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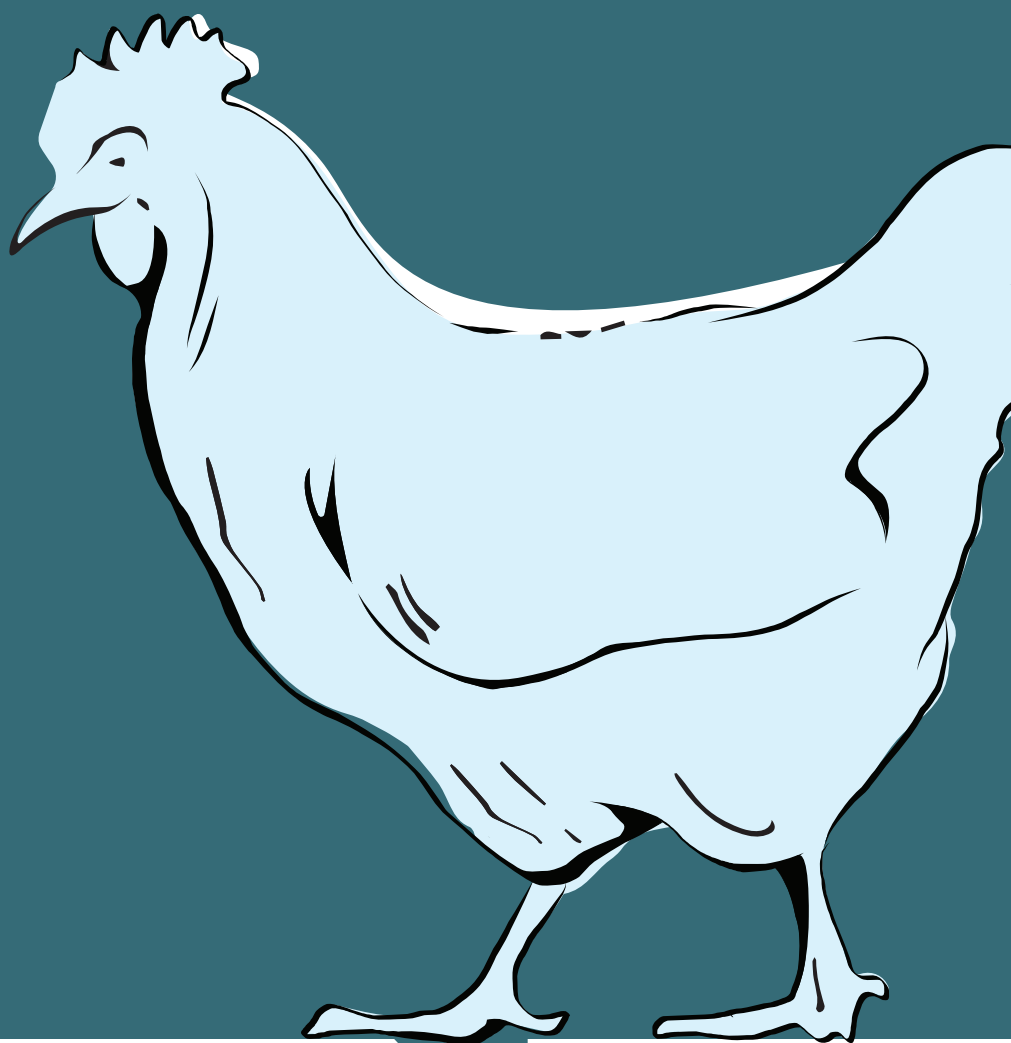
**AFRICA
SUSTAINABLE
LIVESTOCK
2050**



Biosecurity and
public health practices along
the poultry value chain

KENYA

*Evidence from Kiambu and
Nairobi City Counties.*



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1. Introduction

In response to the increased threat to human health posed by zoonotic pathogens, major One Health programs have been launched to foster the design of policies and practices that reduce public health risks along livestock value chains. However, their implementation remains scanty (Munyua et al., 2019). Reduction of livestock-related public health risks requires that all stakeholders along the value chain adopt good practices that minimize disease introduction, emergence and spread. This includes the prevention of selection for antimicrobial resistance and spread of resistance conferring genes.

In Kenya, to satisfy the rapidly increasing demand for animal source food (ASFs) of growing urban populations, livestock holdings and value chains in and around peri-urban and urban areas are transforming more rapidly than elsewhere in the country, risking to exacerbate the negative impacts of livestock keeping on the environment and public health.

The extent to which livestock-associated pathogens pose risks to public health is determined by the broader context in which livestock stakeholders operate and behave, both collectively and individually (FAO, 2011). Understanding stakeholders' behaviour as they perform various functions along the various livestock value chains is therefore crucial to inform, revise, and update policies.

In order to identify major public health hazards associated with the particularly rapidly expanding poultry value chain(s), FAO, in collaboration with the veterinary service directorates of urban and peri-urban counties of Kiambu and Nairobi, surveyed the poultry value chain actors to assess their business practices and extent to which they comply with recommended biosecurity and public health practices. We noted that stakeholders tend more to adopt practices that are anticipated to have a positive impact on their business (e.g. vaccination), often poorly complying with other practices (e.g. reporting sick animals to the authority), and that those that, as part of their business, keep animals for a relatively long period, such as the producers, invest more in biosecurity practices than those who keep animals for a few hours (e.g. traders and retailers).

2. Materials and methods

The study consisted of two components: (i) a review of good practices and regulations pertaining to various 'nodes' (production, trade/transport, retail, and slaughter) of the poultry value chains, and (ii) a survey of the characteristics and compliance with the identified good practices and regulations of poultry value chain actors.

2.1. Biosecurity practices and legislation

We reviewed relevant 'biosecurity practices' documents and the existing legislation, including Acts and Regulations (Animal Diseases Act (CAP364), 1989 revised 2012; Animal Diseases (Hatchery) Rules, 1985; Animal Diseases Rules, 1968; VMD Regulations, 2015; Environmental Management and Coordination Act (EMCA), 1999; Meat Control (Transport of Meat) Regulations, 1976; Meat Control (local slaughterhouses) Regulations, 2010; Public Health Act (CAP 242), 1986 revised 2012; The Public Health (food handling) Regulations, 1998) and policies (National Livestock Policy, 2020; Veterinary Policy, 2020; National Policy on Prevention and Containment of AMR, 2017; National Environment Policy, 2013) and distilled the relevant 'biosecurity practices' and regulations for each of the four value chain nodes (Tables 1 to 4).

