REPORT ON SOCIO-ECONOMIC, CULTURAL, STRUCTURAL AND TECHNICAL BARRIERS IN ACCESS TO NEWCASTLE DISEASE (ND) AND CONTAGIOUS CAPRINE PLEUROPNEUMONIA (CCPP) VACCINES

Introduction

Rural small holder women farmers in sub-Sahara Africa derive substantial livelihoods from livestock[1]. Chicken and small ruminant keeping in particular, remains major sources of livelihood and cash reserve in times of emergencies for a majority of rural women. Chicken and small ruminant production require less capital to start and are easy to manage alongside other domestic chores. Women are largely involved in making crucial management and investment decisions around chicken and small ruminants in their households in comparison to any other livestock species such as cattle[2]. The exploitation of the full benefits of chicken and small ruminant rearing by smallholder women farmers is often impeded by diseases. The diseases not only erode flock-sizes but also income and livelihoods to the farmers with dire consequences on food security which negatively impact mostly the women and children. Newcastle disease (ND) affecting chickens and contagious caprine pleuropneumonia (CCPP) of goats have been identified as the most devastating diseases hindering chicken and goat production in Makueni county, respectively. The two livestock diseases have been prioritized by the county government of Makueni for targeted control and/or eradication. While use of potent vaccines against ND and CCPP has been shown to be effective in preventing these diseases[3,4], vaccine uptake and use remains low in the region. Smallholder farmers, particularly women, are hindered in vaccine acquisition and use due to low levels of awareness, high acquisition costs, accessibility[5], unequal gender relations at household level among other barriers.

We postulated that by identifying and intervening on barriers in access to ND and CCPP vaccines in Makueni County, Kenya, loses (economic and non-economic related) arising from ND and CCPP diseases would be minimized leading to improved livelihoods and income from chicken and small ruminant production. We presupposed that with this intervention, the improved returns from chicken farming would enable and encourage women farmers to not only keep small ruminants in addition to chickens, but also take advantage of opportunities existing in ND and CCPP vaccine value chains. We envisaged that by intervening on barriers to access and use of ND and CCPP vaccines, smallholder women famers would reap more benefits from improved chicken and small ruminant keeping leading to enhanced economic empowerment and improved household nutrition. In order to intervene on

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[1] Kristjanson P. *et al.* (2014) Livestock and Women's Livelihoods. In: Quisumbing A., Meinzen-Dick R., Raney T., Croppenstedt A., Behrman J., Peterman A. (eds) Gender in Agriculture. pp 209-233. Springer, Dordrecht.

[2] Campbell ZA, Marsh TL, Mpolya EA, Thumbi SM, Palmer GH (2018) Newcastle disease vaccine adoption by smallholder households in Tanzania: Identifying determinants and barriers. PLoS ONE 13(10): https://doi.org/10.1371/journal.pone.0206058

[3] Alders, R. G. (2014). Making Newcastle disease vaccines available at village level. Vet. Rec, 174(20), 502-03.

[4] Rurangirwa, F. R., McGuire, T. C., Mbai, L., Ndung'u, L., & Wambugu, A. (1991). Preliminary field test of lyophilised contagious caprine pleuropneumonia vaccine. Research in veterinary science, 50(2), 240-241.

[5] Wallace, D. B., Mather, A., Chetty, T., Goga, S. and Babiuk S. (2013). Five diseases, one vaccine - a boost for emerging livestock farmers in sub-Saharan Africa. http://repository.hsrc.ac.za/bitstream/handle/20.500.11910/2420/8245.pdf?sequence=1

the barriers of access to and uptake of ND and CCPP vaccines, one of the main objective of the project was therefore to first identify these socio-cultural, economic, and technical barriers in access to ND and CCPP vaccines. This report presents the findings.

