBN 978996605801010.
14. King'ori A .M, Wachira A. M and J. K Tuitoek (2010): Indigenous chicken production in Kenya: A review – *International journal of poultry science* 9(4):309-316.2010
15. Kyule N Miriam, Nkurumwa O Agnes, Konyango J. J, Jacob O. (2015): Performance and constraints of indigenous chicken rearing among small scale farmers in Mau-Narok ward, Njoro sub county Nakuru County, Kenya. Department of Agricultural Education and Extension Egerton University. P.O. Box 536-20115 Egerton. *International Journal of Advanced Research* 2015, Volume 3 Issue 3 283-289. Retrieved on 28 January 2017 from <http://www.journalijar.com>
16. Makueni County Kenya (2013): Makueni County Agriculture Profile, County Director of Agriculture, March, 2013
17. Mapiye C, Mwale M, Mupangwa J. F, Chimonyo M, Foti R, and Mutenje M. J (2016): A Research Review of Village Chicken Production Constraints and Opportunities in Zimbabwe. Department of Livestock and Pasture Science, Faculty of Science and Agriculture, University of Fort Hare, Private Bag X1314, Alice 5700 South Africa. *Asian-Aust. J. Anim. Sci. Vol. 21, No. 11: 1680 –1688*, Retrieved on 12 January 2016 from www.ajas.info
18. Mfaume M .S (2008): *Productivity and resource use efficiency of local chicken production in Masasi District*. MSc Thesis. Sokoine University of Agriculture, Morogoro, Tanzania 118pp.
19. Magothe T. M, Okeno T .O, Muhuyi W. B and Kahi A. K, (2012): Indigenous chicken production in Kenya: Current status; *World's Poultry Science Journal*, Vol. 68, March 2012. Retrieved on 24th February 2017 from <https://www.researchgate.net/publication/271934831>..
20. Mwobobia R. Murangiri, Kanui T. I, Amwata D. Akinyi, Nguku A. Susan, (2015): *Comparing use of ethno-veterinary products among and peri urban chicken farmers in Katulani district Kenya*- MSc Thesis. School of Agriculture and Veterinary Sciences. South Eastern Kenya University.
21. Ndathi A. J. N, Muthiani E. N, Kirwa E.C, Kibet P. F .K and Cheruiyot H. K (2012): Constraints and opportunities in indigenous chicken production and marketing in Mashuru and Loitokitok divisions of Kajiado district. KARI Headquarters, P.O. Box 57811, Nairobi, Kenya
22. Nyaga Philip (2007): Good Biosecurity practices in small scale, commercial and scavenging production systems in Kenya, FAO Strategies for the prevention and control of infectious diseases in Eastern Africa, University of Nairobi, Kenya.
23. Nyaga Philip (2007):. (Eds: Schwarz, 2008) Poultry sector country review-Kenya, University of Nairobi, Kenya FAO, Animal Production and Health division, Emergency centre for trans-boundary animal diseases socio economics, production and biodiversity unit.
24. Odwasy Henry, Wesonga Heziron and Okitoi lodovicus (2006): *KARI technical Note No. 18*. February 2006 – Indigenous Chicken Production Manual.
25. Okwor E.C and Eze D.C (2011): Epizootic Newcastle Disease in Local Chicken reared in South East Savannah Zone of Nigeria; *International Journal of Poultry Science* 10(3) 212-215,2011. ISSN 1682-8356 [Accessed on 2nd July 2016]
26. Omiti John M. and Okuthe Sam O. (2010): An overview of the poultry sector and status of Highly Pathogenic Avian Influenza (HPAI) in Kenya-(Background paper-Africa/Indonesia Region Report No. 4).

27. Onuekwusi, G. C (2001): Adoption of Improved Rabbit Technologies by Farmers in Akwa-Ibom State Nigeria Implications for Extension. Proceedings of *36th Annual Conference, Agric. Society of Nigeria F.U.T. Owerri* Oct. 20-24: 368-371.
28. Oosthuysen Pieter (2013): Opportunities and challenges for poultry production in sub Saharan Africa. Retrieved on January 2017 from <http://www.wattagnet.com/articles/17306-opportunities-and-challenges-for-poultry-production-in-sub-saharan-africa>.