

Original Research Article

Household Baseline Survey on Indigenous Chicken Production Characteristics and Constraints in Busia and Machakos Counties of Kenya.

ABSTRACT

Aims: To collect preliminary baseline data using a structured questionnaire prior to validation of three climate-smart technologies within the project sites.

Study design: An action research methodology was employed with participation, reflection and empowerment of actors along the [Indigenous Chicken Production](#) value chain.

Place and Duration of Study: This study was conducted from May 2019 to June 2020 within four (4) Sub-Counties in Busia and Machakos where high IC populations are found.

Methodology: A total of 147 households were surveyed. Targeted household information was recorded viz: distribution of respondents by village in the Counties; farmer socio-economic factors; flock structure and characteristics; disease and parasite constraints, management practices; disease reporting and communication amongst recruited farmers within Busia and Machakos Counties of Kenya.

Results: Results revealed that 56.5% of the respondents were male with the remaining 43.5% being female with average mean age of 50 years. Most farmers had formal education (97%) and practiced semi extensive poultry farming system (59%). Both indigenous and exotic chicken (62%) were kept for income purposes (82.6%) and only young chicks received feed supplements (55.8%). Newcastle (18.5%) and coccidiosis (16.4%) comprised the two major disease constraints reported. Prevalent bird disease symptoms were diarrhea (24.9%) and coughing (23.1%) while mites (27.9%) and fleas (22.3%) dominated the ecto-parasites. Disease control strategies included use of vaccines (72.8%), dewormers (44.9%) and ethno-veterinary medicine. *Aloe secundiflora* and *Aloe feroxin*, were singled out as locally available and effective means of treating diarrhea (62.9%), respiratory infections (61.9%) and worm control (64.5%). Majority of IC farmers (76.8%) failed to report illnesses among their flock and had no access to poultry health services (72.1%). Majority of farmers accessed health information through radio (26.5%) as opposed to mobile phones (1.65%).

Conclusion: Findings of this survey reveal a low-grade free-range poultry system characterized by poor disease control. This scenario calls for deliberately targeted efforts by both government extension services and private stakeholders to improve the local chicken management and help farmers adopt alternative disease control interventions such as the use of ethno-veterinary medicine in the face of changing climatic and economic conditions.

Keywords: Baseline survey, Indigenous chicken, production characteristics, constraints Busia, Machakos.

Comment [B1]:

Comment [B2]: Why this study took more than 1 year? Depending on your sample point of view even you can collect within 6 months. Or was it depending on the aim of project duration? Does the influence of season also included? Or any other difficulties encountered! I think you need to justify!

1.0 INTRODUCTION

In Kenya, the poultry population is estimated at 43 million, 80% of which are indigenous Chicken (IC) [21]. IC population is concentrated in the rural areas among poor smallholder farmers who are worst hit by climate shocks. The IC sub-sector produces 61% of poultry meat and 47% of the eggs and employment for over 3 million people in the country [21]. To the Kenyan economy, IC contributes 6% of the livestock GDP and 0.7% of the total GDP [21]. IC production is especially attractive to women and youth in Kenya as it requires low start-up capital and low maintenance cost (4, 32). Moreover, it is common among smallholder mixed crop-livestock farmers who rely on their chicken in the event of drought and crop failure (4, 32). To these rural poor farmers, IC provides affordable animal protein, cash incomes, manure and socio-cultural value [25].

Comment [B3]: Your introduction is too short!

There is a projected double increase in demand for IC and their products by 2030 [16]. This presents an opportunity for the transformation of the IC into a vibrant, commercial and profitable sub-sector with the potential to create more jobs and income along the value chain. However, rampant diseases mainly, Newcastle disease, Infectious Bursal Disease (IBD) and parasitic infections have hampered the transformation of IC into a profitable sub-sector [8,35]. Currently, the IC sub-sector is experiencing increased disease outbreaks due to modification of disease pathogens and a decrease of IC immunity resulting from variable and extreme weather events [38]. The inability of the IC owners to control these diseases makes their impact even greater in this sub-sector. They therefore result in high mortality and economic losses along the IC value chain.

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Herbal plants are safe cost-effective alternative medicines [33]. The tremendous potential of herbal medicinal plants could be made practical with the use of formulations with extracted active ingredients. This would be useful to farmers. *Aloe secundiflora* extracts is one such formulation that has shown promising efficacy against parasitic infection under laboratory conditions [20]. For future prospects and promotion of alternative medicines, it would be more informative and useful to validate this extract with farmers under field conditions. Disease surveillance system in Kenya is limited by poor reporting [42] which often results in difficulty in enforcing control.

The broad objective of this World Bank-funded project was to validate three climate-smart technologies namely: thermostable I-2 and D78[®] IBD vaccines to enhance control of Newcastle and Gumboro diseases; the ICT-based system for disease surveillance and antimicrobial resistance; and potent *Aloe secundiflora* leaf extracts formulation for controlling ascariasis and coccidiosis in indigenous chickens (IC). The specific objective of this study was to collect preliminary baseline data using a structured questionnaire prior to validation of the three climate-smart technologies in the project sites. Critical IC parameters were collected namely distribution of respondents by village in the Counties; farmer socio-economic factors; flock structure and characteristics; disease and parasite constraints, management practices; disease reporting and communication among recruited farmers. This project responds to climate change-induced infectious and parasitic diseases that increase mortality and seriously reduce IC productivity in Kenya.

2.0: METHODOLOGY

2.1: Study site

The study was carried out within two counties of Busia and Machakos, Kenya. The counties were purposively selected from amongst the KCSAP project locations to represent the high rainfall, semi-arid and arid zones, with high IC population and their importance to the livelihoods. Busia County is situated in western Kenya and covers an area of 1,694.5 square kilometres (km²). It lies between latitude 0° and 0° 45 North and longitude 34° 25 East. The altitude is undulating and rises from about 1,130 meters (m) above sea level at the shores of Lake Victoria to a maximum of about 1,500m in the Samia and North Teso Hills. Busia County receives an annual rainfall of between 7 millimeters (mm) and 2000 mm. Agriculture, fishing and trade are the main economic activities especially in the lower Northern parts including Nambale, Butula and Teso South are suitable for maize, livestock, poultry, robusta coffee and sugar cane cultivation (Government of Kenya, 2018; Busia County Integrated Development Plan of 2018).

Machakos County lies between latitudes 0° 45' South and 1° 31' South and longitudes 36° 45' East and 37° 45' East, and covers a total area of 6208.2 km². The County receives bimodal rainfall ranging between 500mm and 1250mm and is unevenly distributed and unreliable. Temperatures vary between 18°C and 29°C throughout the year. Agriculture is the main economic activity in the County, which is largely semi-arid. Most of the crops grown include maize, beans, fruits, vegetables and drought-resistant crops such as sorghum and millet.