Table 1: ‘Biosecurity practices’ and regulations for poultry production

Practice	Regulation
Purchase DOCs from licenced suppliers	
Obtain health records for all treatments/vaccinations done at the hatchery	
Clean and disinfect the poultry house before introducing birds	
Separate newly introduced birds for at least two weeks and observe regularly	
Separate poultry species, different ages should be housed separately	
Provide treated footbaths at farm/poultry house entry points	
Change wear when entering and leaving poultry house	
Vaccinate birds according to the recommended schedule	Animal Diseases Rules, 1968. Part V Section 38, 40, 41
Call a public veterinarian when there is dead stray animal on the farm.	Animal Diseases Rules, 1968. Part V Section 41
Isolate/quarantine and treat sick birds	Animal Diseases Act CAP 364 (Revised 2012) Section 4
Use antibiotics prudently as advised by a veterinarian	Veterinary Surgeons and Veterinary Para-professionals Act (CAP 366), 2011: Second Schedule part D Section 2
Observe feed and drug withdrawal periods	
Dispose dead birds in a safe way by (bury /incinerate/ deep pits)	Animal Diseases Act CAP 364 (Revised 2012) Section 7 Sub section 1 (f)
Disposal of waste (litter) in a way that it does not contaminate the environment	EMCA 1999, Part VIII Section 87 Sub section (1)

Not all the recommended biosecurity practices at farm level are enforceable through regulations. Indeed, half of them, including wearing protective clothing, providing foot baths, observing feed and drug withdrawal periods, sourcing DOCs/starter flocks from licenced suppliers, though they are important good practices and expected to be carried out by the producers, are not legally enforceable.

Table 2: ‘Biosecurity practices’ and regulations for poultry transport

Practice	Regulation
Use a proper vehicle, well ventilated and spaced carriages to transport poultry	Prevention of Cruelty to Animals Act (transport of animals) Section 4 and 5
Clean and disinfect vehicle and boxes/crates before transport	
Inspect birds before loading	
Check the documentation and obtain a movement permit	Animal Diseases Rules ,1968. Part III Section 17 (4)
Record the batch number against cage/carrier	
Segregate poultry according to species, age, and flock	
Do not transport poultry from infected areas to other areas	Animal diseases Act CAP 364 (Revised 2012) Section 4 Sub section 5 (d)
Isolate birds that fall sick during transport once at the market	
Safely dispose of birds dying during transport	Animal Diseases Rules, 1968. Part III Section 27 Sub section (1)
Transport live birds and meat in separate vehicles	
Ensure cold storage of dressed poultry products during transport	
Transport meat consignment only after obtaining a certificate of transport	Meat Control (transport of meat) Regulations 1976, Section 8
Clean and disinfect carriers/cages before leaving LBM	
Wear protective gear when handling poultry meat	Meat Control (transport of meat) Regulations 1976, First Schedule Section 6
Wash hands and other exposed parts of the body using disinfectants and clean water when handling meat	Meat Control (transport of meat) Regulations 1976, First Schedule Section 6

Compared to the production node, good practices at the transport node are more regulated, with a majority of good practices addressed in several regulations (Table 2), but mostly by the Meat Control (transport of meat) Regulations of 1976.

Table 3: ‘Good practices’ and regulations for poultry marketing/retail

Practices	Regulation
Inspect all birds received	
Do not mix birds from different farms/sources	
Do not keep birds at the market for more than 24 hours	
Clean and disinfect holding/carriage cages after every use	Animal Diseases Rules 1968 Part VI, Section 47
Use compartmentalized holding cages for different batches	
Remove faecal material and solid waste on daily basis and place in bins for subsequent disposal	
Safely dispose of dead birds	Animal Diseases Act CAP 364 (Revised 2012) Section 7 Sub section 1 (f)
Isolate sick birds that have been brought to the market and report to a market inspector	
Keep birds that have been in the market for more than 24 hours away from incoming new supplies	

Regulation of bird markets is limited. There are few provisions in the current legislative framework that prescribe how actors in the live bird markets should operate. There are however numerous good practices available as guidelines (Table 3), but since they are not legislated, enforcement faces legal challenges.

Table 4: ‘Good practices’ and regulations for poultry slaughter and processing

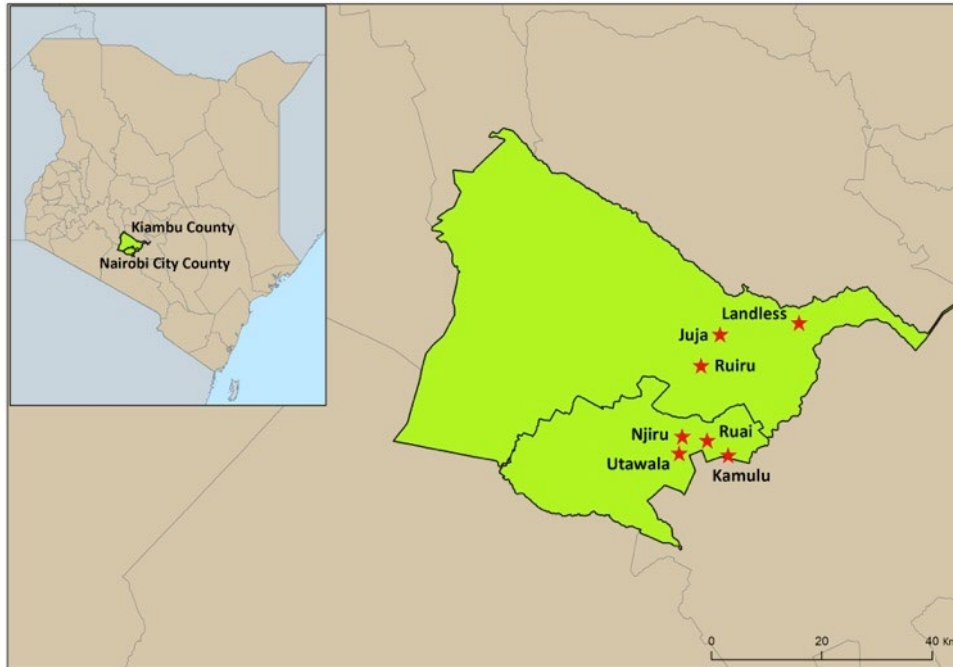
Practices	Regulation
Ensure slaughter facility is isolated from poultry farms, residential areas	Meat Control Act (local slaughterhouses) 2016, Schedule A Section 1
Source birds only from areas free of notifiable poultry diseases	Animal Diseases Rules 1968, Part III, Section 22
Regular cleaning and disinfection of slaughterhouse and equipment	Meat Control (local slaughterhouses) Regulations, 2010. First Schedule Part B Section 1 and 3
Separate areas for different slaughter operations	Meat Control Act (local slaughterhouses) 1973 (revised 2016), Schedule A Section 3
Separate staff working in clean and dirty areas	Meat Control (local slaughterhouses) Regulations, 2010. Second Schedule, Category B Section (J)
Personal hygiene of staff, health certification and use of PPEs	Meat Control (local slaughterhouses) Regulations, 2010, First Schedule Part Public Health (food handling) Regulations, 1998, Section 26 Sub section (I)
<i>Ante</i> and <i>postmortem</i> inspection to be done by a qualified inspector	Meat Control (Poultry Meat Inspection) Regulations, 1973 (revised 2016), Schedule Part D and E
Batching (labelling specific batch numbers)	
Transport meat only if issued with certificate of transport by the Inspecting officer	Meat Control (transport of meat) Regulation, 1976, Section 8
Use of recommended meat carries (meat boxes, refrigerated and insulated vehicles) for meat transport	Meat Control (transport of meat) Regulation, 1976, Section 20-22
Slaughter birds, which at <i>ante mortem</i> inspection are found with or suspected of having a disease/condition, after all healthy birds have been processed	Meat Control (Poultry Meat Inspection) Regulations, 1973 (revised 2016), Schedule Part D (5 and 9)
Safely dispose of offal and slaughter waste	EMCA 199, Part VIII Section 87 (1)
Immediate disposal of condemned birds/carcasses and not offered for human consumption	Meat Control (Poultry Meat Inspection) Regulations, 1973 (revised 2016), Schedule Part D (10)
Use stainless-steel or other suitable materials for evisceration tables, chilling equipment	Meat Control (Poultry Meat Inspection) Regulations, 1973 (revised 2016), Schedule Part A (2)