Methods

Profile of the Study Area

Makueni County covers an area of 8169.8 Km^2 and lies between Latitude 1°35' and 32°00' South and Longitude 37°10' and 38°30' East. The county has an estimated population of 987,653 persons and 244,669 households as per the 2019 Kenya Population and Housing Census[6]. Makueni is administratively sub-divided into Six sub-counties, namely: Makueni, Mbooni, Kiati, Kilome, Kibwezi East and Kibwezi West Sub-counties. Makueni county is largely (87%) arid and semi-arid in nature and is marginal to crop production but ideal for small ruminants and chicken production.

Temperature ranges between 12 ºC and 28 ºC, while bimodal rainfall range between 250 mm - 400 mm per annum on the lower regions and 800 mm – 900 mm per annum on the higher regions; typical of ASALs in Kenya. Owing to its climate, the county is among those with a high population of Indigenous Chicken (IC) and a sizeable small ruminant population raised in rural households[7]. Over 75-80% of all farm families in the county keep chicken and small ruminants; mainly indigenous breeds. Our study was carried out in six randomly selected wards within three purposively selected sub-counties, namely: Kathonzweni and Kitise wards within Makueni sub-county; Makindu and Kikumbulyu wards within Kibwezi east sub-county and Msongaleni and Mtito-Andei wards within Kibwezi East sub-county.

Study design

We employed a mixed methods approach involving household survey, Focus Group Discussions (FGDs) and Key Informant Interviews (KIIs). For the household survey, we sampled 1,274 households across the six Wards. The selection of households followed the adaptive cluster sampling approach with the initial village selection being done at random. Neighbourhood villages were added until the target sample size for the ward was reached. The survey was designed to measure the outcome variable; household self-reported use of ND and CCPP vaccines in the chicken and small ruminant flocks. The survey captured the predictor variables: household demographic characteristics, socio-economic factors, knowledge, attitudes and practice on vaccination, sources of ND and CCPP vaccines and distances to vaccine vendors/suppliers. Twenty-three FGDs were carried out with participants ranging from 6 to 12 in number and a further, seven KIIs conducted. The FGDs and KIIs provided qualitative insights from Women Smallholder Farmers (WSHFs) into the socio-economic, cultural structural, and technical barriers to vaccine uptake identified by the survey.

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[6] Kenya National Bureau of Statistics (2019). 2019 Kenya Population and Housing Census. Volume III: Distribution of Population by Age and Sex. Pg. 12. December 2019. Accessed from https://www.knbs.or.ke/?wpdmpro=2019-kenya-population-and-housing-census-volume-iii-distribution-of-population-by-age-sex-and-administrative-units .

[7] MESPT, (2015). Documentation of Indigenous Poultry Programming in Makueni, Interventions and Lessons (2011-2014). Micro Enterprise Support Programme Trust, Nairobi, Kenya.

The survey questionnaire and qualitative data collection guides were translated into Akamba language with the former administered as an electronic questionnaire on *ArcGIS Survey123*. The administration was conducted by pairs of local research assistants, a male and a female, to eligible household members. Eligible respondents included those aged 18 years and above, currently own chicken and small ruminants or had owned them three months prior to the survey. All respondents were read the statement explaining the purpose, the duration, potential benefits and risks of participating in the study. The respondents were informed of the voluntary nature of their participation, those who participated therefore, provided written consent by signing the printed consent form, a copy of which they retained. This study was cleared by Strathmore University Institutional Ethical Review: SU-IERC0523/19 and National Commission for Science, Technology and Innovation: NACOSTI/P/19/207.

Data analysis

Several socio-economic variables (WSHF's level of education, gender, age, number of chicken kept/flock size, number of chicken lost to ND, perception of effectiveness of ND and CCPP vaccines, previous experience/incidence of ND and CCPP, access to training seminars and type of chicken kept) and structural variables (distance to the nearest vaccine vendor, vaccine packaging, vaccine affordability) were examined. Distance was measured using proximity analysis of GPS locations of WSHF and nearest location of vaccine vendors. The ND and CCPP knowledge score was a measure of the respondent's ability to correctly answer to a set of five (5) questions about key ND vaccines. Packaging on the other hand was operationalized as the aptness with which the vaccine packaging dosses aligns with WSHF needs in terms of flock size.