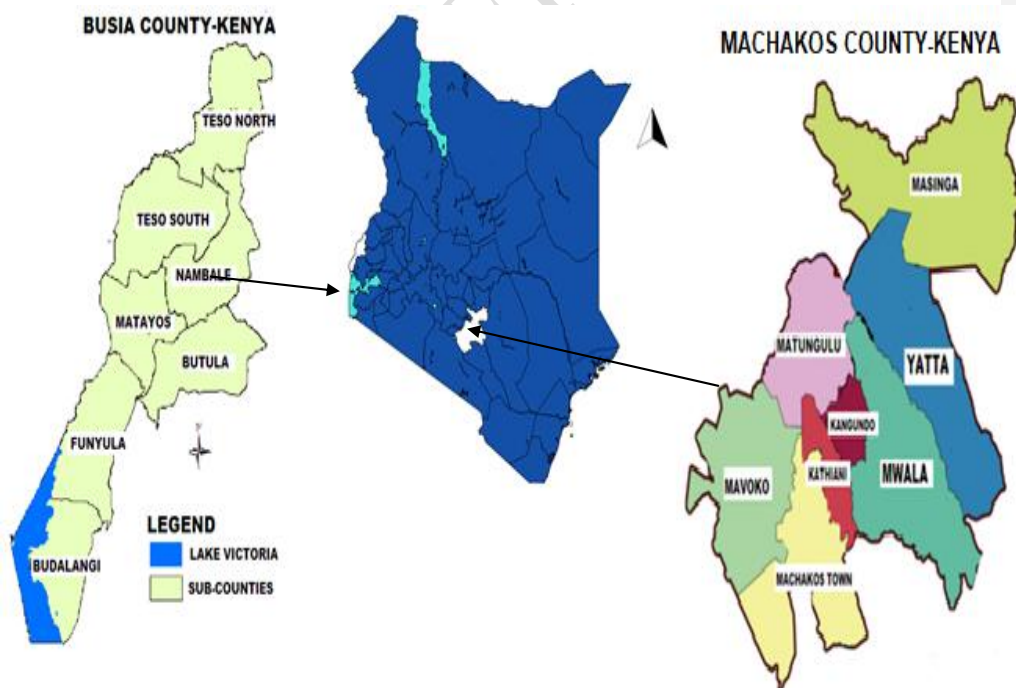


Fig. 1: Map of Kenya, Inset location of Busia and Machakos counties

Table 1: Study sites (County, Sub-County Ward Village and their GPS coordinates.

County	Sub-county	Ward	Village
Machakos	Yatta	Kithimani	KwaKitema (GPS: Lat -1.19632, long-37.4653)
			Nguumo (GPS: Lat -1.16529, long-37.420537)
			Muthesya (GPS: Lat -1.15945, long-37.500251)
		Ndalani	Utithini (GPS: Lat -1.1991109, long-37.444627)
			Kwaleli (GPS: Lat -1.0724, long-37.4854)
			Kyeni (GPS: Lat -1.0800, long-37.4349)
	Mwala	Mwala	Mavoloni (GPS: Lat -1.10786, long-37.4169)
			Kamulu (GPS: Lat -1.1021, long-37.4523)
			Yanthooko(GPS: Lat -1.4200, long-37.4300)
		Masii	Mutuyu (GPS: Lat -1.2000, long-37.4000)
			KwaNdoo (GPS: Lat -1.3802, long-37.45732)
			Uini (GPS: Lat -1.3802, long-37.45732)
Busia	Teso-South	Amukura West	Kimwala (GPS: Lat -1.300, long-37.4823)
			Kanduu (GPS: Lat -1.3291, long-37.5247)
			Matulani(GPS: Lat -1.3567, long-37.4765)
		Amukura Central	Kitulia (GPS: Lat -1.3740, long-37.5271)
			Amairo (GPS: Lat 0.6231, long-34.19762)
			Machakusi (GPS: Lat 0.6005, long-34.2561)
			Osuret (GPS: Lat 0.6361, long-34.2147)
			Parater (GPS: Lat 0.6205, long-34.18231)
			Apatit (GPS: Lat 0.5822, long-34.2301)
	Chakol North	Achunet (GPS: Lat 0.5829, long-34.2456)	
		SimbaChai (GPS: Lat 0.5503, long-34.2517)	
		Asing'e (GPS: Lat -0.5723, long-34.1824)	
	Nambale	Bukhayo Central	Sikinga (GPS: Lat 0.4729, long-34.3811)
			Siekunya (GPS: Lat 0.47081, long-34.2527)
			Malanga (GPS: Lat 0.4291, long-34.3241)
		Bukhayo North	Lwanyange (GPS 0.4309, long-34.2886)
			Sidende (GPS: Lat 0.4745, long-34.2750)
			Musokoto(GPS: Lat 0.50163 long-34.2995)
			Khwirale (GPS: Lat 0.4821, long-34.2521)
			Otir (GPS: Lat 0.4897, long-34.2876)

2.2: Sampling frame and Sample size determination

The study involved key IC value chain actors: input suppliers, veterinary service providers, IC producers, IC bulkers, traders and transporters. The survey targeted 480 IC producers, 40 input suppliers, 20 veterinary providers, 60 IC traders from the two counties of Busia and Machakos. Briefly, IC producers were selected using a multistage sampling approach. First, a list of sub-counties in the selected counties was prepared and sub-counties with the highest IC populations were purposively selected. In each selected sub-county, a list of wards was also drawn before two wards are purposively selected. The selection was based on IC population and accessibility. In each ward, four villages were purposively selected based on IC population and accessibility. In each village, a list of farmers was drawn with the assistance of county livestock and veterinary officers. IC producers'/ producer groups with flock sizes of at least 10 birds were purposively pre-selected and a sampling frame prepared from where a random sample of 5 farmers per village sampled working up to 120

Comment [B5]: Veterinary service provider

Comment [B6]: Please make it clear, are these all 480 ICP, 40 IS, 20 Vets, 60...are your source population or study population? Because only 147 households were interviewed!

Comment [B7]: Why local leaders were not included to draw farmers?

Comment [B8]: Which type of random sampling Simple or systematic? If it was systematic every how many household did you collected your sample?

Comment [B9]: If so 5*16 village = 80 * 2 counties = 160 households. So why 147? Or are these farmers are household owners or household members?

farmers per county. Other value chain actors were selected at both county and village levels. The entry point to the communities was through the County Governments with whom the project was discussed and their assistance and support sought. The 120 farmers per county and other IC stakeholders at each project site were sensitized by the project team appropriately.