Poultry slaughter is highly regulated. Nearly all activities at this node are directly or indirectly linked to a legislation, including the Meat Control Regulations, Public Health Food Handling Regulations and the Environmental Management and Co-ordination Act (EMCA). Since most slaughter takes place on the farms and live bird markets, where there is limited investment in slaughtering facility, and inspecting officers are few, adequate enforcement of these practices is a challenge.

2.3. Survey of poultry value chain actors

A survey of poultry value chain actors was conducted in the urban and peri-urban areas of Kiambu and Nairobi City counties, Kenya (Figure 1), in September and October 2020. Nairobi City and Kiambu are

the first and second most populous counties in Kenya, with 4.3 million people living in Nairobi City county and 2.1 million residents in Kiambu county (KNBS, 2019). The two counties are of interest, as they are both within the pockets of urban and peri-urban areas and have thriving livestock value chains in densely populated areas.



Source: for country boundaries: United Nations, Map No 4170, October 2020; for regional boundaries, GADM, accessed in January 2021. The boundaries and names shown and the designations used on this/these map(s) do not imply the expression of any opinion whatsoever on the part of FAO concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers and boundaries. Dashed lines on maps represent approximate border lines for which there may not yet be full agreement.

Figure 1: Kiambu and Nairobi City Counties

The survey targeted actors in the key four poultry value chain nodes: production, transporting, processing (on the farm and in live bird markets), and marketing of live birds. Thika, Juja, Ruiru sub counties in Kiambu County and Embakasi East and Kasarani sub-counties in Nairobi city county were purposely selected based on their high numbers of actors in poultry production and live bird marketing.

The FAO developed a checklist of good practices for Focus Group Discussions (FGDs) and semi-structured questionnaires for stakeholders at each node of the poultry value chain. With the help of the county veterinary staff of Kiambu County, the questionnaires were pretested and revised.

County veterinary directors nominated ten frontline animal health staff to hold Focus Group Discussions for each of the four prioritized nodes of the poultry value chain and to administer the semi-structured questionnaires to individual actors and key informants (KIs). The FAO staff trained the frontline staff in using the checklist and in administering the questionnaires.

A total of seven FGDs were conducted in the two counties. Twenty key informants and 160 respondents were selected randomly from the sub counties to participate in the surveys (Table 5). The sample comprised small-scale to medium-scale poultry (meat) producers, transporters, slaughterers

(on the farm and in live bird markets (LBMs)), and traders/retailers of live birds (in LBMs) and of poultry meat (in butcheries).

Table 5: Number of FDGs and individuals surveyed at each value chain node in Nairobi and Kiambu

	Kiambu	Nairobi	Total
Focus group discussions	3	4	7
Production value chain node	60	40	100
Transporting value chain node	12	8	20
Marketing value chain node	18	12	30
Processing value chain node	18	12	30

After the data was collected, it was recorded in MS Excel, cleaned and summarized using graphs and tables.

3. Findings

This section presents the socio-economic characteristics of value chain actors and the reported processes undertaken at the four nodes.

3.1. Characteristics and practices of poultry producers

Slightly more than half of the producers interviewed are women (Table 6). Nearly three quarters of the producers interviewed are elderly (40 years or older), with about half of them possessing tertiary education. Slightly more than half of the producers have been in the poultry business for more than five years. Producers raise an average of 6 batches of 500 to 600 birds each per year.

Table 6: Socio-economic characteristics of poultry producers in Kiambu and Nairobi counties

Characteristic	Kiambu (n=60)	Nairobi (n=40)	Overall (n=100)
Gender			
Female	35(58.3%)	22(55.0%)	57(57.0%)
Male	25(41.7%)	18(45.0%)	43(43.0%)
Age category			
<30 years	7(11.7%)	1(2.5%)	8(8.0%)
30-40 years	15(25.0%)	4(10.0%)	19(19.0%)
40-50 years	28(46.7%)	15(37.5%)	43(43.0%)
>50 years	10(16.7%)	20(50.0%)	30(30.0%)
Highest education level			
Primary	4(6.7%)	0(0.0%)	4(4.0%)
Secondary	30(50.0%)	17(42.5%)	47(47.0%)
Tertiary	26(43.3%)	23(57.5%)	49(49.0%)
Respondent type			
Family	2(3.3%)	1(2.5%)	3(3.0%)
Farm manager	1(1.7%)	1(2.5%)	2(2.0%)
Farm worker	4(6.7%)	2(5.0%)	6(6.0%)
Owner	53(88.3%)	36(90.0%)	89(89.0%)
Area of settlement			
Urban	0(0.0%)	5(12.5%)	5(5.0%)
Peri-urban	57(95.0%)	35(87.5%)	92(92.0%)
Rural	3(5.0%)	0(0.0%)	3(3.0%)
Farming experience			
<1 year	1(1.7%)	5(12.5%)	6(6.0%)
1-5 years	27(45.0%)	9(22.5%)	36(36.0%)
5-10 years	20(33.3%)	16(40.0%)	36(36.0%)
>10 years	12(20.0%)	10(25.0%)	22(22.0%)
Volume of production			
Mean no batches/year (SD)	6(4)	7(4)	6(4)
Mean no poultry/batch	533	673	533

Producers obtain day-old chicks (DOCs) from the major hatcheries dominating supply, comprising Kenchic, Kenbird, and Muguku limited. Small-scale breeders such as KULA KUKU in Nairobi also supply DOCs. The preference of the source is based on trust and performance of previous batches. The DOCs are supplied through agro-vet shops and company agents; however, some large-scale and medium-scale producers are being supplied directly from the hatcheries. Producers reported that, due to COVID-19, there is a shortage of DOCs, resulting in purchases from Uganda and Tanzania. Prior booking is made with a partial payment, and the delivery period ranges from one week to about two months.

The lapse between booking and delivery provides the farmer time to prepare the brooder by thoroughly cleaning and disinfecting the house to reduce pathogen build-up. The most common practices included: fumigation and disinfection of the floors, walls, poultry curtains; washing the feeders, drinkers, shoes, and overalls worn in poultry houses; removing old litter/sawdust and manure as well as placing a heating source in the brooders. The farmers maintain a minimum period of at least two weeks before introducing a new batch. As most producers have a single poultry house, different batches of birds are separated using plywood or boxes within the same house. Where different species

of birds are raised, they are kept in separate houses. Indigenous (kienyeji) poultry are mostly reared in a free-range system.