Qualitative data, from the FDGs and KIIs data were transcribed, translated from Swahili and Akamba to English, reviewed and coded via NVivo-12 after which a thematic analysis framework was deployed. We use the convergent approach of mixed methods to compare findings from qualitative and quantitative data sources.

Results

Socio-economic barriers

Our findings indicate that knowledge on ND vaccines as measured by proportional knowledge score had a significant association with vaccine uptake ($t\ (1269) = -20$, $p = 0.001$). The proportional knowledge scores for farmers that vaccinated their flock was 0.5 on a scale of 0.1 while for farmers that did not vaccinate their flock the average proportional knowledge score was 0.14. The estimated marginal effects reveal that having knowledge of ND vaccine increases the probability of farmers vaccinating their chicken by up to 30.3% (95% CI [.188, .417]) with a 1-unit increase in the proportional knowledge score. Qualitative findings underscored the challenge posed by lack of vaccine knowledge even where the farmer is aware of the existence of ND vaccines as highlighted by the statement […] *Again, we do not have the knowledge on how to administer the vaccine ourselves and take this scenario where the seller does not have the time to fully explain the procedures to me. So, if I carry this vaccine and I do not know*

how to use it, it will be another burden because then I have to look for someone who vaccinates to teach me or do it for me. For this reason, I just give up and say 'chicken, just die' (FGD, Female).

Similarly, CCPP vaccine proportional knowledge score returned a below average index - indicating that inadequate knowledge around CCPP vaccines is an important barrier to access and use of CCPP vaccine in the county. Only 10.2% of the respondents accurately reported that CCPP vaccine cannot help already sick goats to get better (use of vaccine is contraindicated in already sick animals) while up to 49.0% of respondents wrongly reported that it could help them get better, and another 40.8% reporting that they had no idea. Up to 27.9% of respondents wrongly believed that CCPP has no treatment, that it can only be prevented using a vaccine with a meagre 16.1% of respondents accurately reporting that CCPP had a treatment. For effective prevention of CCPP in Kenya, 31.9% of respondents correctly reported that goats should be vaccinated every six (6) months while 5.3% of the respondents incorrectly believed this was not the case. With regards to whether CCPP vaccine can protect goats from all other diseases, a sizable proportion of respondents (32.0%) wrongly reported that it could with only 15.1% accurately reporting that it could not. The last question was whether CCPP vaccination may not be effective if not carried out routinely as recommended by manufacturers, a moderate proportion of respondents (49.6%) correctly reported that this was the case.

There was also a weak positive correlation between the number of small ruminants owned and number of years spent in school ($r= .042$, $p= .255$) and age ($r= .031$, $p=.401$) by the household head. There was statistically significant difference between action taken by households to prevent CCPP including vaccination and education level of the household head (χ^2 (3, N = 526) = 8.2692, $p = .0407$), and since majority of women had lower primary or no formal education is an indication that this is also a barrier in access to and use of CCPP vaccines.

Through FGDs, we also established that general awareness about the vaccines and their benefits and lack of extension officers were factors in ND vaccine uptake as the following statements indicate […] *I do not vaccinate because I do not know the importance of vaccination. Suppose we could get a person from within here to educate us on the importance of vaccination, then we would be willing to vaccinate our chickens; … We hear that chicken are vaccinated but we do not know when and how it is vaccinated. Personally, I have never seen the vaccine; … I do not vaccinate my chickens because I have never seen anyone trained and offering the vaccination services from around here* (FGD, Female). Awareness of CCPP disease (91.8% of respondents) did not however translate to awareness of existence of CCPP vaccine (only 53.9% of respondents aware of CCPP disease were aware of CCPP vaccines) or in high vaccination rates (only 44% of respondents aware of CCPP vaccine presented their small ruminants for vaccination).

