



GENDER BARRIERS AND OPPORTUNITIES ALONG THE NEWCASTLE DISEASE VACCINE VALUE CHAIN IN MACHAKOS TOWN SUB-COUNTY, KENYA †

[BARRERAS DE GÉNERO Y OPORTUNIDADES A LO LARGO DE LA CADENA DE VALOR DE LA VACUNA CONTRA LA ENFERMEDAD DE NEWCASTLE EN EL SUBCONDADO DE MACHAKOS TOWN, KENIA]

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SUMMARY

Background. Traditionally, poultry is kept and reared by women in extensive production systems. In Kenya and most developing countries, smallholder poultry productivity is constrained by diseases such as Newcastle disease (ND), which is preventable via a vaccine, yet contributes to significant morbidity and mortality among flocks primarily owned and managed by women in villages. **Objective.** This study aimed to map the Newcastle disease vaccine value chain stakeholders and identify the barriers and opportunities for women's engagement along the Newcastle disease vaccine value chain. **Methodology.** Qualitative data were collected with 15 key informant interviews and four focus group discussions with a total of 42 poultry farmers in Machakos Town sub-county, Kenya. **Results.** The majority of the vaccine value chain consumers were women, and limited information was one of the root causes for not vaccinating their chickens. Vaccines were considered expensive and difficult to access as the production areas were remote from the agrovet shops that retail vaccines. **Implication.** The study showed that women farmers had no financial control to enable vaccine procurement. **Conclusion.** Based on the results the government using the Extension service providers should train smallholder farmers on how to use the ND vaccine. Furthermore, manufacturers of thermo-stable ND vaccines should furnish Agrovet shops with data to enable its adoption in remote areas where the cold chain is unreliable.

Keywords: Chicken; Limited information; Women; Gender.

RESUMEN

Antecedentes. Tradicionalmente, las aves son mantenidas y criadas por mujeres en sistemas de producción extensivos. En Kenia y la mayoría de los países en desarrollo, la productividad avícola de los pequeños productores se ve limitada por enfermedades como la enfermedad de Newcastle (ND), que se puede prevenir mediante una vacuna, pero que contribuye a una morbilidad y mortalidad significativas entre las parvadas que son principalmente propiedad de

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mujeres y están a cargo de ellas en las aldeas. **Objetivo.** Mapear las partes interesadas de la cadena de valor de la vacuna contra la enfermedad de Newcastle e identificar las barreras y oportunidades para la participación de las mujeres a lo largo de la cadena de valor de la vacuna contra la enfermedad de Newcastle. **Metodología.** Los datos cualitativos se recopilaron con 15 entrevistas a informantes clave y cuatro discusiones de grupos focales con un total de 42 avicultores en el subcondado de Machakos Town, Kenia. **Resultados.** La mayoría de los consumidores de la cadena de valor de las vacunas eran mujeres, y la información limitada fue una de las causas principales de no vacunar a sus pollos. Las vacunas se consideraron caras y de difícil acceso ya que las áreas de producción estaban alejadas de las tiendas agroveterinarias que venden vacunas al por menor. **Implicaciones.** El estudio mostró que las mujeres agricultoras no tenían control financiero para permitir la adquisición de vacunas. **Conclusiones.** Según los resultados, el gobierno que utiliza los proveedores de servicios de extensión debe capacitar a los pequeños agricultores sobre cómo usar la vacuna contra la enfermedad de Newcastle. Además, los fabricantes de vacunas contra la enfermedad de Newcastle termoestables deben proporcionar datos a las tiendas agroveterinarias para permitir su adopción en áreas remotas donde la cadena de frío no es confiable.

Palabras clave: Pollo; información limitada; Mujeres; Género.

INTRODUCTION

Poultry farming and production in Kenya yields ~25,000 tons of poultry meat and 1.3 billion eggs annually, which is jointly valued at Kenyan Shilling (KESs) 28.5 billion and contributes 8% to the value of the entire agriculture industry in the country (FAO, 2017). Poultry production plays a significant role in poor households' economic and social lives in Kenya (Magothe *et al.*, 2012). It is a source of animal protein and cash income. Indigenous chickens are found wherever human settlements are, and their economic strength lies in their low production cost (Magothe *et al.*, 2012). Kenya's poultry production comprises indigenous chickens (80%) and exotic chickens (20%). Endemic Newcastle disease (ND) is a significant constraint in Kenya due to frequent outbreaks (Apopo *et al.*, 2020). However, vaccination failures have been attributed to virus shedding, environmental contamination, and improper vaccine application (Apopo *et al.*, 2020).