2.3: Research design

The survey was conducted between May 2019 and June 2020. An action research methodology was employed with participation, reflection and empowerment of actors along the IC value chain. Qualitative and quantitative methodologies were utilized to collect data for the baseline evaluation. Qualitative methods collected data on the opinion of stakeholders on the process and their attitude on the climate smart technologies. Gender dynamics were taken into account in order to get the representative opinion from men, women and youth. Key informant interviews were held with at least 2 key stakeholders per county. Quantitative methods were employed to gather IC production and productivity parameters such as disease incidence, flock sizes, chick survival, off-take and mortality rates. This data was collected before application and validation of the TIMPs technologies.

2.4: Data management and analysis

The process of data management involved cleaning the questionnaires for errors and coding quantitative data and then entry was made in the Epi-Info-7.2 software. The coded information was then managed and analyzed using Epi-Info and SPSS software. Descriptive statistics methods viz: means, frequencies and proportions, analysis of variance ANOVA, were used to analyse data yielding results with different focuses. An alpha level of 0.05 was used in all the statistical analyses for testing significant differences.

[Do you think that your study doesn't have any limitation?](#)

[So that could you please include any study limitation encountered!](#)

3.0: RESULTS

3.1: Distribution of respondents by village within Busia and Machakos Counties

Results indicated that 51% of the respondents were from Busia whereas 49% were from Machakos. In Machakos County, (30%) were from Mwala and (21%) were from Yatta Sub-Counties while Nambale (20%) and Teso-South (29%) were from Busia County. In Busia County, the respondents' distribution by village was as follows: Achunet (7%), Amairo (3%), Asing'e (6%), Apatit (7%), Khwirare (3%), Isidende (3%), Musokoto (8%), Otir (5%) and Simba-chai (5%). In Machakos County the respondents were distributed as follows: Kalyambeu (5%), Kamulu (5%), Kanduu (3%), Kitulia (5%), Kiwanza (8%), Kwaleli (5%), Kyeni (5%), Kyumu (4%), Malumani (5%) and Manzoni (5%), see Figure 2.

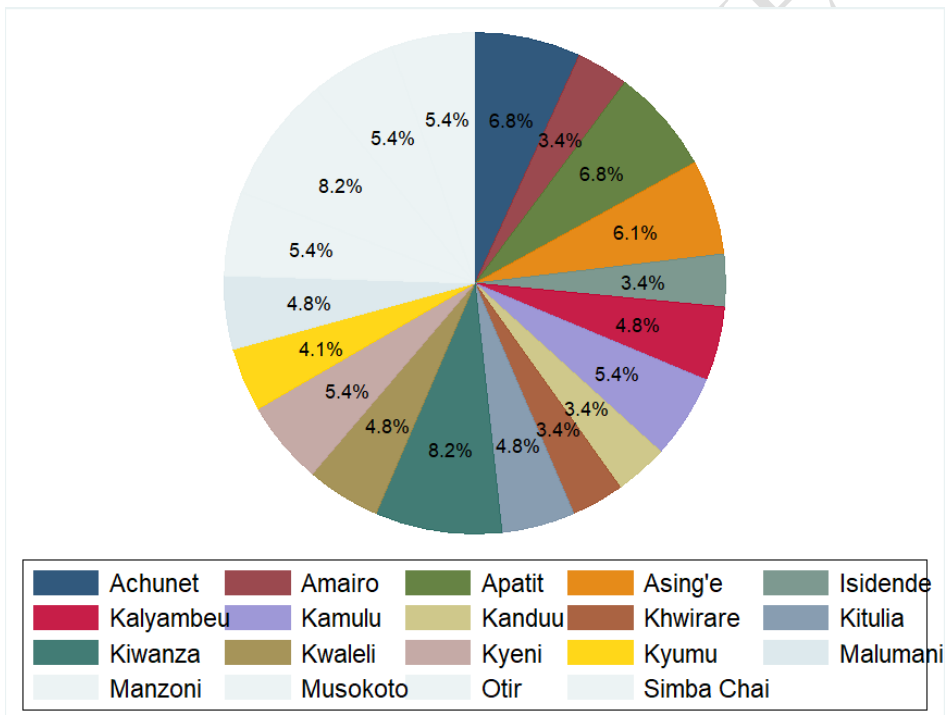


Fig. 2: Distribution of respondents by village Busia and Machakos Counties.

3.2: Farmer socio-economic characteristics

Results showed that out of 147 farmers interviewed, 55% were male while 45% were female (Table 2). The average age of respondents was 50 years with a minimum of 27 years and a maximum of 95 years. Farmers had been keeping poultry for an average of 13 years ranging from 1 to 50 years (Table 2). Majority (97%) of respondents had formal education whilst 3% had no formal schooling. Agriculture (80%) was the main source of income as opposed to salary. Poultry keeping (52%) was the dominant farming system followed by mixed livestock (26%) and mixed crop and livestock (22%) respectively. Extensive (38%) and semi-intensive (59%) poultry farming systems were prevalent over intensive (3%) farming. As summarized in Table 1, majority (70%) of the respondents had registered as (CIG) while 30% had not. Moreover, majority (96%) were not registered members of VMGs (Table 2).

Table 2: The Mean for farmer socio-economics characteristics.

Variables	Description	Busia	County	Machakos	County	Overall mean(%)
		Teso-South (n=42)	Nambale (n=30)	Yatta (n=31)	Mwala (n=44)	
Household age	Age of the household	45.57 ±10.10	45.13±10.09	52.45±15.58	54.11±12.98	49.49±12.84
Years of keeping poultry	Years of poultry farming	10.19±6.29	9.33±3.45	13.35±10.39	17.68±14.03	12.93±10.39
Gender	Male	14.46	15.66	20.48	49.40	56.46
	Female	46.88	26.56	21.88	4.69	43.54
Household education	No formal education	0.00	0.00	0.00	2.04	2.04
	Primary level	32.76	15.52	27.59	24.14	39.46
	Secondary level	26.15	27.69	16.92	29.23	44.22
	Tertiary level	28.57	14.29	4.76	52.38	14.29
Income source	Agriculture	35.90	25.64	10.26	28.21	79.59
	Salaried employment	0.00	0.00	44.44	55.56	6.12
	Business	0.00	0.00	60.00	40.00	10.20
	Casual labour	0.00	0.00	4.08	0.00	4.08
Farming system	Mixed crop & Livestock	6.25	0.00	93.75	0.00	21.77
	Mixed Livestock	0.00	0.00	2.63	97.37	25.85
	Poultry Only	51.95	38.96	0.00	9.09	52.38
Poultry farming system	Extensive	0.00	0.00	38.60	61.40	38.78
	Semi-intensive	48.84	34.88	8.14	8.14	58.50
	Intensive	0.00	0.00	50.00	50.00	2.72
Registered as CIG	Yes	11.36	11.36	0.00	77.27	29.93