Whereas more women (53.4%) than men (46.6%) knew about CCPP vaccines, decisions on whether to vaccinate or not were mainly made by the men. Mostly men were involved in the actual purchase of vaccines from the agro-veterinary outlets (where that was possible as local regulatory laws only allow qualified and licensed veterinary officers to vaccinate against CCPP) or in payment for vaccination services offered by a licensed veterinary officer. The study also revealed that a higher

proportion of smallholder chicken farmers (51.4%) did not know where to source for CCPP vaccines or vaccination services. Of these that were aware, proportionately more men (60.6%, $p<0.05$) than women (51.7%) reported having knowledge of where to source CCPP vaccines. Likewise, a significantly higher proportion of men (55.2%) than women (45.9%) had access to CCPP vaccine suppliers with a higher proportion of women (51.0%) than men (38.0%) reporting that they would like to be linked with a vaccine supplier. Overall, a higher proportion of respondents (56.6%) did not have access to a CCPP vaccine supplier indicating vaccine availability as a challenge hindering vaccine uptake.

As to whether vaccine cost is a contributing factor to the low uptake of CCPP vaccines, majority of the farmers (49.7%, $p<0.05$) reported that they can afford to purchase the vaccines while 19.9% could not. A higher proportion of women (34.8%) than men (22.6%) didn't know whether or not their households could afford to purchase vaccines, probably because men make sole decisions that have financial implications in their households. This was further reinforced by the fact that a higher proportion of men (55.6%) than women (43.9%) knew with certainty that they could afford CCPP vaccine.

Again, as with distance from the farmers' home to the vaccine vendors, the intersection between knowledge and aggregate vaccination cost became apparent as pointed out in our qualitative findings […] *Another thing if you call the service providers to come do the vaccination for you, they will demand 10 shillings for every chick and this can amount to even being more expensive than buying the chicks* (FGD, Female). Yet again, statement also provides a different perspective on the issue of aggregate cost of vaccination […] *I want to say the challenge is lack of money to buy that vaccine and money to pay the vaccinator, because most people in this area do not know how to vaccinate* (FGD, Female).

We also found that the number of chicken kept by a farmer was associated with vaccine uptake ($t(1269) = -8.962$, $p < 0.001$). The average flock size of farmers who vaccinated their flock was almost twice (25) the number of chicken (13) kept by farmers not vaccinating their chicken. The number of chicken kept was found to be a significant predictor of vaccine uptake in Kathonzweni and Makindu only and not the full sample and the other 4 wards. Results of the estimated marginal effects indicate that the probability of vaccine uptake increased by 0.6% (95% CI [0.003, 0.009]) and 0.5% (95% CI [0.0016, 0.0085]) respectively for Kathonzweni and Makindu Wards with one additional chicken kept. The following statement from our qualitative findings provided more insights to influence of flock size in vaccine uptake. […] *The number of chicken we keep contributes to us not vaccinating. When we buy the vaccine, it requires you to have 100 and above chicken, so you wonder having 10 chicken, you will buy a vaccine worth that money to vaccinate only 10 chicken and the rest go to waste, so the number of chicken we have makes us rethink about buying the vaccine* (FGD, Female); […] *Those with few chickens do not have a lot of chickens to lose if they do not vaccinate their chickens but those with more chickens have a higher stake* (KII, Female). Type of ownership of small ruminants influenced decisions on CCPP vaccination. While more women solely owned small ruminants (26.3%) than by men (20.2%), and also carried out most of the management activities,

decisions on husbandry practices that had financial implications such as vaccination and treatment were mostly made by men.