Indigenous chicken farmers are demoralized by the yearly loss of large numbers of their birds to ND outbreaks (Alders *et al.*, 2001).

In addition, women are more particularly impacted by ND because they do not routinely or successfully vaccinate for the disease than commercial poultry production in which vaccination is common, and men primarily manage profits.

In areas where ND is endemic, disease control through vaccination is generally a very cost-effective intervention and should be given priority by farmers. Most ND vaccine needs an effective cold chain to preserve the efficacy of vaccines and, often cold chain is unavailable or not used (Grimes, 2002). I-2 vaccine is a thermostable vaccine becoming popular due to its many advantages over the other vaccines. It is easily administered through various routes, including oral (in

drinking water), eye drops, or mixed with food (Miller *et al.*, 2009).

However, unlike other vaccines, I-2 does not deteriorate as quickly during transportation to the field (Grimes, 2002).

As two-thirds of the world's poor livestock keepers are rural women (Kristjanson *et al.*, 2014), and to increase women's ability to participate in and benefit from the vaccine value chain, which is from production to the final consumer (Gereffi *et al.*, 2011), an analysis of the barriers and opportunities that exist for their engagement was carried out in South Eastern Kenya.

The value chain includes production, processing, delivery to farmers, and vaccination (Rota *et al.*, 2010). However, such an approach has not been used to evaluate gender roles in the chicken vaccine value chain.

This paper is the partial result of action research to support and empower women in distributing, delivering, and using livestock vaccines in Rwanda, Uganda, and Kenya.

This research aims to generate evidence and formulate strategies that help women effectively and efficiently contribute to and benefit from livestock vaccines and enhance women's participation in livestock vaccine distribution, delivery, and use.

MATERIALS AND METHODS

Study area

The study was conducted in Machakos Town sub-county, Kenya, located 61.6 km southeast of Nairobi, Kenya's capital city. Machakos Town sub-county has seven wards, from which Kola and Kalama wards were selected (Figure 1). Machakos Town Sub-county's population is estimated to be 170,606

(KNBS, 2019). The climate is semi-arid, and the county has an altitude of 1000 to 2100 meters above sea level. It lies between latitudes of 0.45°S and 1.31°S and longitudes 36.45°E and 37.45°E and covers an area of 6,850 km². The average rainfall ranges from 500-1300mm, and the average temperature is 18-25°C. Subsistence agriculture is the main farm activity, and such drought-resistant crops as sorghum and millet, Maize, is grown due to the area's semi-arid state (County report, 2018).

Identification of participants and data collection

The two wards of Kola and Kalama, located in Machakos Town sub-county, were purposively selected due to their proximity to Nairobi County, and the county government prioritized indigenous chicken farming (Ipara *et al.*, 2019). Three main tools were used to collect data: focus group discussions, key informant interviews, and stakeholder meetings.

Focus group discussions

Four focus group discussions (FGD) were conducted, two in Kola and two in Kalama wards. Extension officers in Kola and Kalama wards invited households owning between 10 –100 indigenous chickens.

Extension officers are county government employees providing farmers with important information such as crop cultivation, marketing management methods, livestock rearing, and training in new technologies (Muyanga *et al.*, 2006). Each FGD comprised between 6-13 adult participants. The conversations related to knowledge about vaccines and diseases, access to veterinary services, and vaccine. A total of 42 farmers (7 men and 35 women) participated in the FGD. All FGD were audio-recorded, and notes were taken during the discussions. The age of participants ranged from 25 to 70 years old. Women mainly had primary education (65.7%) while men had a secondary level (57.1%).

Key informant interviews

A total of 15 key informant interviews (KII) were conducted with adults who worked along the ND VVC, including farmers, extension officers at the county level, agrovet managers/workers, vaccine regulators, vaccine importers, and vaccine producers (Table 1). The interviews were conducted in Swahili for farmers who did not understand the English language in a convenient location. The interview probed the participant about their involvement in the ND VVC and the barriers women face to participating in the vaccine value chain at all levels, and the interviews were audio-recorded.