	No	35.92	24.27	30.10	9.71	70.07
Registered as VMG	Yes	83.33	0.00	16.67	0.00	4.08
	No	26.24	21.28	21.28	31.21	95.92

3.3: Characteristics of Indigenous Chicken (IC) production system

The IC flock size, structure, dynamics and performance in the four Sub-Counties are presented in Table 3. Generally, the trend on the flock composition, dynamics and management practices followed the same pattern in all the counties. Majority (52%) of the farmers were rearing poultry mainly both indigenous and exotic breeds (62%) while (38%) kept indigenous chicken breeds only. The mean flock size was 43.14 chickens per household. The flock structure was mainly dominated by chicks (12.47 %), growers (10.67%) and hens (8.67%), whilst cocks were the least (3.83%) (Table 3). IC kept were primarily sold (18.56 %) to generate income as opposed to being consumed (13.50%) or given as gifts (3.20%). Most of the eggs laid (77.56%) were incubated with a mean hatchability of 52.99%, and chick survival rate of (38.23%) and (24.80%) for three and six months respectively (Table 3). Chicks and growers were mainly supplemented by concentrates (55.78%) and (36.73%) respectively feeds such as chick mash, growers mash whilst (35.37%) and (34.01%) correspondingly were scavenging without any supplements. Majority of growers and adult IC were mainly scavenging and received little or no feed supplements (37.43%), see Table 3.

Table 3: Characteristics of Indigenous Chicken (IC) production system

Variables	Description	Busia	County	Machakos	County	Overall mean (%)
		Teso-South (n=42)	Nambale (n=30)	Yatta (n=31)	Mwala (n=44)	
Mixed poultry species	Yes	55.26	36.84	1.32	6.58	51.70
	No	0.00	2.82	42.25	54.93	48.30
Poultry breeds	Exotic only	0.00	0.00	0.00	0.00	0.00
	Cross-breed	0.00	0.00	0.00	0.00	0.00
	Indigenous	0.00	0.00	55.36	44.64	38.10
	Both exotic and indigenous	46.15	32.97	0.00	20.88	61.90
Flock size	Number of chickens	57.50±48.24	35.7± 34.63	31.00 ± 15.10	46.45 ± 36.52	43.14 ± 40.02
Flock structure	Chicks(3months)	10.48 ± 6.82	12.10 ± 6.20	9.87 ± 5.74	16.45 ± 8.31	12.47 ± 7.50
	Growers(3-6months)	4.45 ± 0.01	4.83 ± 1.33	19.87 ± 6.41	14.09 ± 7.06	10.67 ± 4.16
	Pullets and Cockerels(6-12)	3.81 ± 1.59	6.57 ± 4.68	7.80 ± 6.92	11.32 ± 5.11	7.46 ± 4.14
	cocks	5.26 ± 3.74	3.48 ± 1.22	2.13 ± 1.12	3.88 ± 2.04	3.83 ± 1.28
	Hens	7.33 ± 3.21	8.67 ± 4.72	5.13 ± 4.88	12.50 ± 4.88	8.67 ± 4.77

Change in flock size	Yes	3.75	2.50	38.75	55.00	54.42
	No	58.21	41.79	0.00	0.00	45.58
IC dynamics	Sold	9.38 ± 4.70	11.80 ± 6.90	23.06 ± 7.94	28.75 ± 5.77	82.56 ± 7.38
	Consumed	23.55 ± 7.39	7.93 ± 4.36	10.23 ± 8.45	10.02 ± 8.08	13.50 ± 9.51
	Donation e.g., gifts	3.02 ± 2.41	2.20 ± 1.56	3.03 ± 2.64	4.16 ± 2.19	3.20 ± 2.20
Egg production	Incubated	65.40 ± 9.27	75.67 ± 9.67	48.70 ± 7.60	110.8 ± 10.08	77.56 ± 9.38
	Sold	0.95 ± 0.84	5.00 ± 3.71	16.51 ± 7.21	40.36 ± 12.24	16.86 ± 6.00
	Consumption	21.05 ± 4.76	14.67 ± 7.11	20.58 ± 12.97	45.60 ± 9.60	27.00 ± 8.61
	Donation e.g., gifts	0.29 ± 0.17	0.00 ± 0.00	2.68 ± 0.77	6.25 ± 2.26	2.31 ± 1.05
Chick performance	Hatched	53.86 ± 25.24	40.10 ± 29.08	38.48 ± 21.66	79.52 ± 52.30	52.99 ± 38.88
	Survived to 3 months	37.90 ± 21.33	26.83 ± 22.02	26.03 ± 22.26	62.15 ± 35.68	38.23 ± 25.32
	Survived to 6 months	23.31 ± 14.30	14.6 ± 13.15	20.90 ± 15.72	40.39 ± 29.30	24.80 ± 18.11
Feed types - chicks	Nothing	48.08	50.00	0.00	1.92	35.37
	Food Scraps	20.00	0.00	0.00	80.00	3.40
	Concentrates	17.07	4.88	28.05	50.00	55.78
	Others	0.00	0.00	100.00	0.00	5.44
Growers	Nothing	48.00	48.00	4.00	0.00	34.01
	Food Scraps	4.76	0.00	9.52	85.71	14.29
	Concentrates	37.04	5.56	16.67	40.74	36.73
	Others	0.00	0.00	81.82	18.18	14.97
Adult birds	Nothing	51.56	45.31	3.13	0.00	37.43
	Food Scraps	0.00	0.00	2.44	97.56	23.98
	Concentrates	18.92	2.70	16.22	62.16	21.64
	Others	0.00	0.00	68.97	31.03	16.96

3.4: Indigenous chicken disease and parasite constraints

Indigenous chicken (IC) disease and parasitic constraints are outlined in Table 4. Newcastle (18.48%) and Gumboro (17.54%) diseases were among the most prevalent diseases among IC followed by coccidiosis (16.35%), fowl pox (15.17%), Influenza Coryza (15.17%), whilst fowl cholera (2.61%) was the least prevalent. The most common infection symptoms were greenish diarrhoea (24.89%), coughing (23.11%), pox lesions (14.89%), white diarrhoea (14.67%), and bloody diarrhoea (12.89%) while difficulty breathing (4.00%) was the least (Table 4). The average mortality rates in the past one year among IC due to Newcastle, Gumboro, coccidiosis infections were (4.86%), (3.37%) and (1.57%) respectively (Table 3) while infection averages for Gumboro and coccidiosis were (4.34%) and (2.89%). In the last one year 45.58% of poultry farmers reported that they had experienced Newcastle outbreak, while 53.74% and 60.54%

confirmed Gumboro and coccidiosis occurrences (Table 4). Mites (28.98%) were exemplified as the most prevalent parasites followed by fleas (27.92%), lice (22.26%), worms (20.49%) and others (0.35%) such as ticks (Table 4).

