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Nutrition-sensitive chicken production in Ethiopia: a qualitative evaluation

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Abstract

Small-scale chicken production holds great potential as a nutrition-sensitive strategy in low-income settings, due to its potential for improving income, increasing the consumption of nutritious foods (including eggs and meat), and empowering women. This study sought to evaluate the impacts of and to identify challenges and solutions for a nutrition-sensitive chicken production intervention in rural Ethiopia. We conducted a qualitative study following the endline evaluation of the African Chicken Genetic Gains and Agriculture to Nutrition project in the Amhara and Oromia regions of Ethiopia. Using semi-structured interviews, we held twelve Focus Group Discussions with woman project participants and six Key Informant Interviews with project staff. Data were analyzed using thematic analysis. Six Focus Group Discussions were with participants in the African Chicken Genetic Gains intervention, through which women received 25 high-yielding chickens. The other six Focus Group Discussions were held with participants who (in addition to the African Chicken Genetic Gains intervention) also received the Agriculture to Nutrition intervention, which focused on nutrition-sensitive behavior change communication related to child feeding, water, sanitation and hygiene, and home gardening. The African Chicken Genetic Gains and the Agriculture to Nutrition interventions benefited participants through improved income, nutrition, and child caregiving knowledge. Nutrition and child feeding benefits were emphasized more in the nutrition-sensitive behavior change arm, while income benefits were emphasized more in the arm that did not receive behavior change. The primary challenges of the project included death and disease of chickens and implementation issues at both the project and household levels. Recommendations to address these challenges included improved chicken housing designs, access to inputs, access to veterinary care (including vaccines and medication), and project logistics. The nutrition-sensitive and chicken production interventions were largely well-received by participants. Most participants agreed that the benefits of the project outweighed the challenges. Future projects would benefit from logistical and infrastructural improvements to improve implementation and impacts on nutrition, health, and livelihoods.

Keywords: Chicken, Poultry, Animal husbandry, Qualitative, Ethiopia, Child health, Nutrition, WASH

Introduction

The promotion of backyard chicken systems has been proposed as a nutrition-sensitive strategy in low-income settings due to its potential for increasing income, improving consumption of nutritious foods,

and empowering women [1]. First, chicken production can contribute to increased income from selling eggs and whole chickens for their meat, both of which can garner high prices in many low-income countries [2]. Second, a chicken's eggs and meat are both complete sources of amino acids that are packed with essential nutrients considered to be important for child growth and development, including vitamin B-12, iron, vitamin A, and choline [2, 3]. Finally, promoting chicken

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production as a livelihood strategy could empower women and increase their incomes, since women are often responsible for taking care of smaller livestock and poultry [4, 5].

Interventions that improve diets and livelihoods are especially needed in the context of Ethiopia, where over 37 percent of children under 5 years of age are stunted (have a height-for-age z -score < -2) [6]. Young children in Ethiopia also have the fifth lowest Minimum Acceptable Diet in the world, with only 4 percent of children ages 6–23 months achieving a sufficient meal frequency and dietary diversity [7]. Household-level chicken production could provide an avenue for improving these outcomes in rural Ethiopia, where eggs and meat have a high monetary, social, and cultural value and women tend to control the income and decision-making related to poultry [8, 9]. Previous evidence has consistently shown that advancing women's empowerment is a key component of nutrition-sensitive agriculture interventions that succeed in improving diets and nutritional status [10].

A recent cluster-randomized controlled trial in rural Ethiopia explored the potential of these income, consumption, and empowerment pathways to improve child nutrition in the context of a chicken production intervention. The trial was conducted from 2016 to 2018 and contained two arms: the African Chicken Genetic Gains (ACGG) intervention, which provided high-yielding exotic chicken genotypes to participating households to evaluate five breeds in Ethiopian environments; and the ATONU intervention, which tested the added benefit of nutrition-sensitive behavior change in combination with the ACGG intervention. Results from the study evaluation showed higher height-for-age z -scores in the ACGG + ATONU group at midline, and higher height-for-age and weight-for-age z -scores in the ACGG group at endline [1]. The children in the ATONU intervention group also consumed a more diverse diet and more eggs compared to the ACGG intervention alone, showing positive impacts of the nutrition-sensitive behavior change. No adverse effects were found on child health outcomes, including anemia or the 2-week prevalence of diarrhea, fever, or vomiting [11].

Despite these positive impacts, intermediary study outcomes showed high chicken mortality, with only seven out of the 25 chickens provided to each household surviving at the study's midline evaluation (after 9 months) on average. In addition, at the study's midline, a mixed-methods evaluation of the project found variable implementation of chicken management practices such as the use of coops, a high degree of exposure of young children to animal feces, a number of challenges related to chicken rearing, and gaps in the ACGG/ATONU project's implementation [12].