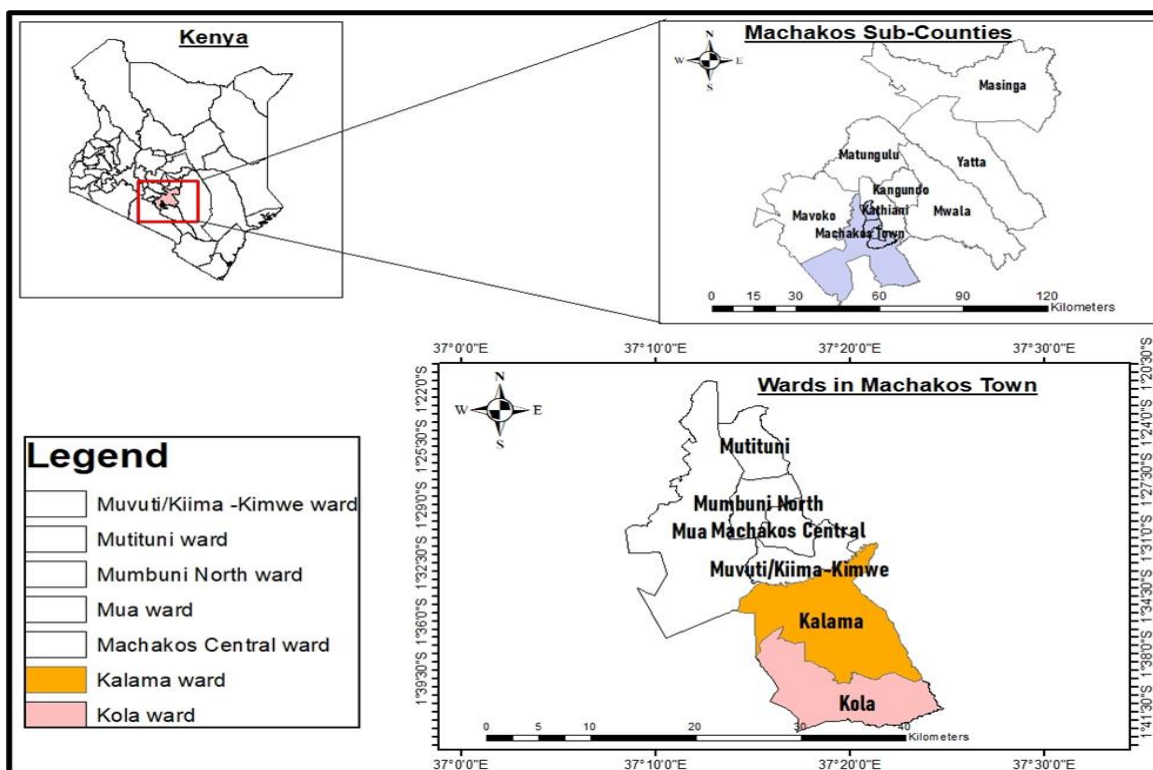


Figure 1. A Map of the study area, showing Machakos Town sub-county and its wards (Source, Author).

Table 1. Key informant interviews (KII) conducted across the vaccine value chain (VVC).

Chain node	Function	Male	Female
Policy and Legislation	Give license to vaccine producers, importers, distributors, and sellers	2	1
Producer and Importers	Produce/Import vaccines	3	-
Distributors and Sellers	Sell vaccines	2	3
Village chicken farmers	Farmers	2	2
Total		9	6

Stakeholder meetings

Five stakeholder meetings were held with different actors along the ND VVC (29 men, 15 women), four in Machakos town, and one in Nairobi. During the stakeholder meetings, actors and players along the ND VVC were identified, discussing barriers and entry points for women. Diagraming, group work, discussion were used to understand and explore the collective knowledge and ideas of the stakeholders. Particular attention was given to understanding current gender balances among actors along the entire ND VVC. Stakeholder meetings were audio-recorded, and notes were taken during the discussion. In addition, diagrams were photographed and saved.

Data analysis

Audio files from focus group discussion, key informant interviews, and stakeholder meetings were transcribed verbatim in the language in which they were recorded and then translated to English if the original recording was in Swahili. The transcripts were verified by comparing the audio files and transcripts with the field notes taken during the discussions. A codebook was developed for the three countries involved in the research during three days meetings. It included definitions that allowed researchers to group extracts of the interviews and facilitate data analysis. Data were managed and coded into emergent themes in Excel and analyzed using the content analysis method. The content analysis defines a family of methodological methods ranging from impressionistic, intuitive, interpretive analysis to formal, strict textual analysis (Hsieh *et al.*, 2005).