In addition, the average number of chicken lost during an ND outbreak had a significant association (t (1026) = -4.22, p =0.001*)* on smallholder farmer's choice of vaccinating their chicken against ND. The average number of chicken lost by farmers who vaccinated their flock was 23 versus 15 for those who did not vaccinate their flock. Our analysis show that having lost more chicken due to ND increases the probability of vaccine uptake by 0.2%. (95% CI [0.0004, 0.0026]) compared to those who had not lost chicken to ND.

Our findings indicate that perception of effectiveness of vaccination in preventing ND was associated with vaccine uptake *($\chi^2(1, N = 189) = 34.583, p = 0.001$),* as 99 percent of farmers who perceived vaccines to be effective in preventing ND vaccinated their flock. Similarly, the type of chicken kept was associated with vaccine uptake *($\chi^2(2, N = 1287) = 72.018, p = 0.001$).* A WSHF's view or perception on the effectiveness of ND vaccines was also found to have a significant influence on uptake of vaccines. Farmers who considered vaccines to be effective in preventing ND were 29.6% (95% CI [0.0443, 0.5483]) more likely to use ND vaccines than those that did not consider ND vaccine to be effective. Our qualitative finding revealed views of some the farmers surrounding ND vaccines […] *There are also issues because there is a time, we had a program under the national government and we brought vaccines and the people had their own beliefs, they were saying we are going to kill their chickens. …. So, there are those who refused to vaccinate their chicken because of their own beliefs* (KII, Female).

Our qualitative study also revealed that fear of perceived ND vaccine side effects was a barrier to the uptake of vaccines. Some study informants indicated that from their perspective, ND vaccines have negative side effects on chicken and human beings. They reported several perceived side effects which include increased deaths of chicken after vaccination, sterilization of chicken, hens may stop laying eggs when vaccinated and that vaccinated chicken can be harmful for human consumption as illustrated by the following excerpts. […] *My hen was about to start laying and I called the community vaccinator who gave it ND vaccines. The hen took more than two months before it could show signs of laying eggs. … I believe that ND vaccines can make hens infertile and/or stop laying eggs*" (FGD, Female). […] *The reason I don't vaccinate my chicken is I know the constituents of the ND vaccines and my chicken are for subsistence. I don't want to vaccinate them and later when we eat them…, one gets affected or even gets cancer*" (IDI Female).

Structural, technical and institutional barriers

Our results revealed that there was a significant association between distance of the farmer from vaccine vendors and vaccination uptake (t (1269) = 3.42, p < 0.001). The mean distance from vaccine vendors for farmers who vaccinated their flock was 8.18 kilometres compared to 10.13 kilometres for those who did not vaccinate their flock. The estimated marginal effects show that distance reduces the probability of farmers vaccinating their chicken by up to 0.3% (95% CI ([-00656, -.00005]) for every 1-kilometre increase in distance away from the vaccine vendors. This is exemplified by the following statements from our qualitative findings when we explored on the factors influencing

vaccine uptake […] *another reason could be the distances because our areas are quite extensive. The distances are usually big* (KII, Female). […] *it could be stocked in the nearby agro-vets for us to be able to access it. You have to send the Matatus* (public service taxis) *to buy and bring it which is very costly. If the matatu delays, the vaccine goes bad and suffer losses* (FGD, Female). We found out that while our predictor model did not identify cost as significant predictor of vaccine uptake, our qualitative findings reveal that aggregate cost of accessing the vaccines was increased by distances to vaccine vendors […] *We usually get the vaccines from Kibwezi at an agrovet called County and you have to take a motorbike for 100 shillings* (approximately 1USD) *from here, you buy the vaccine and immediately go back and pay another 100 shillings* (approximately 1USD) (KII, Female).