In light of these midline qualitative findings, we proposed a follow-up study to learn from the project's successes and challenges, and to document recommendations for improvements directly from participants themselves. Thus, after the project's endline evaluation, we conducted a participatory qualitative evaluation consisting of Key Informant Interviews with project leaders and Focus Group Discussions with project participants, guided by the following research questions:

1. How did the ACGG and ATONU interventions impact participants?
2. What were the challenges of the ACGG and ATONU interventions?
3. What are some potential solutions to these challenges?

These findings provide qualitative evidence of the intervention's effectiveness, as well as policy recommendations for practitioners wishing to inform the implementation of nutrition-sensitive projects and interventions.

Methods

Study participants

This research consisted of 12 focus group discussions (FGDs) with woman project participants; six with participants in the ACGG group alone, and six with participants in the ACGG + ATONU group. We also conducted six one-on-one Key Informant Interviews (KIIs) with staff involved in the project's implementation. Below, we describe the data collection and analysis procedures for the 12 FGDs and the six KIIs.

The ACGG + ATONU project

The ATONU (Agriculture-to-Nutrition) project was a cluster-randomized trial that sought to evaluate the effects of a nutrition-sensitive chicken production intervention (clinicaltrials.gov identifier # NCT03152227). Project implementation occurred from February 2017 to April 2018 in four regions of Ethiopia, including Amhara, Oromia, SNNPR (Southern Nations, Nationalities, and Peoples' Region), and Tigray. The trial and interventions have been previously described in detail [1]. Villages were randomly assigned to one of three intervention arms: (1) the ACGG (African Chicken Genetic Gains) arm, which included the receipt of 25 high-yielding chicks from five exotic breeds and technical assistance on chicken production and management; (2) the ATONU arm, which in addition to participating in ACGG, also received a behavior change communication (BCC) intervention on nutrition, child feeding practices, WASH (water, sanitation,

and hygiene) behaviors, women's empowerment, home gardening, and a vegetable seed distribution; and (3) a control arm. Participants in all three arms had to meet the inclusion criteria, which consisted of having produced chickens for at least 2 years, currently having fewer than 50 birds, and having at least one woman of reproductive age (18–49 years at enrollment).

Focus group discussions

The FGDs were limited to two regions due to geographic constraints—Oromia and Amhara. A total of twelve villages were selected as sites for the focus group discussions through purposive maximum variation sampling [13] to achieve balance across treatment groups. Sampling was based on the following procedure: within each region, three woredas (districts) were selected; from each of these woredas, two kebeles (villages) were selected—one from each of the two treatment groups—for a total of 12 kebeles. We then held one focus group discussion per kebele with project participants who were the primary woman caregivers of young children. The first four focus groups were conducted in July of 2018 (3 months after the conclusion of the ACGG and ATONU activities); when it was determined that saturation had not yet been achieved, eight more focus groups were conducted in September after additional funding, personnel, and ethical approval were obtained.

The FGDs followed a semi-structured interview format. The size of the focus groups was allowed to range from 6 to 12 participants and included women who had an index child aged 0–36 months at the start of the ACGG/ATONU project. Local project staff informed all participants in advance about the upcoming discussion to encourage participation, and participants were compensated for their time with soap. Informed consent was read to all participants, and confirmation was received verbally before initiation of the interview. All FGD's were led by a Master's-level trained qualitative researcher (YM) in either Afan Oromo or Amharic, depending on the region, and accompanied by one note taker (HA), who holds a Master's of Public Health. The first four focus groups were also attended by a PhD student from Boston (SP), who took additional notes. After each day of interviews, the primary qualitative interviewer (YM) wrote a summary of the day's interviews in English, which SP then reviewed before subsequent interviews. All interviews were recorded on a device, anonymized, transcribed verbatim into its original language, and then translated into English by HA.

Key informant interviews

Six KIIs were conducted in July of 2018 with key informants who had been highly involved in ACGG and/or ATONU intervention oversight and/or implementation. Written informed consent was provided by all participants. All interviews were conducted in Amharic, except for one, which was conducted in English. YM led the interviewing using a semi-structured interview guide and was accompanied by HA as a note taker. SP was present and taking notes at all KIIs, and SA was present at two. At the end of each day, YM provided written summaries of the interviews in English, which SP then reviewed before subsequent interviews. All interviews were recorded, transcribed, and translated into English by HA. In our presentation of quotes from the KIIs, we have omitted the individual's job title to preserve their anonymity.