Table 4: Indigenous chicken disease and parasite constraints

Variables	Description	Busia	County	Machakos	County	Overall mean (%)
		Teso-South (n=42)	Nambale (n=30)	Yatta (n=31)	Mwala (n=44)	
Diseases	NewCastle Disease	21.79	6.41	24.36	47.44	18.48
	Influenza Coryza	53.13	45.31	0.00	1.56	15.17
	Gumboro Disease	22.97	13.51	9.46	54.05	17.54
	Coccidiosis	18.84	26.09	15.94	39.13	16.35
	Fowl Typhoid	60.00	33.33	3.33	3.33	7.11
	Fowl Cholera	45.45	9.09	36.36	9.09	2.61
	Pullorum	43.75	40.63	15.63	0.00	7.58
	Fowl Pox	23.44	6.25	9.38	60.94	15.17
Disease symptoms	Greenish diarrhoea	32.14	26.79	13.39	27.68	24.89
	Whitish diarrhoea	13.64	1.52	25.76	59.09	14.67
	Pox lesions	46.27	8.96	11.94	32.84	14.89
	Bloody diarrhoea	17.24	3.45	8.62	70.69	12.89
	Difficulty breathing	16.67	0.00	72.22	11.11	4.00
	Coughing	33.65	25.96	14.42	25.96	23.11
	Sudden death	16.00	0.00	84.00	0.00	5.56
Newcastle Outbreak	Yes	33.75	3.75	21.25	41.25	45.58
	No	22.39	40.30	20.90	16.42	54.42
Newcastle mortality	IC mortality	5.35± 2.23	1.53± 0.15	3.74± 1.27	7.45± 5.99	4.86± 2.66
Gumboro Outbreak	Yes	34.18	2.53	17.72	45.57	53.74
	No	22.06	41.18	25.00	11.36	46.26
	IC infections	6.35±5.62	0.53± 0.10	2.87± 1.20	6.04±4.95	4.34± 2.10
Coccidiosis outbreak	IC mortality	5.54± 3.00	0.40 ±0.19	2.74± 1.82	3.77± 1.42	3.37± 1.27
	Yes	39.33	7.87	11.24	41.57	60.54
	No	12.07	39.66	36.21	12.07	39.46
	IC infections	4.19±2.51	1.06± 0.24	1.39 ± 0.44	3.95±2.03	2.89±2.68
	IC mortality	3.04±1.79	0.53± 0.38	0.26 ±0.05	1.81± 0.12	1.57±0.93

Parasites	Lice	12.70	4.76	22.22	60.32	22.26
	Fleas	8.86	27.85	36.71	26.58	27.92
	Mites	36.59	28.05	21.95	13.41	28.98
	Worms	0.00	1.72	31.03	67.24	20.49
	Others	0.00	0.00	0.00	100.00	0.35

3.5: Indigenous chicken disease control and management

Disease control and management strategies among IC farmers are summarized in Table 5. Majority of farmers used dewormers (44.94%) compared to herbs (20.25%) while (34.81%) did not use any worm controlling strategy. Majority (72.79%) utilized vaccines in disease prevention mainly against Newcastle (51.76%) and Gumboro (34.67%) diseases. A noteworthy proportion (61.90%) of poultry farmers reported that they utilized herbs as a disease and parasite control policy (Table 5). Aloe species was exemplified as the commonly used herb in treating diarrhoea (62.96%), respiratory infections (61.97%) and in worm control (64.55%). Farmers selected herb option based on what other farmers (74.19%) used as compared to availability (0.00%), herb effectiveness (24.73%) or other sources (1.08%) such as internet (Table 5).

Table 5: Indigenous chicken disease control and management

Variables	Description	Busia	County	Machakos	County	Overall mean (%)
		Teso-South (n=42)	Nambale (n=30)	Yatta (n=31)	Mwala (n=44)	
Parasite control	None	40.00	47.27	12.73	0.00	34.81
	Dewormers	23.94	4.23	21.13	50.70	44.94
	Herbs	3.13	0.00	28.13	68.75	20.25
	Others	0.00	0.00	0.00	0.00	0.00
Use of vaccine	Yes	30.84	23.36	15.89	29.91	72.79
	No	22.50	12.50	35.00	30.00	27.21
	Newcastle	30.10	24.27	15.53	30.10	51.76
	Gumboro	34.78	21.74	7.25	36.23	34.67
	Fowl pox	51.85	22.22	0.00	25.93	13.57
Use of herbs	Fowl typhoid	0.00	0.00	0.00	0.00	0.00
	Yes	19.78	7.69	26.37	46.15	61.90
	No	42.86	41.07	12.50	3.57	38.10
Diarrhoea treatment	Aloe Species	22.35	7.06	23.53	47.06	62.96

	Neem	0.00	0.00	0.00	0.00	0.00
	Pawpaw	100.00	0.00	0.00	0.00	8.15
	Pepper	52.38	0.00	23.81	23.81	15.56
	Sisal	0.00	0.00	0.00	0.00	0.00
	Acacia	0.00	0.00	0.00	100.00	1.48
	Others	0.00	0.00	62.50	37.50	11.85
Respiratory treatment	Aloe Species	21.59	6.82	23.86	47.73	61.97
	Neem	0.00	0.00	0.00	0.00	0.00
	Pepper	66.67	0.00	12.50	20.83	16.90
	Pawpaw	100.00	0.00	0.00	0.00	10.56
	Acacia	0.00	0.00	0.00	100.00	1.41
	Others	0.00	0.00	46.15	53.85	9.15
Worm control	Aloe Species	25.35	8.45	21.13	45.07	64.55
	Neem	0.00	0.00	100.00	0.00	0.91
	Pepper	45.16	0.00	6.45	48.39	28.18
	Acacia	0.00	0.00	0.00	100.00	0.91
	Others	0.00	0.00	66.67	33.33	5.45
Mode of herb selection	Other farmers	1.45	0.00	34.78	63.77	74.19
	Availability	0.00	0.00	0.00	0.00	0.00
	Effectiveness	78.26	21.74	0.00	0.00	24.73
	Others	0.00	0.00	100.00	0.00	1.08

3.6: Indigenous chicken disease reporting and communication

Results on IC farmer's disease reporting, communication channels and sources of IC related information are presented in Table 6. Majority (76.87%) of farmer did not report cases of infections among their flock while those who reported (23.13%) mainly communicated to government (36.73%) and private (34.69%) veterinarians (Table 6). Majority (72.11%) did not have access to poultry health services. Those who had access to poultry health services (27.89%) mainly accessed through government and private veterinary personnel. Farmers mainly accessed information on poultry disease control from radio (26.45%), other farmers (25.62%) government and private vets (15.70%), (16.53%) in contrast to mobile phones (1.65%) and other (1.65%) sources such as flyers (Table 5). Compared to poultry farmers with access to poultry diseases control information (44.90%), majority had no access (55.10%) to information on disease control (Table 6).