Our qualitative findings indicated that ND vaccines packaged in dose-formats that were beyond the flock size of most farmers was a barrier to vaccine uptake as exemplified by these statements […] *The vaccines are packaged in inappropriate quantities; the least package size is for fifty chickens and once you open it you have to make use of all of it. Most of us keep less than fifty chickens and hence costly for us to use vaccines. This is why we do not vaccinate* (FGD, Female, Kitise Ward); […] *I don't vaccinate because like I was telling you earlier, I keep chickens in small scale thus uneconomical to buy vaccines which are very expensive, and their packaging does not qualify a small-scale farmer.* (FGD, Female).
Majority of the farmers (86.5%) did not have access to a cold chain storage. The few farmers that had access to cold chain storage (11.8%), men were more proportionately represented (12.8%) than women (10.8%) pointing to their more flexible mobility. Overall, majority of farmers had not attended training seminars on small ruminant health and CCPP vaccines (79.1%). While women are more closely involved in management of small ruminants, fewer women (18.2%) reported having access to trainings compared to men (20.2%).

Cultural Barriers

Most farmers (58%) believe in ethnomedicine for chicken diseases management including ND. Qualitative findings corroborate this through the following statements […] *Mostly what we do here is that we use herbal remedies to control chicken diseases such as; "Kiluma" (Aloe Secundiflora) mixed with chicken's drinking water, "Uthunga" (Launaea Cornuta) and also there are some other powder drugs we buy from the agro-vets which we mix with the chicken drinking water …We also use herbal remedies, we mortar the leaves of a tree called "Muharubaini" (Azadirachta Indica) and mix the end-product with the chickens drinking water* (FGD, Male). Likewise, a significant proportion of smallholder chicken farmers (12.3%) relied on herbal remedies to prevent CCPP disease in goats while 19.8% did not take any preventive action with majority in this category being men. The intimate involvement of women in goat management positively correlated with the fact that majority of respondents that presented their goats for vaccination to prevent CCPP were women. Our qualitative findings showed that there was a general belief that indigenous chickens do not need vaccination. This was an interesting finding as one informant said, *"I do not vaccinate my chicken because all of them are local types… as I know vaccines are for the hybrid type"* (IDI, Female). Many FGD discussants believed that vaccination is for improved and hybrid chicken as opined by FGD discussants *"we normally know that indigenous chickens do not require vaccines, do they? ... As for me, I am aware of vaccinating improved and hybrid types"* (FGD, Female).

Discussion

Our findings indicating that knowledge of ND vaccine increases the probability of farmers vaccinating their chicken by up to 30.3% with a 1-unit increase in the proportional knowledge score is quite significant in the identification of the key areas of focus for the project in terms of enhancing WSHF vaccine general knowledge and awareness of the benefits. Specific knowledge on the handling and administration of ND and CCPP vaccines in the absence of effective veterinary services or a functional system of trained community vaccinators is however vital in both ensuring the vaccines are not mishandled in a manner that makes them lose potency which in turn affects the farmers' perception on vaccine effectiveness. This is also significant because, we found that WSHF who considered vaccines to be effective in preventing ND and CCPP diseases were more likely to use ND and CCPP vaccines than those that did not consider the vaccines to be effective. Insights gained from our qualitative interviews indicated that training WSHF without addressing challenges such as availability of service providers (veterinarians and community vaccinators) with an incentive structure that is affordable to the farmers may not result in sustainable uptake of ND and CCPP vaccines. This view is supported by findings elsewhere[8]. There was also a challenge with access to and availability of cold chain storage for the vaccines. Addressing the issue of proper handling of vaccines to preserve potency in order to avoid negative perceptions about vaccines are therefore important considerations when addressing barriers to vaccine uptake. This view is supported by literature[9,10].