Farmers check whether DOCs are pre-vaccinated and, if not, they administer the required vaccine. They stated that vaccination play a significant role in the flock's health management. The vaccine is administered orally in clean drinking water following various regimes based on recommendations of the hatchery that supplied the DOCs. Due to the non-complexity of the vaccination process, most farmers prefer to carry out the vaccination without the involvement of qualified practitioners', which would entail additional costs. The vaccines can easily be acquired across the counter in agro-vet shops.

Most (83%) of the interviewed producers use disinfectants. However, not all have footbaths and many use improvised basins and spray bottles containing disinfectants. Those who have footbaths rarely change the disinfectant unless the footbath is dirty or when it has rained. The majority (88%) of the interviewed farmers reported that they clean drinkers and feeders daily using soap, water, and disinfectants.

Table 7: Biosecurity and hygiene practices of poultry producers

Practice	Kiambu (n=60)	Nairobi (n=40)	Total (n=100)
Use and frequency of changing disinfectants in foot baths			
Use a disinfectant	48(80.0%)	35(83.0%)	83(83.0%)
Do not use a disinfectant	12(20.0%)	5(12.5%)	17(17.0%)
Never used	1(1.7%)	2(5.0%)	3(3.0%)
When it is dirty	17(28.3%)	12(30.0%)	29(29.0%)
After rain	0(0.0%)	4(10.0%)	4(4.0%)
When it dries up	6(10.0%)	4(10.0%)	10(10.0%)
According to manufacturer's recommendations	10(16.7%)	11(27.5%)	21(21.0%)
Occasionally	21(35.0%)	11(27.5%)	32(32.0%)
Frequency of cleaning drinkers			
Daily	56(93.3%)	32(80.0%)	88(88.0%)
At least once per week	3(5.0%)	5(12.5%)	50(50.0%)
Occasionally	1(1.7%)	5(12.5%)	6(6.0%)
At the end of the cycle	1(1.7%)	3(7.5%)	4(4.0%)
When the equipment is dirty	1(1.7%)	3(7.5%)	4(4.0%)

Most of the farmers reported that they had not experienced any major infectious disease outbreak. When their poultry fall sick, most of them separate the sick birds from the rest of the flock before reporting to a public health practitioner, while some seek the advice of veterinarians or agro-vet attendants. A few reported that they sought advice from friends and neighbours who had experienced a similar outbreak. A fair share of producers slaughters sick birds for sale to unsuspecting consumers, dog owners, and for consumption at the household, while dead birds are sold as pet food or thrown on dumpsites.

Table 8: Actions taken a bird falls ill or dies on the farm

Practice	Kiambu (n=60)	Nairobi (n=40)	Total (n=100)
Access to veterinarian			
Easy to find	51(85%)	19(47.5%)	70(70%)
Actions taken when a bird falls sick at the farm			
Immediately separate it from all other birds	45(75.0%)	33(82.5%)	78(78%)
Sell it alive	4(6.7%)	1(2.5%)	5(5.0%)
Report to a public animal health professional	26(43.3%)	19(47.5%)	45(45.0%)
Seek the advice of an animal health professional	39(65.0%)	31(77.5%)	70(70.0%)
Seek the advice of the agro-vet shop keeper	22(36.7%)	17(42.5%)	39(39.0%)
Seek the advice of neighbours / friends	11(18.3%)	10(25.0%)	21(21.0%)
Give it the medicines I have at home	12(20.0%)	8(20.0%)	20(20.0%)
Slaughter and consume	5(8.3%)	7(17.5%)	12(12.0%)
Slaughter and give to the dogs	10(16.7%)	4(10.0%)	14(14.0%)
Slaughter and sell	2(3.3%)	3(7.5%)	5(5.0%)
Slaughter, burry/incinerate	17(28.3%)	4(10.0%)	21(21.0%)
Other	2(3.3%)	0(0.0%)	2(2.0%)
Actions taken when a bird dies at the farm			
Report to the public animal health professional	30(50.0%)	18(45.0%)	48(48.0%)
Consume	3(5.0%)	1(2.5%)	4(4.0%)
Give it to the dogs	14(23.3%)	18(45.0%)	32(32.0%)
Sell	0(0.0%)	3(7.5%)	3(3.0%)
Bury/incinerate	38(63.3%)	22(55.0%)	60(60.0%)

The majority of the producers reported that they administer vitamins and occasionally antibiotics to DOCs on arrival. Producers also administer medicines to the entire flock, even when only a few birds are ill. The majority administers medicine based on qualified professionals' advice, while some producers base it on previous disease signs they had encountered. Antibiotics are the most frequently used medicines. A few producers reported using human medicine and traditional methods such as *aloe vera* mixed in water. Human medicine was said to promote weight gain so that birds reach market weight earlier. Only indigenous (kienyeji) poultry farmers give human medicine (Septrin, i.e. cotrimoxazole) to sick birds. Treatment of birds just before or immediately after transportation was practised by a majority of producers, pointing to lack of observation of drug withdrawal periods.

Table 9: Medication practices of poultry producers

Practice	Kiambu (n=60)	Nairobi (n=40)	Total (n=100)
Give medicine only as advised by an animal health professional			
Always	43(71.6%)	17(42.5%)	60(60.0%)
Sometimes	16(26.7%)	22(55.0%)	38(38.0%)
Never	1(1.7%)	1(2.5%)	2(2.0%)
Give medicine to DOCs			
Always	36(64.5%) ¹	19(48.7%)	55(58.5%)
Sometimes	14(25.4%)	11(28.2%)	35(26.6%)
Never	5(9.1%)	9(23.1%)	14(14.9%)
No response	5(8.3%) ²	1((2.5%)	6(6.0%)
Give medicine to the entire flock when a few birds show signs of disease			
Always	39(71.2%)	22(55.0%)	61(64.9%)
Sometimes	15(27.8%)	12(30.0%)	27(28.7%)
Never	0(0.0%)	6(15.0%)	6(6.4%)
No response	6(10.0%)	0(0.0%)	6(6.0%)
Use medicine for humans to treat poultry			
Always	2(4.0%)	1(2.6%)	3(3.4%)
Sometimes	4(8.0%)	4(10.5%)	8(9.1%)
Never	44(88.0%)	33(86.8%)	77(87.5%)
No response	10(16.7%)	2(5.0%)	12(12.0%)
Observe the recommended dosage (quantity and duration)			
Always	42(76.4%)	28(73.7%)	70(75.3%)
Sometimes	12(21.8%)	8(21.0%)	20(21.5%)
Never	1(1.8%)	2(5.3%)	3(3.2%)
No response	5(8.3%)	2(5.0%)	7(7.0%)
Give medicine to poultry based on symptoms treated before			
Always	20(37.0%)	16(41.0%)	36(38.7%)
Sometimes	26(48.2%)	12(30.8%)	38(40.9%)
Never	8(14.8%)	11(28.2%)	19(20.4%)
No response	6(10.0%)	1(2.5%)	7(7.0%)
Treat poultry before and after transportation, when the weather changes or if there is an outbreak in the area			
Always	21(38.9%)	20(51.3%)	41(44.1%)
Sometimes	27(50.0%)	9(23.1%)	36(38.7%)
Never	6(11.1%)	10(25.6%)	16(17.2%)
No response	6(10.0%)	1(2.5%)	7(7.0%)

¹ Percentage of respondents; ² percentage of sample

Producers cited poor flock performance as a significant setback to their business, which they attribute to the low quality of (expensive) chicken feeds.