Interview guides

The interview guides are included in the Appendix of this paper for both the FGDs and KIIs (Appendixes 1 and 2, respectively). The guides were developed based on the three research questions outlined in the introduction and were tailored to the perspectives of the participants. For example, the FGD questions focused more on the challenges of and experiences with raising chickens, while the KIIs focused more on the challenges of and experiences with project implementation. The semi-structured interview format ensured that the most relevant points to the research questions were covered, but also allowed the interviewer flexibility in guiding the discussion along a natural and comfortable course.

During qualitative research from the study's midline, we noticed high variability in the types of chicken coops, and a high prevalence of chickens sleeping inside the house at night [12]. To address the issue of chicken housing specifically, FGD and KII participants were presented with pictures of eight chicken housing designs and asked to discuss them and select their favorite.

Data analysis

Data were analyzed using deductive coding through thematic analysis, in the style described by Braun and Clarke (2006) [14]. The coding process for both the FGDs and KIIs proceeded as follows.

The codebook development began with having the primary coder open-code the data during their initial readthrough of the transcripts, jotting down all codes that came to mind. This list was then refined to develop and define the initial set of codes. The secondary coder then audited the codebook by reading a selection of transcripts and suggesting edits to the codebook. After their revisions were incorporated, the primary coder then

coded all transcripts based on the codebook, and the secondary coder reviewed the coded transcripts, making corrections when necessary. For the FGDs, the primary coder was SP and the secondary coder was SA, and for the KIIs, the primary coder was SA and secondary coder, SP. Coding for the FGDs was conducted in NVIVO, version 12.5, and manually for the KIIs. For the FGD analysis, data were also organized into data matrices in the style described by Bernard et al. [15]. This part of the analysis was conducted in an Excel spreadsheet, and involved comparing the FGD responses to the three research questions across several characteristics by which we suspected responses might vary, including treatment group (ACGG or ACGG + ATONU), number of chickens currently owned, district, village, number of participants, and age of the index child.

The identification of themes was conducted by sorting codes into concepts, and then themes into subthemes using the cutting and sorting method [15]. The final themes were discussed and agreed upon by both coders. A concept map (presented in the Results section) was created to group and connect the concepts that emerged under challenges and solutions.

Results

The following section discusses the key themes that emerged as a result of our thematic analysis of the FGD and KII data. This section is structured based on the three research questions we investigated. Under each research question, we present the themes alongside supporting evidence. These themes include: nutritional benefits to the children and family; financial benefits; improvements in knowledge, attitudes, and practices; chicken disease and death; project-level implementation challenges; participant-level implementation challenges; proposed solutions to these challenges; and proposed infrastructural improvements.

How did the ACGG and ATONU interventions impact participants?

Nutritional benefits to the children and family

The most common benefits noted by ACGG/ATONU participants were household income and nutrition. In every focus group discussion, participants discussed increases in their household's consumption of eggs, especially for children. According to one discussant:

“there is a big difference compared to before. After the initiation of [ACGG+ATONU], the difference is I am feeding the whole family eggs. Especially for children, I regularly provide eggs. It is not feasible to buy from the market to feed family including children; it is not affordable. If I have 5 chickens; I can get 5 eggs

a day; I give two eggs to the family and sell three eggs to make money” (R3, Bake Sirba, ACGG+ATONU).

ACGG + ATONU participants attributed health, growth and development benefits to their children's egg consumption. While members of the ACGG group also mentioned household consumption of eggs and meat as a benefit, there was less emphasis on child feeding specifically and more emphasis on supplementing household diets and income. According to one participant:

“there is no question; chickens are beneficial to make money and eat in the house. To serve guests, feed family and make money, chickens are useful” (R4, Addis Mender, ACGG).

Financial benefits

Economic benefits were also noted in almost every household involved in the FGDs, but ACGG households were more likely to emphasize the economic benefits of the intervention, and more likely to report selling chickens and eggs compared to the ACGG + ATONU households. One discussant described how:

“I was selling the eggs of chickens. I did not feed child and family members at all; the feeding practice of my family including children is all the same before and after I received these chickens” (R2, ACGG).

ACGG + ATONU households mentioned that, after the training and education sessions they received, they felt that the economic benefit from selling eggs and male chickens was of secondary importance to the benefit of feeding their families. As one discussant described:

“on different education and discussion sessions we have been told to feed family first and financial benefit could be the secondary. On my previous experience I did not feed children with eggs; I prefer to sell and purchase another food alternative. I prefer to put eggs under local chickens to hatch more chicks but now I give priority to feeding [my] child” (R6, Dukuli, ACGG+ATONU).

A handful of discussants, mostly in ACGG villages but one in an ACGG + ATONU village, reported selling chickens to buy sheep. Households reported doing this once they realized their chickens were dying off from disease, or in the case of the ACGG + ATONU participant, the income from selling male chickens was sufficient to purchase sheep.