RESULTS

During the stakeholder meetings, five main nodes that make up the ND VVC were identified (Figure 2):

1. Policymakers and regulators
2. Producers and importers
3. Distributors and sellers
4. Extension and educative service
5. Consumers of vaccine/ village chicken farmers

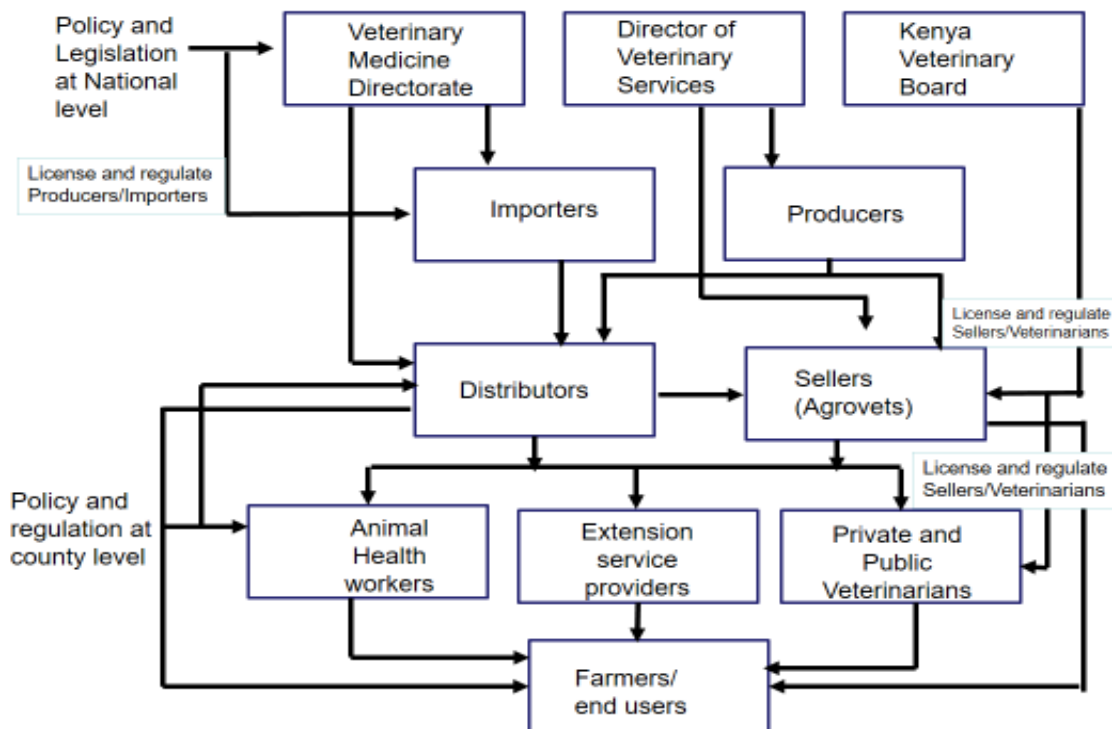


Figure 2. ND VVC map in Machakos Town sub-county, Kenya.

Node One: Policy and regulation

There are three national vaccine legislation and policymakers: 1) Kenyan veterinary board (KVB); 2) Veterinary medicine directorate (VMD); and 3) Directorate of veterinary services. The KVB regulates veterinarians and para-veterinarians through registration, licensing, and field practice in Kenya to ensure the delivery of quality veterinary services. The board employs 9 Females and 10 Males including CEOs, and secretaries (Figure 3). The board also inspects and accredits veterinary professional training institutions. With the ND VVC, the KVB regulates the veterinarians that sell and supply the vaccines. In Kenya, the VMD regulates the manufacturing, importation, distribution, prescription, and dispensing of veterinary medicines and other animal health products, including the ND vaccine. Finally, the Directorate of veterinary services advises the national and county government on the use of controlled vaccines and facilitates decisions on how and when to distribute them. Its role in the control of ND is an indirect one. Counties make decisions on the administration of these vaccines in their area of jurisdiction.

The majority of women who participate in the ND VVC are end-users of the vaccine: smallholder poultry farmers who vaccinate their flock (80.5%). As one moves up from the small village chicken farmers to the policy-making in the ND VVC, there are fewer and fewer women, as indicated in Table 2 below. Some of the nodes could not be verified due to variable answers provided by some of the vaccine value chain actors.