3.2. Characteristics and practices of poultry transporters

Actors involved in poultry transport are diverse. They consist of farmers transporting live birds or poultry meat (broiler), traders who source and transport live birds or poultry meat, while others are vehicle/motorcycle owners who only provide transport services at an agreed fee. When transport is offered as a service, agreements are oral since some are impromptu transport requests. Most of the transporters are also marketers.

Live birds are transported to the live bird markets, slaughter facilities, and informal indigenous chicken retail joints, while poultry meat is transported from farms (broilers) and informal slaughter joints (live bird market stalls) to retailers, individual consumers, fast-food outlets, institutions such as schools, hotels, and hospitals.

Both males and females are involved in poultry transport business; about half of the transporters interviewed were in the age bracket of 40 to 50 years. The majority have at least secondary education and have been in the business of poultry transport for over 5 years.

Table 8: Socio-economic and demographic characteristics of poultry transporters

Characteristic	Overall (n=20)
Gender	
Male	11(55.0%)
Female	9(45.0%)
Age category	
< 30 years	4(20.0%)
30-40 years	4(20.0%)
40-50 years	9(45.0%)
>50 years	3(15.0%)
Highest level of education	
Primary level	1(5.0%)
Secondary level	15(75.0%)
Tertiary level	4(20.0%)
Work experience	
> 1-5 years	6(30.0%)
5-10 years	5(25.0%)
> 10 years	7(35.0%)
No response	2(10.0%)

Transporters commonly use plastic cages for transportation, as they are easy to clean. A few of the transporters used metal and wooden cages/crates, which are not easy to clean, while others transport the poultry on public services vehicles. Live birds would easily be tied onto the motorcycle and let to hang. Poultry meat is transported mainly in nylon gunny bags (recycled feed bags/sacks) in the boot of public service vehicles, which also ferry people. Motorcycle operators, who mainly transport people, are a major means of transporting poultry meat. They also use nylon gunny bags.

Table 11: Business characteristics of poultry transporters

Characteristic	Overall (n=20)
Transport live birds	
Yes	18(90.0%)
No	2(10.0%)
If yes, the average number per week	
<100	5(27.5%)
101-500	9(50.0%)
501-1000	2(11.1%)
>1000	2(11.1%)
Transport dressed chicken	
Yes	7(35.0%)
No	13(65.0%)
If yes, the average number per week	
<100	1(14.3%)
101-500	4(57.1%)
501-1000	1(14.3%)
>1000	1(14.3%)
Type of crate/cage used for transportation	
Plastic cage/crate	9(42.9%)
Metal cage/crate	4(19.0%)
Wooden cage/crate	4(19.0%)
Do not use any cage/crate during transportation	3(14.3%)

Trader-transporters reported that for sourcing the birds they enter the poultry house to select the birds that satisfy their preferred quality attributes, which comprise size, alertness, vent cleanliness, absence of signs of disease, etc. Poultry health certificates are not a major requirement. Traders also look for producers able to provide a constant supply of birds conforming to the traders' quality requirements.

Poultry from different sources/suppliers are frequently transported in the same vehicle, in some cases also in the same cages/crates. Some transporters mix chickens with non-poultry products, such as vegetables and other livestock products. A majority (76%) of the transporters do not clean the cages before and after each consignment.

Table 12: Business practices of poultry transporters

Practice	Overall (n=20)
Practices for selecting poultry to (purchase and) transport	
Compare the price of different suppliers	8(40.0%)
Only source the birds from registered suppliers	1(5.0%)
Always source the birds from the same suppliers	8(40.0%)
Ask for a health certificate	1(5.0%)
Enter the farm and select the birds	11(55.0%)
Refusal to transport poultry	
Signs of sickness	9(60.0%)
No animal health certificate	3(20.0%)
Price higher than expected	10(66.7%)
Birds not meeting the weight requirements	9(60.0%)
Transport of poultry from multiple suppliers	
Always/sometimes	18(90.0%)
Transport poultry with other non-livestock products	
Always/sometimes	19(95.0%)
Cleaning of vehicle/crate/cage used for transportation	
Before and after each transport	6(24.0%)

Only a few transporters reported obtaining a movement permit before transportation, with a majority stating that such a permit was unnecessary for their business (Figure 2).

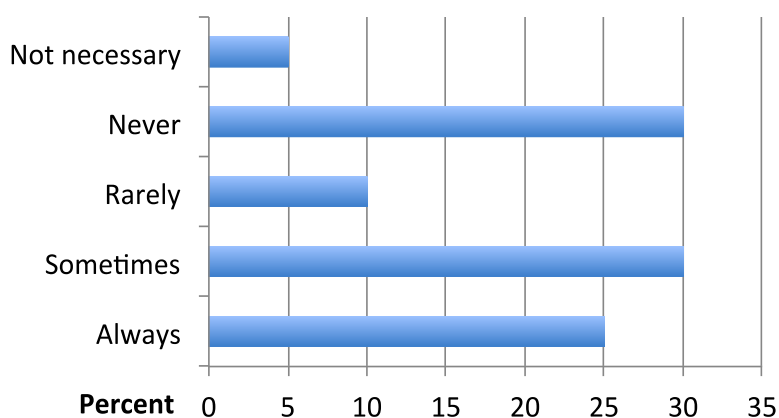


Figure 2: Frequency of obtaining a movement permit before transporting live and slaughtered poultry

In case chickens get ill or die in transit, some reported to deliver and sell all the same, others contact/return them to the owners, while others self-consume or slaughter and sell the chickens as dog food.

Table 13: Actions of poultry transporters when birds fall ill or die during transport

Actions	Overall (n=20)
Actions taken when a bird falls sick in transit	
Immediately separate if from all other birds	10(50.0%)
Sell it in any case	2(10.0%)
Slaughter and consume	2(10.0%)
Slaughter and give it to dogs	1(5.0%)
Slaughter and sell	2(10.0%)
Slaughter and bury/incinerate	5(25.0%)
Nothing	1(5.0%)
Contact the owner	3(15.0%)
Throw it away	1(5.0%)
Others	2(10.0%)
Actions taken when poultry dies in transit	
Report to the public veterinarian/animal health professional	4(20.0%)
Consume	6(30.0%)
Feed it to the dogs	1(5.0%)
Sell	3(15.0%)
Throw it away	4(20.0%)
Bury/incinerate	8(40.0%)
Others	2(10.0%)

Challenges cited by some actors in this value chain segment included the limitation of specializing in the chicken transport business due to low demand as many traders and producers use their own vehicles to transport their consignments. They also complained of frequent arrests by county council officials for not having a movement permit, which they believe is not a requirement for small-sized livestock. This depicts their lack of awareness of the legal requirements for move.