Economic benefits were also mentioned frequently in the KIIs. Informants noted that the community benefited from egg production and selling chickens. According to one informant:

“There is a change in the amount of eggs mothers are taking to market; from local chickens, mothers take three or up to four eggs per week, but after they have received the improved chicken breed they sell 30 to 40 eggs per week” (KII, ACGG).

Improvements in knowledge, attitudes and practices

Both the KIIs and FGDs revealed gains in knowledge, attitudes, and practices related to chicken management, nutrition, and child caregiving. When asked about changes in chicken production, every FGD discussed how practices had improved since the start of the program. Many mentioned previously, coops were not formally constructed or built in a “modern” way. When participants built more established coops for the project, it was often their first experience with doing so.

Another benefit identified from the KII analysis was a change in men’s attitudes regarding the value that women bring from chicken production following sensitization training. One informant noted:

“the main problem is that men undermine women as well as the role of women; hence they do not accept chicken management...and the benefits gained from chickens. It was perceived to be minor compared to other farming activities...Through consecutive training and discussion sessions; they started to be convinced after they realized the benefits of chickens and chicken products” (KII, ACGG+ATONU).

ACGG + ATONU participants discussed improvements in their nutrition knowledge, including the importance of feeding eggs to children (especially in favor of selling them), increased awareness about sanitation and hygiene, knowledge about breastfeeding and complementary feeding, and dietary diversification. Discussants noted the impacts of their behavior change; for example, one participant described how:

“after training, children less than two years of age have better attention. We feed children from eggs better than before. Not only children but also family members. Additionally, we learned exclusive breastfeeding practices up to 6 months of child age... Previously we were giving water and milk before 6 months. Fruit and vegetables such as cabbage were considered food created for the urban community...but recently after home gardening was introduced, I buy carrot, cabbage, red beet from the market and feed my family” (R5, Tsion Teguazh, ACGG+ATONU).

ACGG + ATONU participants also discussed the home gardening program, although this had mixed success

among participants due to seasonality, lack of water, and in some cases lack of interest or space. FGDs noted that some crops were particularly successful, and that some individuals saved their seeds for future planting. One discussant described, for example:

“nine different types of “[vegetable]” seeds were distributed for home gardening. We successfully benefited from carrot, cabbage, swiss chard, tomato and others. These...vegetables were beneficial for the family including children; we were feeding them consistently” (R10, Arabbo, ACGG+ATONU).

There also appeared to be increased awareness among ACGG + ATONU participants about the health consequences of children and chickens interacting. Participants did not explicitly raise child–chicken interactions as a challenge of the intervention, but when asked specifically whether children and chickens should be kept separate, nearly all participants agreed that they should. Their reasons for this ranged from physical harm to insect exposure to getting into each other’s food to threat of diarrheal disease. As one discussant noted:

“There should be separate places for chickens and children...the project worker told us this is health harming behavior...previously, people did not separate chicken and children...due to lack of awareness. In recent times, child health is becoming the main challenge of the community. If they (children) stay with chickens, the health condition might worsen. Hence it could be better if children are kept separate from chickens” (R3, Oda Haro, ACGG+ATONU).

What were the challenges of the ACGG and ATONU interventions?

Chicken death and disease

There was notable variation in how participants perceived the benefits of the program, which was often directly related to how many of their chickens survived. In some cases, participants lost most or all of their chickens within a few weeks of delivery. The ACGG program was testing the performance of five different breeds of chickens, and one of these breeds had a very low survival rate. The high death rates were especially problematic, because the chickens were hybrid varieties, and so could not be replenished by participants’ own flocks or breeding. Participants with this experience were frustrated that they went through the effort and expense of building a coop, preparing for chickens, caring for them, and feeding them when they died before producing eggs or being old enough to sell for meat:

“Even though they are beneficial; they do not survive

chicken disease. My household members wanted to eat chicken meat but I refused because I wanted to benefit from selling eggs; but they died one by one; I was hopefully waiting for eggs but it failed—they all died. I found dead chickens every morning” (R6, Ashuda, ACGG).