Table 2. Gender proportions of actors by sex along the Newcastle Disease Value Chain.

Chain node	Vaccine value chain actors	Percentage (Male)	Percentage (Female)
Extension and Education Service	Community vaccinators	50%	50%
	Extension officers	33.3%	66.7%
	Veterinarians	69.2%	30.8%
Policy and Legislation	VMD	40%	60%
	KVB	52.6%	47.4%
Seller	Sellers	60%	40%
Consumers	Farmers	19.5%	80.5%

Node Two: Vaccine manufacturers, /producers, and importers

Two organizations produce vaccines in Kenya. The first is a government-owned body called Kenya Veterinary Vaccines Production Institute (KEVEVAPI), which develops and produces the ND vaccine, amongst other livestock vaccines. In addition,

they produce two ND live attenuated vaccines: One is prepared from the Lasota strain of the virus, and the other is prepared from the 'F' strain. The second organization is an emerging private company that produces a thermostable ND vaccine. Two main private companies import the ND vaccines and supply the agrovets in Machakos town sub-county. They also distribute the vaccines directly to distributors or sellers of the vaccine. The distributors provide vaccines either to sellers or directly to the large- and small-scale farmers.

Node Three: Distributors and sellers

Most sellers are agrovets, a shop that sells fertilizers, animal feed, veterinary supplies, and other available farm supplies. They sell the vaccine to the end-users and offer veterinary extension services to the farmers (large- and small-scale farmers). Employees in agrovets are divided into two groups: those who deal with agricultural inputs and those who deal with veterinary drugs and vaccines. The ones that deal with veterinary drugs are veterinarians or animal health assistants who play a crucial role in vaccine use including, providing livestock vaccination services. The KVB licenses all the personnel involved with veterinary drugs and vaccines. However, in Machakos Town sub-county, agrovets shops were located only within Machakos town, where there are more users of their services than in Kola and Kalama wards, the distance from Kola to Machakos town is 32.4km and from Kalama to Machakos is 23.9km. Agrovets are set up where the business is more profitable and where they can get more customers. To ensure vaccine efficacy, agrovets shops must maintain a cold chain to keep the vaccine refrigerated. Agrovets are an essential link in ensuring quality vaccine handling and issuing vaccine use directives. The two main vaccines sold in agrovets shops in Machakos town are the I-2 vaccine and the Lasota strain.

Barriers faced by female agrovets workers

The barriers faced by women working in the agrovets shops included: financial barriers, access to agrovets positions, gender-based opportunities, and fewer women veterinarians than men.

Financial barrier

Key informants reported that the reason the majority of agrovets owners are men is the start-up financial barrier. Although women had the education to enable them to open agrovets shops, the majority were risk-averse. However, some reported that with the availability of capital, they would also start their agrovets shops. One male key informant said, "we have

women who are technically competent, but they might be hindered by start-up capital if finances and business management skills are given, I don't think there is anything that is hindering women from participating” and also one female key informant that was an agrovet manager said that “the only thing that is hindering them from owning agrovet shops is lack of initial capital.”

Access to agrovet positions

All the six agrovet (2-Men, 4-Women) interviewed in Machakos town reported that hiring is based on a recommendation from someone within a network and not through advertisement. This makes it hard for women to be hired as competition is high, and the pool of potential employees has many more males than female veterinarians. An agrovet male owner said that he “looks around” for those veterinarians he knows when there is a vacancy, and the chance arises.

Gender based-opportunity

Some opportunities are based on the type of work that is available at a given time. For example, two female agrovet workers reported that sometimes there are available jobs, but women are not considered for these jobs because of them being perceived as men's jobs.

Female agrovet worker said that “You cannot have more women than men because of the labor needed in the shop a lady cannot carry a sack.”

Fewer female veterinarians

Veterinary practitioners in Kenya are classified into veterinary surgeons and veterinary Paraprofessionals. Paraprofessionals hold a diploma of three-year training in animal health while the surgeons have completed a five-year degree course.

It was reported that the county governments employ fewer women veterinarians than men. This is also the case in private practice in Machakos county (31% female vs. 69% male).

One male Machakos country veterinary officer reported: “There are four veterinary surgeons; among them, there is only one woman. At the Diploma level, there are eight (four women). Among thirty certificate holders, only five are women.”