Table 6: Indigenous chicken disease reporting and communication

Variables	Description	Busia	County	Machakos	County	Overall mean (%)
		Teso-South (n=42)	Nambale (n=30)	Yatta (n=31)	Mwala (n=44)	
Report diseases	Yes	30.09	25.66	24.78	19.47	23.13
	No	23.53	2.94	8.82	64.71	76.87
	Government vet	0.00	38.89	5.61	55.56	36.73
	Private vet	11.76	0.00	17.65	0.59	34.69
	NGO	0.00	0.00	0.00	100.00	12.24
	CAHW	0.00	0.00	100.00	0.00	2.04
	Local administrator	0.00	0.00	0.00	100.00	14.29
Poultry health services	Yes	19.51	0.00	29.27	51.22	27.89
	No	32.08	28.30	17.92	21.70	72.11
	Government vet	28.57	0.00	28.57	42.86	44.68
	Private vet	13.33	0.00	13.33	73.33	31.91
	NGO	0.00	0.00	18.18	81.82	23.40
	CAHW	0.00	0.00	0.00	0.00	0.00
	Disease control info.	Yes	12.12	0.00	22.73	65.15
No		41.98	37.04	19.75	1.23	55.10
Government vet		26.32	0.00	31.58	42.11	15.70
Private vet		5.00	0.00	10.00	85.00	16.53
Other farmers		0.00	0.00	9.68	90.32	25.62
Radio		0.00	0.00	12.50	87.50	26.45
Television		0.00	0.00	0.00	100.00	9.09
Internet		0.00	0.00	100.00	0.00	3.31
Mobile phone apps		0.00	0.00	100.00	0.00	1.65
Others		0.00	0.00	100.00	0.00	1.65

4.0: DISCUSSION

In this study, preliminary baseline data was collected using a structured questionnaire prior to validation of three climate-smart technologies from purposely recruited farmers within Machakos and Busia Counties of Kenya. The results revealed that the mean age of farmers was 50 years, implying that they were still in their active productive age to manage available IC resources. These findings, concur with those reported elsewhere in developing countries [2,6, 34, 36]. This is probably because of relative immobility and a decline in the ability to perform physical tasks among elderly farmers. Kimhi and Bollman [24] showed that farmers over a particular age will probably “exit” from agricultural farming practices as they age on. Similarly, Breustedt [10] pointed out that after establishing themselves in agribusiness, young farmers’ particularly youthful agriculturists swiftly increase the dimensions of farm operations and cultivating ventures in the first decade of operation.

Data from this study indicate majority of the poultry farmers had formal education (97%) in contrast to those without formal education. Formal education opens the mind of the poultry farmer to knowledge through hands-on training, and better methods of chicken production thus keeping the farmers abreast with changing innovations and ideas. This corroborates findings by Eric and Elfreda [14], who showed that education enhances agricultural productivity primarily by improving farmers’ decision-making ability and secondarily by alleviating their technical efficiency. [Need more argument or even contrary finding!](#)

Results further divulge that agriculture was the predominant (80%) economic activity among poultry farmers. Perhaps this is because farming is considered the fabric of rural society and in many countries of the world; it is the main economic activity. Any sudden and profound changes which impact the farm sector could have severe consequences in terms of social and political stability in economically developing countries. According to Dethier and Effenberger [12], the agricultural sector continues to play a crucial role in development, especially in low-income countries where the sector is large both in terms of aggregate income and total labor force. Similarly, Aker [5] argued that agriculture contributes to growth in developing countries by generating income, employment and providing food at reasonable prices in urban areas and can therefore be an effective tool to reduce poverty.

The results of this survey reveal that 59% of the respondents practiced semi-intensive poultry farming. This could probably be due to its economical use of land in comparison to the free-range system and to an extent, scientific management operations can be applied in this system with huge benefits to the farmer. According to Wantasen *et al.* [41], advantages of a semi-intensive poultry production system include low investments and higher returns, significant savings in feed costs, better meat quality, the meat is lean and fat-free compared to broilers grown in confined cages, and better returns to the entrepreneur. [Strengthen your discussion by adding additional studies finding!](#)

Over 96% of poultry farmers in this study were members of local agricultural groups. This could be due to the fact that membership to a social group widens farmers’ interactive tendencies, exchange of ideas relating to their farming activities and market opportunities. This observation concurs with [7, 39] who

reported membership to cooperatives enhance farmers' access to input and output markets which is necessary for the non-disruptive flow of poultry resources for meeting sustainability requirements of production.

This study revealed that respondents mainly preferred a blend of indigenous and exotic breeds of chicken (68%) perhaps due to the high tolerance among indigenous chickens to diseases, climatic conditions, scavenging ability, improved meat and egg productivity among exotic birds. Findings elsewhere by Gebremariam and Gebremariam [18] revealed that exotic chickens were treasured for their high egg production and crossbred chickens were valued for their intermediate characteristics of being adaptive and possessing economically important traits. Studies elsewhere by Teklewold *et al.* [40] showed that trait categories like high egg and meat production ability were among the principal factors determining farmers' choice and adoption of improved chicken breeds. [Add more findings, those might support your finding or opposite to yours!](#)

The overall average chicken flock size of (43.14) found in this study was higher than those reported in other developing countries by [1, 19]. However, chicks constituting the largest proportion of the flock have been reported [29, 43]. This could be due to the variation in the availability of feed, the presence of different diseases of various aetiologies, predators and the socio-economic status of the owners. Indigenous chickens were mainly kept as a source of income and chicks were primarily supplemented with concentrates. The readily available markets and the ever-increasing demand for IC products especially live chicken both in rural and urban households [9, 26] could explain their high ranking as a source of income. According to young chicks (1-4 weeks old) are given priority towards supplementary feed. Similarly, research findings by Fisseha [17] indicated that majority of chicken owners in Bure district, western Ethiopia, gave prioritized giving supplements to young chicks to encourage growth and maintain flock health.