A lack of veterinary care was not always the issue—many women reported seeking medicine or care from an animal clinic, but the medicines were not always effective. In one KII, the interviewee relayed how one participant sold her chickens immediately to avoid such losses: *“during data collection she reported all the chickens died. It was by chance that we have identified the chickens did not actually die; rather she sold them in fear of more chicken death” (KII, ACGG).*

Project-level implementation challenges

Key Informants raised several project implementation challenges, including issues with importing the foreign chicken breeds and distributing them. Two of the breeds—including one from Brazil and one from South Africa—could not be imported, which led to delays as new arrangements had to be made. Relatedly, the distribution of chicks to participants was postponed and occurred unevenly across regions and households: *“all chicken breeds were not distributed at the same time... Additionally, the available chicken breeds were not distributed to all areas as the same time” (KII, ACGG).* At the regional level, other issues mentioned included delayed releases of financial capital, lower than expected recruitment of community animal health workers, internet connectivity issues that affected data compilation, staff turnover, distribution of chickens during the rainy season resulting in low chick survival, maintenance of program participation when chicken mortality was high or delivery was delayed, and as previously mentioned, high mortality of some of the imported breeds. One Key Informant suggested that a strategy to reduce disease could have been better managed before distribution:

“We lost a number of chickens before the endline of project. Though we have discussed how to control chicken disease...before chicken distribution, it was unfortunate that higher officials started chicken distribution before we intervened [on] chicken disease. Newcastle’s was the common chicken disease outbreak we have faced” (KII, ACGG).

Another participant mentioned how even though chickens were vaccinated before being distributed, follow-up village-level vaccination could have prevented high rates of death.

Participant-level implementation challenges

Challenges that program participants mentioned (in order of their own ranking) included: high levels of chicken death and disease, lack of veterinary and vaccination services, high feed requirements of improved chickens, predators, the labor-intensive nature of caring for improved breeds (such as cleaning the coop two to four times a day) and difficulty of constructing a chicken coop. Nearly all participants acknowledged that, except for the death and disease of the chickens, all of these other challenges were manageable at the household level, and necessary to reap the benefits of production: *“if the issue of chicken disease and death has a solution; we do not care about the other issues; it is all manageable. I am able to do whatever I am expected to do, except chicken disease. It is beyond my ability of control” (R3, Ashuda, ACGG).* However, as one Key Informant described, the training provided to participants to help them respond to the disease challenges could have been more robust:

“Death of chickens was among the challenges we have encountered. Some households have only one chicken from distributed 25 chickens; some have two or three chickens due to death. The only thing I have experienced is people have been informed and oriented to keep hygienic and handle them properly to minimize death” (KII, ATONU).

What are some potential solutions to these challenges?

Proposed recommendations to challenges

Some suggestions made during the FGDs addressed several of the aforementioned problems simultaneously. In response to the challenge of chicken death and disease, participants suggested a consistent, pre-determined vaccination schedule. Other recommendations included the provision of medication during the chicken distribution, follow-up deliveries of chicken medication, the provision of formulated food with chickens to improve their adaptability, payment for lost chickens, and better access to household-level (rather than animal clinic-level) veterinary services. Some participants noted that proper veterinary capacity would be enough to make the program wholly successful:

“I do not go back in fear of any challenge. I wish to get more chickens and face more challenge...The challenge which was beyond the scope of our managing capacity was lack of treatment medicine or drug. The medicine used to treat chicken disease could be distributed with chickens early” (R3, Bake Sirba, ACGG + ATONU).

In addition, a discussant also suggested more technical training on how to manage chickens to prevent and treat disease, specifically for women:

“My concern is regarding training. The training could be provided for mothers directly; this is our first time to participate in discussion of chicken related issues; if we have enough training on the modern chicken management; probably we might manage chickens in a better way” (R1, Abu Dorani, ACGG).

Proposed infrastructural improvements

When FGD participants were asked to select their preferred coop design, they nearly universally selected one particular design, citing three features: protection from predators, a safe place for chickens to sleep at night, and an area for them to roam during the day without having to be let in and out. A design similar to the one used in the discussion is exhibited in Fig. 1. As one discussant described, *“it seems perfect because it has wider space to roam in the daytime and keep them at night. We do not have to look for another plan to graze them around” (R1, Tarkanfate Gibe, ACGG)*. Many participants also liked a design that offered more shade, but similarly had room

for chickens to both sleep at night and roam during the day (see Fig. 2 for a similar example). Participants agreed that these two designs could be constructed with local materials, while other designs were seen as infeasible or too expensive to build. Participants liked designs that allowed for chickens to be fed inside of the coop, which saved them time in rounding chickens up and reduced the risk of losing them to predators. Some participants also discussed a design where the coop sat on an elevated post, which was seen as useful for protecting chickens from predators; it also allowed chicken droppings to fall freely without having to clean out the coop, which was viewed as more hygienic.

It is worth noting that in several cases, focus group discussants mentioned that their husbands were the ones responsible for coop construction and that they would know which designs would be best. In some cases, participants suggested that we repeat the photo activity with men so that they could see them and model the construction of a coop after the pictures. Thus, while chicken management is most often under the purview of women, men likely play a central role in the decisions regarding and execution of coop construction.