Node four: Extension and educative services

Veterinarians

Veterinary officers (Private and Public) in the field have direct contact with the smallholder farmers and

offer services, including vaccination and treatment of chickens. The number of practicing veterinarians is lower than required to meet the need in the expected area of coverage in the field. In Machakos, retired veterinarians have not been replaced. Traveling from farm to farm is also a challenge. However, not all smallholder farmers hire the services of a veterinarian to vaccinate their chicks: Some prefer to do it themselves.

Agricultural and livestock extension officers

The agricultural and livestock extension officers at the county level train and advice farmers on chicken rearing. They have direct contact with the farmers and help them solve problems related to chicken husbandry and disease burden.

Community vaccinators (Trainer of Trainers, TOTs)

The community vaccinators are farmers trained on vaccinating poultry; they also train other farmers about chicken vaccination. These farmers are unlicensed and thus prohibited by law from vaccinating animals. Their knowledge of vaccination procedures is limited. However, these farmers still vaccinate their neighbor's chickens. They are important resources for farmers and are respected in the community.

Node five: Village chicken farmers (consumers)

The vaccine end-users are large- and small-scale chicken farmers. From the vaccine seller, usually an agrovet, to their homesteads, end-users must maintain the cold chain until the vaccine reaches the farm and is administered to the poultry. A cold chain is often maintained by placing the vaccine in a thermos filled with ice transported by the farmer or a courier on a motorbike. The farmers either vaccinate directly or hire the services of a veterinarian or a neighbor to vaccinate. Under Kenyan law, farmers can vaccinate their chickens but cannot vaccinate those that belong to other people. The vaccine's efficacy depends heavily on its handling and the ability to maintain the cold chain until the use point. Most times, this is the point where vaccine quality and efficacy are compromised. Both the farmers and agrovet workers reported that most of the small-scale village chickens farmers are women and do not have much access to the vaccine. As a result, the farmers come from far to buy the vaccine predisposing them to loss of efficacy. Another element that can compromise vaccine efficacy is incorrect vaccine reconstitution (type and amount of water).

Barriers to effective vaccination of poultry encountered by male and female farmers

The barriers identified included access to vaccines, vaccine cost, knowledge about vaccine use, insufficient agrovet shops.

Access to vaccines

Access to vaccines was a challenge that was identified amongst most poultry farmers. Insufficient agrovet shops are another significant barrier to vaccine use. There were few agrovet shops in the rural areas, so farmers were required to travel long distances to agrovet shops adding to the financial burden. Long distances to vaccine distribution points (i.e., agrovet shops) in Machakos Town were a significant barrier to vaccine access for most farmers. The distance from Kola to Machakos town is 32.4km and from Kalama to Machakos is 23.9km. It can take 35-45 minutes driving, and sometimes more if there is traffic. One female FGD participant said: *“it is difficult to access the vaccines due to the long distance to the Machakos urban center to purchase the vaccines.”* Another female FGD participant reported: *“Inaccessibility of agrovet shops, i.e., most of them are in Machakos town, none around Kalama village, and the ones around sell at expensive prices.”*

Vaccine costs and doses per vial

High vaccine costs were also reported by most male and female farmers as a major barrier to vaccination. One hundred doses of ND vaccine ranged between 250-350 Kenyan Shilling, which is 2.5-3.5 USD. Farmers incurred additional costs if a veterinarian had to administer the vaccine. Vaccination costs are further exacerbated by bus fare to and from Machakos town. The ND vaccine is only sold in vials of one hundred doses or more, and this further increases the cost to the smallholder farmer who has smaller than 100 chicks. ND vaccine vials are not commonly shared between neighboring farmers. According to one female FGD participant, *“at the same time, I might call over the vet doctor to treat my livestock, but I do not have the money to pay him. Therefore, why should I call him? When I know that I cannot afford his services. The problem is lack of money.”*

Knowledge about vaccination usage

Smallholder farmers had poor knowledge of ND vaccination schedules and administration procedures. They were equally unsure how to maintain the vaccine cold chain and were concerned about the linkage between the cold chain and vaccine quality. One female farmer explained: *“Vaccines expire by the time*

one gets back home; this is also because most of us do not own refrigerators, as the vaccines need refrigeration.”

Many farmers were concerned about the quality of the vaccine and the capacity to keep its efficacy. This is a paramount concern shared by many as storing and transporting vaccines at recommended temperatures from the point of manufacture to the point of use is a problem in the distant community where electricity is scarce, unreliable, and sometimes unavailable.