The most prevalent diseases (Newcastle (18.48%), Gumboro (17.54%) coccidiosis (16.35%), parasites (Mites (28.98%), fleas (27.92%) and infection symptoms (greenish diarrhoea (24.89%), coughing (23.11%), pox lesions (14.89%) identified in this study are in line with findings by [9, 18, 27]. The seasonal outbreak of diseases, especially Newcastle disease and greenish diarrhoea observed in this study, has also been reported to cause high mortalities elsewhere [11, 28, 43]. Notification of the season of outbreaks in this study could be used to schedule vaccination programs against these diseases, i.e. chickens can be vaccinated during dry seasons so that they develop immunity before the outbreaks in the wet seasons.

Results from this study revealed that poultry farmers utilized vaccines, dewormers and herbs such as Aloe species and other local herbs to guard against prevalent diseases among chicken this is consistent with findings by [21, 30] who argued that vaccination programmes and ethno-veterinary medicine such *Aloe secundiflora* and *Aloe ferox* can be used to treat and control diseases in indigenous chicken. This study also showed that farmers mainly chose the type of herbs based on recommendation

and influence from other farmers. This concurs with findings elsewhere by Kilpatrick and Johns [23] who reported that farmers preferred to learn principally by seeking information and advice on a one-to-one basis from more than one person, most frequently experts, but often other farmers.

The high proportion of farmers who had neither reported cases of infection (76.9%) nor had access to poultry extension services (72.1%) is in tandem with Oyeboade and Adebisi [37] who reported low access to information from extension agents which may be largely attributed to the disproportionate extension agents to farm family ratio experienced in public extension which has led to the dwindling services provided by extension agents. The high dependence on radio for information on poultry production is believed to be so, because radios are portable, cheap to maintain, have a wide coverage with an array of stations its users can access for information. This is in consonance with findings by [3, 31] who identified radio and television as major sources of information on health, agriculture and related activities. The observed low patronage of the internet and mobile phones (1.65%) for information can be attributed to lack of expertise and cost of accessing information through this platform. This observation is supported by Easdown and Starasts [13], who reported that internet is not available and its value is not appreciated due to its high cost, lack of skill and limited time to explore it for relevant information.

[As you have written in the data analysis, you were also gone to test significance variation. However I didn't see any significance results described in the results part and also in the discussion.](#)

5. CONCLUSION

The objective of this study was to collect preliminary baseline data using a structured questionnaire prior to validation of three climate smart technologies within project sites. The conclusions are as follows:

- a) The socio-economic characteristics of respondents portray a set of farmers who are in the actively productive age of 50 years, with formal education (97%) and solely derive their household livelihood in terms of food provision and income generation from IC poultry farming.
- b) The semi-intensive IC production system reported in this study is characterized by small flock sizes of 43 birds with good meat quality, low investments, and modest returns to the entrepreneurs. Preference for IC in the study was probably due to their tolerance to diseases, adaptability to harsh climatic conditions, scavenging ability and improved meat and egg productivity.
- c) Newcastle, Gumboro, coccidiosis, mites and fleas were major disease and parasite constraints in the study, where only a few farmer respondents reported cases of infection and accessed the government extension services. Notably, reported diseases were all preventable through strict routine vaccination programs and awareness through education on ectoparasite control. Interestingly, only a few IC farmers utilized vaccines, dewormers and Aloe herbs for the control common diseases affecting chicken. This calls for targeted poultry management intervention strategies from all the relevant stakeholders for improved IC poultry farming.

Comment [B10]: In conclusion figure is not as such necessary!

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7. REFERENCES

1. Aboe, P. A. T., Boa-Amponsem, K., Okantah, S. A., Butler, E. A., Dorward, P. T. and Bryant, M. J. Free-range village chickens on the Accra Plains, Ghana: Their husbandry and productivity. *Tropical Animal Health and Production*. 2006;38(3), 235-248.
2. Adebayo, O. O. and Adeola, R. G. Socio-economics factors affecting poultry farmers in ejiabo local government area of Osun State. *Journal of Human Ecology*. 2005; 18(1), 39-41.
3. Adedokun, O.A., Olowu, T.A. and Adekoya, A. E. Sources of information used by women involved in fishing industry in Lagos state, Nigeria. *African Journal of Livestock Extension*. 2002; 1:11-14
4. Ajani, O. I. Y., Chianu, J. N., Chianu, J. N., Olayide, O. E. Livelihood activities and wealth ranking among rural households in the farming systems of Western Kenya. *African Journal of Livestock Extension*. 2007;5: pp 43–52.
5. Aker, J. C. Information from markets near and far: Mobile phones and agricultural markets in Niger. *American Economic Journal: Applied Economics*. 2010; 2(3), 46-59.
6. Akpan, S. B., Patrick, I. V., Udoka, S. J., Offiong, E. A. and Okon, U. E. Determinants of credit access and demand among poultry farmers in Akwalbom State, Nigeria. *American Journal of Experimental Agriculture*. 2013; 3(2), 293.
7. Alho, E. Farmers' self-reported value of cooperative membership: evidence from heterogeneous business and organization structures. *Agricultural and Food Economics*. 2015; 3(1), 1-22.
8. Atela, J., Ouma, P., Onjoro, P. and Nyangweso, S. A comparative performance of indigenous chicken in Baringo and Kisumu Counties of Kenya for sustainable agriculture. *International Journal of Agricultural Policy Research*. 2016; 4: pp97–104.
doi:10.15739/IJAPR.16.013
9. Bett, H. K., Peters, K. J. and Bokelmann, W. Hedonic price analysis to guide in breeding and production of Indigenous chicken in Kenya. *Livestock Research for Rural Development*. 2011; 23(6), 142.
10. Breustedt, G. Driving forces behind exiting from farming in Western Europe. *Journal of Agricultural Economics*. 2007; 58(1), 115-127.
11. Dana, N., Van der Waaij, L. H., Dessie, T. and van Arendonk, J. A. Production objectives and trait preferences of village poultry producers of Ethiopia: implications for designing breeding schemes utilizing indigenous chicken genetic resources. *Tropical Animal Health and Production*. 2010; 42(7), 1519-1529.
12. Dethier, J. J. and Effenberger, A. Agriculture and development: a brief review of the literature. *Policy Research Working Paper Series*. 2011; (5553).
13. Easdown, W. and Starasts, A. Constructing useful information for farmers – the role of IT. 4th international Crop Science Congress. 2004; 27pp.
14. Eric, O. O., Prince, A. A. and Elfreda, A. N. A. Effects of education on the agricultural productivity of farmers in the Offinso Municipality. *International Journal of Developmental Research*. 2014; 4(9), 1951-1960.