3.3. Characteristics and practices of live bird market (LBM) retailers

The types of birds sold at LBMs are indigenous chicken, improved indigenous (*kienyeji*) chicken, ex-layers (spent hens), and a few broilers. Indigenous chicken and the improved kienyeji are mainly sourced from as far as Bungoma, Kericho, and Bomet counties, and transported on public service vehicles. Broilers and culled layers are mainly sourced from within the two counties and are transported on pick-ups in cages. Motorcycles are mainly used to distribute the chickens and dressed carcasses to smaller traders and hotels. Before accepting the consignment, the market traders assess the poultry's health status but are more concerned with the sizes/weights of the birds.

Among the interviewed live bird market actors, there were slightly more men than females. About three quarters were within the age of 30 to 50 years and had secondary education and above.

Table 14: Socio-economic and demographic characteristics of LBM retailers

Characteristic	Kiambu (n=18)	Nairobi (n=12)	Overall (n=30)
Gender			
Female	4(22.2%)	9(75.0%)	13(43.3%)
Male	14(77.8%)	3(25.0%)	17(56.7%)
Age category			
<30 years	3(16.7%)	4(33.3%)	7(23.3%)
30-40 years	6(33.3%)	3(25.0%)	9(30.0%)
40-50 years	7(38.9%)	5(41.7%)	12(40.0%)
>50 years	2(11.1%)	0(0.0%)	2(6.7%)
Highest education level			
Primary	3(16.7%)	6(50.0%)	9(30.0%)
Secondary	10(56.6%)	3(25.0%)	13(43.3%)
Tertiary level	5(27.8%)	3(25.0%)	8(26.7%)

Half of the interviewed LBM traders reported that they engaged in selling both live birds, sold to household consumers, and dressed carcasses, mainly demanded by food outlets. The slaughter process is done at the market and on roadside stalls, with meat inspection being extremely rare.

Most of the traders operate in fixed stalls fitted with metallic cages where they keep birds in the market until they are sold. The majority of traders sell between 100 and 500 birds per week.

Table 15: Business practices and turnover of poultry sellers at LBMs

Practice	Kiambu (n=18)	Nairobi (n=12)	Overall (n=30)
Sell both live and slaughtered birds	9(50.0%)	9(75.0 %)	18(51.4%)
Have a fixed stall to keep poultry at the market	16(88.9%)	7(58.3%)	23(76.7%)
Type of cage/crate			
Plastic cage/crate	3(16.7%)	0(0.0%)	3(10.0%)
Metal cage/crate	12(66.7%)	9(75.0%)	21(70.0%)
Wooden cage/crate	4(22.2%)	5(41.7%)	9(30.0%)
No cage/crate	0(0.0%)	1(8.3%)	1(3.3%)
Number of birds kept within a day in the market			
<100	13(72.2%)	8(66.7%)	21(70.0%)
100-200	2(11.1%)	4(33.3%)	6(20.0%)
400-500	1(5.6%)	0(0.0%)	1(3.3%)
>500	1(5.6%)	0(0.0%)	1(3.3%)
Maximum number of days poultry is kept at the market			
< 1 day	4(22.2%)	0(0.0%)	4(13.3%)
1 day	2(11.1%)	2(16.7%)	4(13.3%)
2 days	3(16.7%)	1(8.3%)	4(13.3%)
3 days	3(16.7%)	3(25.0%)	6(20.0%)
> 3 days	6(33.3%)	6(50.0%)	12(40.0%)
Number of birds sold per week			
<100	8(13.3%)	4(10.0%)	12(12.0%)
101-500	45(75.0%)	23(57.5%)	68(68.0%)
501-1000	5(8.3%)	8(20.0%)	13(13.0%)
>1000	1(1.7%)	5(12.5%)	6(6.0%)

Birds not sold after three days would be sold within the same market at a lower price, or they would be returned home. In extreme cases, traders are forced to slaughter the bird and sell at the shared kitchen or take it to another market where demand is higher.

Sick birds are generally slaughtered (70% of respondents), consumed (30% of respondents), sold at a reduced price (23%) and only occasionally reported to the market authority/veterinarian (10%). Market retailers also treat sick birds with medicines while in their custody.

Table 16: Actions of poultry sellers at LBMs when poultry are not sold, fall ill or die

Action	Kiambu (n=18)	Nairobi (n=12)	Overall (n=30)
Actions taken when birds are not sold in the market			
Keep them longer at the market	7(38.9%)	4(33.3%)	11(35.5%)
Sell at a lower price	6(33.3%)	7(58.3%)	13(41.9%)
Take to another market	2(11.1%)	0(0.0%)	2(6.5%)
Take home	3(16.7%)	0(0.0%)	3(9.7%)
Slaughter and sell	0(0.0%)	2(16.7%)	2(6.5%)
Actions taken when a bird shows signs of disease			
Slaughter and self-consume	2(11.1%)	2(16.7%)	4(13.3%)
Slaughter and sell	3(16.7%)	2(16.7%)	5(16.7%)
Slaughter and bury/incinerate	6(33.3%)	1(8.3%)	7(23.3%)
Slaughter and throw it in the dumpsite	1(5.6%)	4(33.3%)	5(16.7%)
Sell at a lower price for human consumption	3(16.7%)	2(16.7%)	5(16.7%)
Sell at a lower price as animal food (dogs/pigs)	1(5.6%)	1(8.3%)	2(6.7%)
Report to a market inspector/veterinarian	3(16.7%)	0(0.0%)	3(10.0%)
Others	1(5.6%)	1(8.3%)	2(6.7%)
Actions taken when a bird dies in the market			
Bury/incinerate	5(27.8%)	1(8.3%)	6(20.0%)
Throw it in the dumpsite	2(11.1%)	7(58.3%)	9(30.0%)
Sell at lower price human consumption	2(11.1%)	0(0.0%)	2(6.7%)
Sell at a lower price as animal food (dogs/pigs)	3(16.7%)	4(33.3%)	7(23.3%)
Report to an official	5(27.8%)	0(0.0%)	5(16.7%)

Challenges encountered by the market retailers include levies by the county government, harassment by city inspectorate officers and public health inspectors, as the majority of the traders operate in non-licensed areas. Traders also complained of the lack of basic infrastructures in markets and inconsistent supply of birds by producers due to a lack of contractual agreements that cushion traders against low season supply that result in higher purchase prices. The inconsistency of supply has pushed many traders out of business and created unfair competition with large-scale companies that can consistently supply products to consumers.

3.4. Characteristics and practices of poultry slaughterers/processors

Slaughtering / processing actors interviewed included slaughter assistants hired by producers and traders to carry out slaughter on their behalf, and broiler farmers and live bird market traders who themselves perform slaughtering. The majority of the slaughtering actors are men. This can be attributed to the fact that, in most farms, the slaughtering is carried out at night which favours involvement of young male hired assistants who travel to the farms and slaughter at night. Most of the actors have post primary education and have been involved in poultry slaughter for over 5 years. Although all of them reported that they handle poultry carcasses, meat cuts and offals, only a half had valid of a food handler's permit issued by the Ministry of Health. Slightly more than half of the actors were not selling offals but rather disposing them alongside feathers and other slaughter waste. More actors were selling offals in Kiambu than in Nairobi county. The feet and the offals are sold to pig farmers and roadside sellers, who are mainly women.