Specific barriers to women’s participation in the ND VVC

Although the number of women interviewed who reported using the vaccine is very low, the majority of women who participate in the ND VVC are end-users of the vaccine: smallholder poultry farmers who vaccinate their flock. Below are some of the barriers that were specific to women smallholder farmers.

Access to and control over resources

In FGD and KII, most women reported that they had access to resources such as social assets; which includes network interconnections, cooperation, family support, partnership and collaboration, physical assets; including natural resources, air, and water quality, information, banking, and access to related services, personal assets; includes, motivation, self-esteem, self-confidence, self-perception, emotional well-being, and assertiveness, financial assets; includes income from productive activity, available finances/savings, regular inflows of money from family, gifts, and in-kind, and human assets; that includes skills, knowledgeability, good health, and leadership. Control on the use of resources was, however, determined by their husbands. Therefore, women needed permission from their husbands to make decisions about resource use. Challenges related to access to and control over resources became particularly evident when husbands were away and women needed to buy chicken vaccines or drugs. This was one of the most significant challenges reported by women.

A female FGD participant *“The man has the most access and control over the family’s money.”*

Empowerment

In both FGDs and KIIs, women reported that if they were more empowered, they could participate more in the VVC. For most women, farmer’s empowerment meant getting training and education.

“If women are supported and empowered on such issues, they will be able to improve in their poultry farming. This is because, when you go to various homesteads around, you will find that women are doing their best with the small amount of chicken they keep,” a female key informant reported. However, one key informant, a female, cautioned that *“while empowering women, men too have to be included because they are the providers for their household and anything they do not approve of will cause conflict within the household”*.

Access to poultry market and information

In most FGD, access to the poultry market and information was a challenge to farmers. In one focus group discussion with women, access to the market was ranked second out of the five problems farmers faced with poultry rearing. Farmers also reported that if they had good market access for their chicken, they were ready to invest more and even vaccinate it. One female poultry farmer reported: *“Sometimes you can keep chicken, get more than 100 eggs but lack a market to sell them.”*

Opportunities for women to participate in the Newcastle disease VVC

Training and empowering women

One of the main challenges that smallholder farmers reported facing was a lack of knowledge about vaccination and usage. The training was especially desired on vaccination calendars and schedules, vaccine usage, and benefits. A female smallholder farmer said: *“I think we can vaccinate our chicken if they educate us.”*

They felt that training was an excellent opportunity to involve more smallholder farmers in vaccination usage. Education and training could benefit the farmers because they are the backbones of every household. A female poultry farmer key informant reported that; *“The husbands can chip in because they are the providers. In the process of empowering women, men not be left out; they have to be empowered together”*.

Female veterinary role models and creating jobs for women

Community members felt that more female role models would encourage other women to pursue jobs and provide a networking platform. They agreed that it be an excellent opportunity to have more female veterinarians involved in the VVC. Although there are females who support each other, it is not enough. One female agroveter manager mentioned that when there is a chance, she gives the job to qualified female candidates because they do not easily get a job. Minimal job opportunities for women in the higher nodes of the VVC chain were one of the reported barriers. Companies prefer hiring men compared to women. They suggested that a deliberate policy change or encouragement to companies suggesting a certain percentage of women are hired could increase female participation. Investing in female veterinary practitioners can increase the number of females in the VVC. When discussing why companies prefer to hire men, one female agroveter owner-reported; *“they prefer men; maybe because they think men are easier to work with because they do not have maternity leave, those are their arguments, by the way.”*

Table 3. Barriers and opportunities for women along the ND VVC.

Barriers	Opportunities
Barriers and opportunities for female Smallholder farmers	
Limited knowledge about vaccines and their use. Not believing that vaccines work.	Training on vaccination and usage. Education on the benefits of vaccines and the limitations of vaccines.
Access to and control over finances for women smallholder farmers.	Training farmers to share control of resources among the household members, while male farmers should be trained to accommodate more control of resources by their wives.
Inadequate cold chain.	Provide solar fridges for women groups.
Barriers and opportunities for female agroveter workers	
Lack of knowledge about vaccination. Access to agrovets.	Train male and female farmers on vaccine importance. Increase the accessibility to agrovets by encouraging more agrovets to be in the rural areas.
Few female veterinarians. Access to agroveter positions. Gender-based opportunity.	Encourage more females to pursue the veterinary course. Encourage agroveter owners to hire more women. Gender mainstream organizations to hire more women.