15. FAO. AGA News: FAO supports Kenya to address zoonotic diseases and Animal Health www.fao.org/ag/againinf/home/en/news_archives/2017_FAO_supports_Kenya.html; 2017
16. FAOSTAT. Food and agriculture data. www.fao.org/faostat/en; 2016
17. Fisseha, M., Abera, M. and Tadelle, D. Assessment of village chicken production system and evaluation of the productive and reproductive performance of local chicken ecotype in Bure district, North West Ethiopia. *African Journal of Agricultural Research*. 2010; 5(13), 1739-1748.
18. Gebremariam, B., Mazengia, H. and Gebremariam, T. Indigenous chicken production system and breeding practice in Southern Tigray, North Ethiopia. *Poultry, Fisheries and Wildlife Scientific Journal*. 2017; 5(1), 1-8.
19. Halima, H. F. W. C., Neser, F. W. C., Marle-Koster, V. and De Kock, A. Village-based indigenous chicken production system in north-west Ethiopia. *Tropical Animal Health and Production*. 2007; 39(3), 189-197.
20. Kaingu, F. B., Kibor, A. C., Shivairo, R., Kutima, H., Okeno, T. O., Waihenya, R. and Kahi, A. K. Prevalence of gastro-intestinal helminthes and coccidia in indigenous chicken from different agro-climatic zones in Kenya. *African Journal of Agricultural Research*. 2010; 5(6), 458-462.
21. Kaingu, F., Liu, D., Wang, L., Tao, J., Waihenya, R. and Kutima H. Anticoccidial effects of *Aloe secundiflora* leaf extracts against *Emimeria tenella* in broiler chicken. *Tropical animal Health and Production*. 2017; 49: pp 823-828
22. KNBS. (Kenya National Bureau of Statistics). Economic Survey 2016. 2016. Available: <http://www.knbs.or.ke>
23. Kilpatrick, S. and Johns, S. How farmers learn: different approaches to change. *The Journal of Agricultural Education and Extension*, 2003; 9(4), 151-164.
24. Kimhi, A. and Bollman, R. Family farm dynamics in Canada and Israel: the case of farm exits. *Agricultural Economics*, 1999; 21(1), 69-79.
25. Kingori, A.M., Wachira, A.M., Tuitoek, J.K. Indigenous chicken production in Kenya: A review. *International Journal of Poultry Science*, 2010; 9: pp 309–316. doi:10.3923/pjbs.2008.2525.2531
26. Meseret, M., Solomon, D. and Tadelle, D. Marketing system, socio economic role and intra household dynamics of indigenous chicken in Gomma Wereda, Jimma Zone, Ethiopia. *Livestock research for rural development*, 2011; 23(6).
27. Mohammed, B. R. and Sunday, O. S. An overview of the prevalence of avian coccidiosis in poultry production and its economic importance in Nigeria. *Veterinary Research International*, 2015; 3(3), 35-45.
28. Moreki, J. C. Village poultry production in Serowe-Palapye sub-district of Botswana. *Livestock Research for Rural Development*, 2010; 22(3), 46.
29. Mtileni, B. J., Muchadeyi, F. C., Maiwashe, A., Phitsane, P. M., Halimani, T. E., Chimonyo, M. and Dzama, K. Characterisation of production systems for indigenous chicken genetic resources of South Africa. *Applied Animal Husbandry and Rural Development*. 2009; 2(1), 18-22.
30. Mwale, M. and Masika, P. J. Ethno-veterinary control of parasites, management and role of

village chickens in rural households of Centane district in the Eastern Cape, South Africa. *Tropical Animal Health and Production*, 2009; 41(8), 1685-1693.

31. Myhre, S.L. and Flora, J.A. HIV/AIDS communication campaigns: progress and prospects. *Journal of Health Communication*, 2000;5(1): 29-4
32. Ngugi, R.K. and Nyariki, D.M. Rural livelihoods in the arid and semi-arid environments of Kenya: Sustainable alternatives and challenges. *Agriculture and Human Values*. 2005; 22: pp 65–71. doi:10.1007/s10460-004-7231-2.
33. Okitoi, L.O., Ondwasy, H.O., Siamba, D.N.N., Nkurumah, D. Traditional herbal preparations for indigenous poultry health management in Western Kenya. *Livestock Research for Rural Development*. 2007; 19(72), 1423-1434.
34. Ologbon, A. C. and Ambali, I. Poultry enterprise combination among small-scale farmers in Ogun State, Nigeria: A technical efficiency approach. *Journal of Agriculture and Veterinary Sciences*. 2012; 4(1), 7-15.
35. Olwande, P., Ogara, W., Okuthe, S., Muchemi, G., Okoth, E., Odindo, M. and Adhiambo, R. Assessing the productivity of indigenous chickens in an extensive management system in southern Nyanza, Kenya. *Tropical Animal Health and Production*. 2010;42: 283–288. doi:10.1007/s11250-009-9418-4
36. Osuji, E. E., Okwara, M. O., Essien, U. A., Balogun, O. L. and Agu, C. G. Sustainability of climate change adaptation measures in south-south, Nigeria. *Agricultural and Food Science Journal*. 2019;6(1), 120-126.
37. Oyeboade, L. A. and Adebisi, G. L. Access to Public Extension Training Service by Poultry Farmers in Ikpoba-Okha Local Government Area of Edo State, Nigeria. *Agricultural and Food Science Journal*. 2014; 2(3), 31-43.
38. Patterson, C. D. and Guerin, M. T. The effects of climate change on avian migration patterns and dispersal of commercial poultry diseases in Canada. *World Poultry Science*, 2013;69: pp17-26
39. Shiferaw, B., Hellin, J. and Muricho, G. Improving market access and agricultural productivity growth in Africa: What role for producer organizations and collective action institutions? *Food Security*, 2011; 3(4), 475-489.
40. Teklewold, H., Dadi, L., Yami, A. and Dana, N. Determinants of adoption of poultry technology: a double-hurdle approach. *Livestock Research for Rural Development*, 2006; 18(3), 33- 39.
41. Wantasen, E., Elly, F. H. and Santa, N. M. The analysis of semi intensive native chicken farming in rural communities. *Journal of the Indonesian Tropical Animal Agriculture*. 2014; 39(2), 126-133
42. WHO. (World Health Organization). The control of neglected zoonotic diseases: community based interventions for NZDs prevention and control: report of the third conference organized with ICONZ, DFID-RiU, SOS, EU, TDR and FAO with the participation of ILRI and OIE: 23-24 November 2010, WHO Headquarters, Geneva, Switzerland (No. WHO/HTM/NTD/NZD/2011.1). World Health Organization; 2011.
43. Yakubu, A. Indigenous chicken flocks of Nasarawa State, Nigeria: their characteristics,

husbandry and productivity. *Tropical and Subtropical Agroecosystems*, 2010; 12(1), 69-76.

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