Fig. 1 Coop design exhibiting the features selected by Focus Group Discussion participants. This chicken coop design provides an example of the attributes that participants most favored in the Focus Group Discussions, including a roaming area and a connected sleeping area. This photo is under a Creative Commons license and is attributed to Tim Evanson, CC BY-SA 2.0 <https://creativecommons.org/licenses/by-sa/2.0>, via Wikimedia Commons



Fig. 2 Alternative coop design exhibiting the features selected by Focus Group Discussion participants. This chicken coop exhibits qualities similar to the runner-up design selected by discussants during the Focus Group Discussions. Similar to Fig. 1, it has a roaming area and a connected sleeping area, but some participants liked the additional offering of shade provided by this design. This photo is under a Creative Commons license and is attributed to Josh Larios from Seattle, US, CC BY-SA 2.0 <https://creativecommons.org/licenses/by-sa/2.0>, via Wikimedia Commons

To summarize the qualitative findings overall, we have mapped the problems raised during both the KIIs and FGDs with their proposed solutions in Fig. 3.

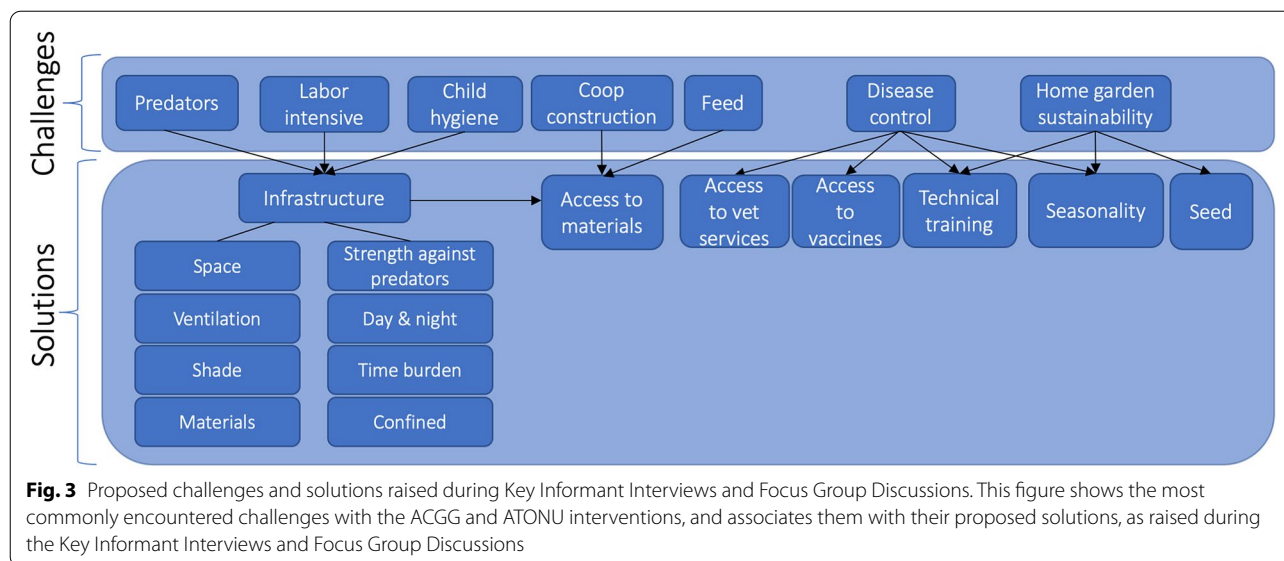
Discussion

Analysis of the KIIs and FGDs provided valuable information on how a backyard chicken production intervention—bundled with or without a nutrition-sensitive intervention—impacted project participants. Based on our thematic analysis, the primary intervention benefits were attained through nutrition, income, and knowledge, attitudes and practices related to childcare and chicken production. Our findings also shed light on specific challenges of the ACGG/ATONU interventions, including implementation challenges at both the project and household levels. Finally, we synthesized policy recommendations from project staff and participants on how to address these challenges through improvements in both implementation and physical infrastructure.

The theme related to improvements in nutrition, income, and health behaviors is consistent with a previously published evaluation [1], which found

improvements in child anthropometry for both the ACGG and ACGG + ATONU groups, and improvements in child dietary diversity and egg consumption in the ACGG + ATONU group. Our qualitative results showing greater emphasis on child feeding and nutrition in the ACGG + ATONU group compared to the ACGG group further support the dietary changes observed in the quantitative evaluation. Discussants in the ACGG-alone group stressed the importance of the additional income gained, which was also shown quantitatively by Passarelli et al. [1]; these combined income and dietary pathways in the two arms could explain the anthropometric improvements observed in the trial. The implementation challenges cited, such as chicken death and disease, and a lack of access to feed, replacement chicks, veterinary services, and chicken coop construction materials, suggest that the project could have resulted in even greater direct and indirect nutrition impacts in the absence of these challenges.