Table 17: Socio-economic characteristics of non-industrial poultry slaughterers/processors

Characteristic	Kiambu (n=18)	Nairobi (n=12)	Overall (n=30)
Gender			
Female	2(11.1%)	2(16.7%)	4(13.3%)
Male	16(88.9%)	10(83.3%)	26(86.7%)
Age category			
<30 years	2(11.11%)	0(0.0%)	2(6.7%)
30-40 years	12(66.7%)	6(50.0%)	18(60.0%)
40-50 years	4(22.2%)	5(41.7%)	9(30.0%)
>50 years		1(8.3%)	1(3.3%)
Highest education level			
Primary	1(5.6%)	3(25.0%)	4(13.3%)
Secondary	9(50.0%)	8(66.7%)	17(56.7%)
Tertiary level	8(44.4%)	1(8.3%)	9(30.0%)
Work experience			
<1 year	0(0.0%)	1(8.3%)	1(3.3%)
1-5 years	11(61.1%)	2(16.7%)	13(43.3%)
5-10 years	7(38.9%)	3(25.0%)	10(33.3%)
>10 years	0(0.0%)	6(50.0%)	6(20.0%)
Location of the facility			
Urban	1(5.5%)	9(75.0%)	10(33.3%)
Peri-urban	16(89.0%)	3(25.0%)	19(63.4%)
Rural	1(5.5%)	0(0.0%)	1(3.3%)
Valid food handler health certificate (<6 months)			
Yes	9(50.0%)	6(50.0%)	15(50.0%)
Products sold			
Whole chicken carcass	18(100.0%)	12(100.0%)	30(100.0%)
Meat cuts	8(44.4%)	3(25.0%)	11(36.7%)
Feathers	3(16.7%)	0(0.0%)	3(10.0%)
Offal	8(44.4%)	5(27.8%)	13(43.3%)
Manure	10(55.6%)	0(0.0%)	10(33.3%)

Slightly more than half of the actors reported that they slaughtered poultry in unlicensed facilities which are rarely or never visited by the veterinary meat inspectors. Therefore, limited to no *ante* or *post-mortem* examination is carried out. Slaughtering is mainly carried out on wooden benches/tables at the farm, while concrete slabs are typical in live bird markets. Other actors reported that they slaughter on the ground. The process involves bleeding the bird, followed by dipping in hot water to remove the feathers, and finally, evisceration.

Table 18: Practices at non-industrial poultry slaughter/processing facilities

Practice	Kiambu (n=18)	Nairobi (n=12)	Overall (n=30)
Slaughter process			
Slaughter in a licensed facility	8(44.4%)	8(66.7%)	16(53.3%)
Separate areas for each of the steps	5(27.8%)	3(25.0%)	8(26.7%)
Concrete slabs	9(50.0%)	2(16.7%)	11(36.7%)
Wooden bench/table	7(38.9%)	8(66.7%)	15(50.0%)
Sufficient water for cleaning	17(94.5%)	8(66.7%)	25(83.4%)
Frequency of a veterinarian/meat inspector visiting the facility			
Daily	4(22.2%)	7(58.3%)	11(36.7%)
Once per week	2(11.1%)	1(8.3%)	3(20.0%)
Rarely	7(38.9%)	2(16.7%)	9(30.0%)
Never	5(27.8%)	2(16.7%)	7(23.3%)
Frequency of cleaning the slaughtering facility			
After each slaughter	12(66.7%)	6(50.0%)	18(60.0%)
Daily	7(38.9%)	4(33.3%)	11(36.7%)
When dirty	0(0.0%)	2(16.7%)	2(6.7%)
Use of disinfectants in the facility			
Yes	9(50.0%)	9(75.0%)	18(60.0%)
Cleaning with disinfectant	9(50.0%)	3(25.0%)	12(40.0%)

Whenever sick birds are encountered at the live bird market, they are either separated from the other birds and treated, or they are immediately slaughtered. The slaughtered birds are consumed by the households or sold at the market to unsuspecting buyers as human or animal food. A fair share of the slaughter operators throw the sick birds away on dumpsites. Others stated that once a bird falls sick before slaughter, they would return it to the supplier.

Table 19: Practices of non-industrial) poultry slaughterers/processors at bird purchase and actions when a bird falls ill

Practice/Action	Kiambu (n=18)	Nairobi (n=12)	Overall (n=30)
Measures practiced when purchasing a bird			
Do not purchase (own farm supply)	5(27.8%)	0(0.0%)	5(16.7%)
Only purchase from registered suppliers	1(5.6%) ¹	2(16.6%)	3(10.0%)
Only purchase from regular suppliers	10(55.6%) ¹	8(66.7%)	18(60.0%)
Ask for health certificates	4(22.2%) ¹	2(16.6%)	6(20.0%)
Inspect the birds at purchase, followed by isolation for several days	11(61.1%) ¹	4(33.3%)	15(50.0%)
Actions taken with sick birds			
Slaughter and self-consume	3(16.7%)	1(8.3%)	4(13.3%)
Slaughter and sell to customers	1(5.6%)	0(0.0%)	1(3.3%)
Slaughter and sell as animal food	2(11.1%)	1(8.3%)	3(10.0%)
Separate and treat	12(66.7%)	4(33.3%)	16(53.3%)
Treat the whole flock	1(5.6%)	1(8.3%)	2(6.7%)
Kill and bury	1(5.6%)	4(33.3%)	5(16.7%)
Kill and throw in dumpsite	0(0.0%)	2(16.7%)	2(6.7%)
Report to a veterinary officer	2(11.1%)	4(33.3%)	6(20.0%)
Others	0(0.0%)	2(16.7%)	2(6.7%)

¹ Percentage of those purchasing birds

Actors in this node lamented the lack of designated slaughter facilities and limited support by the county public health (human and veterinary) staff. Among the respondents there was also a lack of awareness of the requirement to have a food handler's health certificate.

4. Discussion and policy implications

An assessment of the extent to which the animal health sector's prevailing legal framework facilitates the implementation of the One Health approach in Kenya reveals that the current legislation prescribes a comprehensive list of actions that, if complied with, can substantially ensure prevention and timely detection of poultry associated public health threats. Following these laws and regulations and a whole range of good practices recommended in guidelines and training manuals could thus support a sustainable development of the poultry sector. Areas neglected by current legislation include live bird markets and management of poultry litter.