Our study's finding on the heavy reliance on ethnomedicine (herb) in treatment and prevention of ND and CCPP is not unique to our study sites[2,11,12,13,14]. It has been suggested that treating chickens with *Aloe secundiflora* the widely used herb reduces mortality and severity of clinical signs but had no significant effect on antibody levels of chickens inoculated with Newcastle disease[15]. It is this quality

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[10] Otiang E, Campbell ZA, Thumbi SM, Njagi LW, Nyaga PN, Palmer GH (2020) Mortality as the primary constraint to enhancing nutritional and financial gains from poultry: A multi-year longitudinal study of smallholder farmers in western Kenya. PLoS ONE 15(5): e0233691. https://doi.org/10.1371/journal.pone.0233691

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of reducing the severity of clinical signs that makes using *Aloe secundiflora* a competing factor with ND vaccination. The reliance on herbal remedies is also due to the fact that they are readily available at no cost and are easy to use, compared to vaccines. Some farmers use herbal remedies alongside the vaccines out of desperation to save some of their animals during outbreaks. These findings recalibrated our trainings and engagement strategies to ensure among other things continuous community sensitization campaigns on the benefits of ND and CCPP vaccines. Making the vaccines available and accessible in appropriate dose-formats and at affordable costs can also go a long way in increasing vaccine uptake and use in the region.

The finding that flock size influenced vaccine uptake may be tied to other factors. For instance, packaging of vaccines in quantities that were beyond the flock size of most farmers was identified through the FGDs as an important structural barrier to vaccine uptake. The minimum number of doses sold was for 100 chicken while the average flock size was reported to be 15 and farmers found it uneconomical to buy such quantities for small flock. The smallest dose-format for CCPP vaccine was for a 100 goats while average flock size was 28. The relatively low chicken and small ruminant numbers is therefore a potential challenge to uptake of ND and CCPP vaccines. The view that as the flock size increased the perception of the magnitude of potential loss increased and the willingness to invest in vaccines also increased. One of the key component of our theory of change is that the promotion of collectives (groups and cooperatives) mitigates this challenge, as such not belonging to a group or cooperative is a potential barrier in access to ND and CCPP vaccines. Our qualitative findings indicate structural factors compounded social and economic factors for instance distance was found to increase the aggregate cost of accessing the vaccines. Collectives may also mitigate this barrier by increasing the viability of locating vaccine vendors closer due to the pooled demand or just through the economics of collective purchasing.

The disconnect between those tasked with routine chicken and small ruminant management (majority women) and those making decisions (men) around production activities more so those with financial implications such as treatment and vaccination was also identified as a barrier hindering women from accessing and using ND and CCPP vaccines. Women are burdened with roles such as care givers for children, cooking and looking after the homestead leaving them with no part to grasp opportunities in livestock vaccine value chains as captured in the excerpt below; "*Mostly women take care of children, cook, sometimes cultivate and look at the homesteads*". A similar disconnect was also observed when it came to attendance of training seminars where those tasked with management of chicken and small ruminant production (mostly women) had less access to training opportunities compared to men.

Way forward

Whereas enhancing vaccine knowledge has a very high potential for increasing vaccine uptake, failure to address other individual factors may not lead to sustainable uptake of ND and CCPP vaccines. Several of these factors were found to interact and result in a compounding effect. To be effective, the vaccine supply chain needs to address proximity of ND and CCPP vendors and/or service providers, cold chain storage facilities, cost as well as packaging of vaccines in appropriate quantities

matching the average flock size via a comprehensive approach. Among the implications of these findings for women empowerment include the need to address gender parity and biases regarding access to training seminars, roles, labor and decision-making around chicken and small ruminant production if access to vaccines by women smallholder farmers is to be increased. In addition, sensitization of women smallholder farmers to take advantages of opportunities available in ND and CCPP vaccine value chains is essential in increasing women participation. Consequently, a conscious and targeted effect has been made to ensure that project activities have been recalibrated to ensure that these implications are considered in all project trainings, sensitizations, recruitment of community vaccinators, and project activities regarding collectives. The project is continuously monitoring the extent to which project's theory of change (training, community vaccinators and collectives) addresses these barriers for a sustainable increase in ND and CCPP vaccines uptake and ultimately achieving the project outcome of empowering women.