Our analysis also highlighted specific examples of how ACGG + ATONU participants improved their nutrition knowledge and behaviors. While the direct dietary effects



of the chicken intervention may appear small—for example, the addition of several eggs per day spread across a household of six—it is possible that behavior change may lead to more sustainable, long-term improvements. Many studies have shown that behavior change communication has been an effective mechanism for improving child feeding practices [1, 16–18] and nutrition outcomes in Ethiopia [1, 18]. Qualitative research from Ethiopia has argued that BCC could be an important facilitator to overcome cultural and behavioral barriers associated with the infrequent consumption of animal source foods [19]. Our findings provide further evidence that behavior change communication can be effective for making agricultural projects more nutrition-sensitive and for moving the needle on nutrition outcomes. These shifts in behavior could be amplified with women’s empowerment, improved income to purchase healthier foods, and improved knowledge about dietary diversity, feeding practices, sanitation, and hygiene [20].

The specific recommendations related to chicken housing designs should be considered and tested by future program implementers to limit the potentially harmful exposure of household members to environmental contamination. According to previously published results [1], while children living in ACGG-participating households did not suffer from acute health consequences as a result of the intervention, findings showed that animal feces were visible on the property in more than 50 percent of households. Another study based on this same project showed that improvements in chicken production practices—like having an enclosed chicken coop—can help to minimize household exposure to animal feces [12]. Other research from Ethiopia has shown associations between children’s exposure to chicken feces and child stunting

[21]; studies from other countries have found relationships between living in close proximity to livestock and markers of environmental enteric dysfunction, a disorder associated with growth faltering [22].

Participants in this study noted that the most important features of an ideal chicken coop included a daytime roaming area (with or without shade) connected to a nighttime coop. Prior research on interventions to corral poultry to improve health outcomes found that disadvantages related to food and water costs led to the use of corrals only intermittently in Peru. The authors argued that the need to find secure, acceptable, and affordable enclosures while providing adequate space, care, and hygiene proved challenging in their study area [23]. These same factors remain a limitation in the communities participating in ACGG. In a resurgence of evidence and interest on this topic, several projects designed to test different methods for limiting exposure to contamination from poultry are underway [24, 25]. Including program participants in the design process could help to facilitate the acceptability and sustained use of these strategies.

This study has several limitations and strengths. It is possible that social desirability bias could have influenced discussions. Project staff may have been motivated to shed a positive light on the project, or ACGG + ATONU participants could have overemphasized the nutrition and health benefits of the program. In addition, data were only collected in the Oromia and Amhara regions, and thus are not representative of the full ACGG + ATONU project area. This study also has several notable strengths, including its sampling design, which allowed us to compare ACGG and ACGG + ATONU villages, its collaborative transcript coding approach, and its integration of perspectives from both project participants and staff.

Policy recommendations

Based on these findings, we propose the following nine recommendations for future chicken production projects:

1. Provide technical training for participants on preventing and treating disease, on effective husbandry practices (such as ventilation, feeding, watering, and the appropriate use of veterinary services), and on chicken housing construction;
2. Implement gender-aware approaches, especially in cases where labor is expected to increase as that labor demand may disproportionately fall on women. This requires using time-saving methods and technologies, supporting women's decision-making and their control over income, sensitizing men to women's empowerment, and working together with men in situations that may require joint decisions, such as coop construction.
3. Strengthen value chains for inputs such as chicks, formulated feed, medication, and coop construction materials and facilitate participant access to these inputs;
4. Improve access to village-level animal health workers, and have resources and timelines in place for the distribution of medications and vaccinations;
5. Continue improvements in breeding for local adaptability and productivity. These efforts should continue to include small-scale producers to ensure that characteristics are optimal and to improve the likelihood of future chicken production uptake and success.
6. Replace chickens with the best breed in cases of large die-offs, or compensate participants financially for their losses;
7. Engage in participatory coop design with both men and women. Strong engineering designs are needed to withstand predators, minimize women's time, prevent chicken-child interactions, and improve hygiene. A collaborative design process might help to ensure better design features and greater buy-in to technology adoption.
8. Align intervention delivery with the appropriate season and technologies to ensure success. Home gardens can be implemented during the wet season (in Ethiopia, typically July to September) when there is more rain and water access for fruit and vegetable production. If home gardens are implemented in the dry season (in Ethiopia, typically September to March) to improve income and dietary diversification in the off-season, they should be delivered alongside water technologies, such as irrigation. To improve survival rates, chicks should be delivered during the dry season.