4.1. Poultry production

A substantial proportion of poultry producers implement biosecurity measures and display a good knowledge of the recommended good practices. They clean and disinfect poultry houses, remove old litter/sawdust and manure to reduce pathogen load in the house and clean drinkers and feeders using soap daily. Notably, the removed litter is either used as farm manure or sold to dairy farmers for use as feed, which can transfer pathogens. Running tap water for drinking and cleaning is readily available to most of the producers. However, a few use water supplied by private water vendors, whose quality cannot be ascertained and thus could be a source of pathogens. Producers also maintain a minimum of at least two weeks before introducing a new batch. Although most of them raised different batches in separate areas, they used plywood or boxes to separate them within the same house. This practice limits an all-in all-out biosecurity practice and does make it difficult proper house cleaning and disinfection. Though an important biosecurity measure, about 20% of the interviewed farmers rarely use disinfectants. Among those who use them, many lack recommended footbaths and rarely change the disinfectant, which increases the risk of disease being introduced into the poultry house.

Most of the farmers reported that they had not experienced any major infectious disease outbreaks. If a bird showed signs of disease, 80 percent stated that they isolated it from the rest of the flock and 45 percent reported it to a veterinarian or asked for advice from qualified professionals. The majority of the animal health practitioners that provided services to the farmers are those in the private animal health sector, particularly in agro-vet shops. Most farmers reported to rely more on private service providers those in public sector were not easily accessible. Despite over 70 percent of the interviewed producers responding that it is easy to find a veterinarian, about 40 percent stated that in case of disease they did not always resort to professional advice for treatment, that they frequently treated birds based on previous experience (40%) and that they treated the entire flock, even when only a few birds show signs of disease (80%). Slightly more than 10 percent of producers reported to use drugs for humans in their poultry. Eighty percent of the interviewed farmers treated birds with veterinary medicines including vitamins before and after transportation to the market contributing to the risk of exposure to drug residues of consumers.

Some risky practices farmers reported include slaughter and human consumption of diseased birds (22%), slaughtering and consuming dead birds (4%), and feeding dead birds to dogs (32%).

Poor flock performance, attributed to the low-quality of expensive chicken feeds, was cited as a major constraint and could contribute to the use of antibiotics for 'growth promotion'. The uncertainty of the origin and quality of DOCs prompted producers to start them off with a dose of antibiotics as opposed to the recommendation to only source DOCs from registered suppliers. Indeed, the

emergence of unlicensed small-medium hatcheries and presence of informal DOCs retailers in Kiambu and Nairobi could be a key driver for this practice. At national level, the directorate of veterinary services is expected to regulate the quality of DOCs produced/imported: there is a need to improve the capacity of veterinary services to perform this role. Other interventions could include a revision of the process of certifying and inspecting the suppliers of DOCs. Additionally, quality control of poultry feeds needs to be enhanced to ensure they conform with feeds standards as stated in the labels.

The main public health threats at the production node of the poultry value chain include imprudent use of antimicrobials that enhances the risk of AMR emergence, non-compliance with withdrawal periods that results in excessive levels of drug residues in poultry meat and may thus affect the health of consumers.

4.2. Poultry transport/trade

The transporters hold the birds for the shortest time compared to the other actors in the chain. The practice of traders entering the farms/poultry house to select the birds that meet their quality expectations carries the risk of introducing disease into the farm. The mixing of birds from different suppliers in cages/crates that are not regularly cleaned and disinfected increases the risks of disease spread between birds of a consignment; this would however go unnoticed if birds are slaughtered shortly after delivery.

Both live birds and poultry meat are frequently transported in the same vehicle with human passengers, contravening prevention of Cruelty to Animals Act (transport of animals) regulations and leading to contact with humans. The common practice of transporting poultry in vehicles that also ferry humans, allows for close contact between the birds and people. The main associated public threat is that of becoming infected with a zoonotic disease e.g. avian influenza in areas where avian influenza is endemic, bearing in mind that health inspection of birds at farm / markets is rarely done. Food safety is compromised when transporting poultry meat in nylon gunny bags due to the high likelihood of contamination of meat in 'containers' that cannot be properly cleaned and disinfected.

4.3. Poultry retail at live bird markets (LBMs)

Actors sold mostly indigenous chicken and ex layers, with only a few selling broilers. Sources of indigenous chicken and ex layers included far off counties as well producers within the county, whereas broilers were mainly sourced within the counties or from next door counties. Without a traceability system in place, and traders mixing birds from different sources in cages at the market, it is a challenge to ascertain possible sources of a disease should a bird exhibit signs of illness. Selling of live birds in the live bird markets is done alongside slaughtering and selling of poultry carcasses as whole or portions. With the low biosecurity measures at these markets, limited/absent *ante* and *postmortem* inspection and observation that actors handle both live birds and carcasses at the same time, there is high risk of pathogen circulation as well as contamination of the carcasses. Indeed, this is the node with highest non-occupational exposure to poultry associated pathogens. Slaughter of sick and dead birds to either self-consume, sell to customers at lower prices or even selling as pet food was common. This was to avoid incurring losses, but from a public health perspective this practice is prohibited by public health and meat control regulations as it can significantly compromise human health. Lack of safe disposal of waste, including throwing dead birds in dumping sites in the markets or roadside was also being practised and increases the risk of disease spread.

4.4. Poultry slaughter and processing

Findings at the slaughter node validate that most broilers consumed in urban areas, including retail meat markets in Nairobi, are slaughtered at the farm. The farms lack the necessary infrastructure to

support safe and hygienic carcasses as most of the slaughtering is done either on a wooden bench or the ground, in violation of the meat control and public health regulations. Indeed, most of the meat from farm slaughter is not inspected as it is challenging to assign inspectors to visit the many broiler farms, notwithstanding that regulation states that meat inspection can only be carried out in a licensed facility. Similarly, slaughter at LBMs, which is very common, is practiced without adequate biosecurity and public health measures, and the infrastructure does not meet the basic requirements. The LBMs do not have designated poultry areas/slaughter places. Slaughter thus occurs in open or on temporarily erected makeshift tables. Lack of proper tenancy or ownership of the place they operate from limits improvement prospects. Furthermore, the lack of safe disposal of waste, including dead birds increases the risk of disease spread especially to homeless families who scavenge the dumpsites for any food leftovers. It has also been argued that some of the dead poultry dumped into these sites find their way back to the food chain through urban informal roadside chicken roasting vendors.

5. Conclusions

The surveyed nodes of the poultry value chain differ in the risks they pose to poultry and human health. Practices of poultry traders/transporters carry a high risk of introducing poultry diseases into farms. Antimicrobial use at the production node enhances the risk of AMR emergence while non-compliance with withdrawal periods may result in excessive levels of drug residues in poultry meat affecting human health. The risk of zoonotic disease spread is highest at transport, slaughter and in LBMs due to close human contact with poultry in an environment of low biosecurity and poor hygiene.

Prioritization of risks at the different nodes is key to designing actionable recommendations to improve the adoption of good practices along the entire chain. Interventions at one node will impact the other nodes. The robust engagement between producers and private animal health practitioners is an opportunity that can be exploited to foster efficient service delivery based on public-private partnerships.

Deliberate efforts by the public animal health sector to support the supply of safe poultry meat through meat inspection, provision of meat transport certificates, and enforcement of minimum standards for slaughter facilities is an important investment that should be prioritized. The private sector has a role in supporting this by investing in slaughter facilities and transportation means, which could attract wider / niche markets with higher poultry meat quality requirements.

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