DISCUSSION

This study mapped the ND VVC actors and analyzed the gender barriers and opportunities that exist along the chain for women to participate. The study shows that a majority of the poultry keepers are women. This corroborates other published research that reported that women and youth mainly dominate poultry value chain production (Besigye, 2014). However, other peer-reviewed papers reported that women tend to have fewer tropical livestock units compared to men (Covarrubias *et al.*, 2012). Women in this study emphasized that the chickens are theirs, but the goats and cows belong to the men. Women become fewer in other nodes along the ND VVC as progress progresses along with the node's policy-making roles, and men mainly dominate the chain. The community vaccinators can play a key role in vaccinating chickens since they are with the community and can help people that live in remote areas. However, they are prohibited by Kenyan law to vaccinate other people and also stocking vaccines.

Among the identified barriers to vaccine usage, vaccine cost was a challenge to most farmers. This would partially be attributed to the packages/vials available versus the farmers' number of chickens. This can be overcome by farmers forming groups and networks that buy and share the vaccine once it is constituted, reducing the cost of the vaccine. Costs are a critical determinant of vaccine uptake since, in households where the cost of vaccinating livestock is higher than available disposable income (Mutua *et al.*, 2019), most families would not vaccinate. Another paper reported that vaccine costs are a small proportion of the total cost in remote areas where cold chains are unreliable (Alders *et al.*, 2007). Knowledge and access to information were critical to the female smallholder farmers. Limited information was one of the root causes for not vaccinating their chicken. Adequate information, education, and communication are essential to coordinate vaccinations (Alders *et al.*, 2007). The information should flow from the government and decision-makers to the poultry owners so that everyone can acquire the required knowledge to make decisions that can facilitate vaccination activities. Special considerations should especially be given to female farmers that have little access to formal education.

Once women own livestock, they appear to be as market-oriented as men, if not more so, in particular, because of their role in the selling of milk and milk products (Covarrubias *et al.*, 2012). However, the sale of live animals is much more frequently handled by men. Women's access to and control over productive and economic resources is essential to their

empowerment if the cultural beliefs in the household about the ownership of large livestock can change (Walingo 2009). It was observed during the study that women had access to assets but less control over them. This was corroborated by a study that reported household assets are not always joint; instead, they can be held individually by men, women, and children who share a household (Meinzen *et al.*, 2011). Women's access to resources and for what purposes are subject to the broader socio-cultural context and the intra-house allocation rules. Policies aimed at empowering women should consider controlling the money resulting from the sale of chickens and that gender-sensitive programs could maximize the benefits they gain (Campbell *et al.*, 2018). Although women often control chickens, the extent of their control may vary widely depending on the region, ethnicity, and other factors such as class and education.

Furthermore, the participation of women at the policy level of the VVC was lower than men, and there was a gender gap as found in this study. Mugo *et al.* (2011) reported that women's representation in job groups is higher at the bottom and lower at the top, and there are serious gender gaps favoring men that are evident in the agriculture sector.

Walingo (2009) said that women's increased participation in decision-making could positively impact development priorities and poverty reduction. Women's empowerment enables them to make decisions that will improve the overall quality of lifestyle for an entire community.

More research is needed to investigate women's participation in the VVC and how they can be included in higher positions. However, it is also the most effective way that women farmers can be empowered to advance their poultry farming.

CONCLUSION

Although very few small female poultry producers vaccinate their chickens against ND, most women in the VVC are consumers, and few are in the value chain's policy production and distribution node. The vaccine users possessed limited knowledge of vaccines and their usage, which was a barrier to their use and control of ND. Farmers considered vaccines expensive and difficult to access as the production areas and vaccine suppliers were far from their homestead. In addition, women farmers had no financial control to enable their procurement. Two aspects emerge from the research. One is that women's participation in the ND VVC is inadequate due to their scarce cash income. Second, effective and sustainable

solutions to control ND need to be developed in Kenya to improve female farmers' activity in the livestock sector. Engaging in dialogue with the different stakeholders is a priority to discuss and find a suitable solution to the barriers faced by female small poultry farmers. A long-term approach needs to be developed, and at the same time, pilot interventions should be designed to test sustainable options for vaccine distribution and empowerment of women along the value chain

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Data availability. Data will be available upon reasonable request @fadumo.abdullaahi@gmail.com.

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