Participatory approaches in agricultural technology design have long been recognized for their ability to improve adoption and success, due to their demand-driven nature and integration of localized expert knowledge [26]. These recommendations—taken directly from project staff and participants—can be integrated into future program designs in Ethiopia and beyond to improve program delivery, maximize nutritional benefits, and minimize potential health risks.

Conclusions

This study provides a novel contribution to the qualitative literature around backyard poultry production. Based on our findings, it is clear that backyard chicken production, especially when combined with complementary social and behavior change communication, holds the potential to improve nutrition knowledge and behaviors as well as income. Previous research has highlighted how these changes can further result in anthropometric and dietary improvements [1]. These findings, together with our eight policy recommendations, provide actionable considerations for integrating into future policy and programmatic efforts related to small-scale animal husbandry. Our study also highlights a number of implementation challenges that can be improved in future projects to ensure maximal benefits for participants. Our application of qualitative evaluation methods highlights the importance of seeking feedback directly from people involved in the project so that we can document what worked, what can be improved, and what participants want in the future.

Appendix 1: Semi-structured interview guide for Focus Group Discussions

- What have been the main benefits of the ACCG (and ATONU for the two ATONU communities) activities in general?
 - *Prompt if needed:* What have been the main benefits of ACCG (and ATONU) for nutrition of your children?
- Has the ACCG project changed the way you manage your chickens? If so, how?
- What are the main challenges of chicken management practices, e.g., where chickens are kept, how they are fed, where they roam?

- o *Will have the group come to consensus on a few. Then will have the group rank these issues based on level of importance using a prop, such as stones/beans.*
- What would be a beneficial yet feasible solution to the (three most highly ranked) challenges?
- *(Spend more time on this question, with prompts)* Sometimes there can be concerns that chickens being near children can be harmful for health of the children. Do you agree?
- What would be a way to keep chickens so that they are free from harm and separated from children for your households?
 - o *Prompt: what would be the best ways to separate chickens from your children that would still allow you to go about your duties, and still benefit your households? (e.g., where should they be kept during the day and at night, will they have to roam freely at times, how will they be protected from predators)*
 - o What would be the main barriers to adopting these practices in your households?
 - o *Share some pictures of different coops and management strategies and have participants discuss/potentially have them rank (see potential photos attached).*

Thank you very much for your time. Your perspective has been helpful for thinking about these issues.

Appendix 2: Semi-structured interview guide for Key Informant Interviews

- What has been successful about the ACGG interventions?
 - o ATONU interventions?
- *For ATONU: do you think the BCC messaging on nutrition and WASH have been successful? Why or why not?*
- What have been the main challenges of the ACGG interventions?
 - o ATONU interventions?
 - o *For each of the major challenges identified: What do you think would be a feasible solution to this challenge?*

- In your experience, how has the ACGG intervention changed the way households manage their chickens?
 - o Do you think these changes have been beneficial or harmful for nutrition and health of the household?
- *Share some pictures of different coops and management strategies and discuss with program staff.*
- What are some feasible ways that chicken management practices could be adapted to limit exposure of children and other household members to chickens?
 - o *Prompt: what would be the most effective strategies to separate chickens from children that would still be feasible and desirable to households? (e.g., where should they be kept during the day and at night, will they have to roam freely at times, how will they be protected from predators, what kinds of structures could be made locally and what they would look like, what strategies would be feasible for household resources and daily duties)*
 - o What would be the main barriers to adopting these practices in your households?
 - o *Share some pictures of different coops and management strategies and have participants discuss/potentially have them rank (see potential photos attached).*

Thank you very much for your time. Your perspective has been helpful for thinking about these issues.

Abbreviations

KII: Key informant interview; FGD: Focus group discussion; ACGG: African chicken genetic gains; ATONU: Agriculture-to-nutrition; HAZ: Height-for-age z-score; BCC: Behavior change communication; WASH: Water, sanitation, and hygiene.

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Authors' contributions

SP conceived of the concept and original study design. RA, NSG, WF, and DT advised on the study design. YB advised on the fieldwork. DT implemented and oversaw the field team. SP and SA analyzed the data. SP drafted the manuscript. All authors read and approved the final manuscript.

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Availability of data and materials

Transcripts will not be made available to protect confidentiality.

Declarations

Ethics approval and consent to participate

This study was approved by the Institutional Review Boards at both the Harvard T.H. Chan School of Public Health (United States) and the Addis Continental Institute of Public Health (Ethiopia). Verbal consent was witnessed and formally recorded for all focus group participants and written consent was obtained from all Key Informants.

Consent for publication

All participants provided consent for results to be published as part of the informed consent procedure.

Competing interests

None to disclose.

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