Interdisciplinary Approach to Combat Food and Nutrition insecurity in Rural Resource-poor Settings of Central Tanzania

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Abstract

Rural resource-poor settings of central depend largely on crop and livestock production for the livelihood. Lack of diversity and adequate food is an important problem affecting a substantial number of communities in Tanzania especially children aged between six months and one year. Poultry and crop production interventions were part of the project titled "strengthening food and nutrition security through family poultry and crop integration in Tanzania and Zambia" that aimed at utilizing locally available resources to mitigate food and nutrition insecurity. Interdisciplinary approach to combat food and nutrition insecurity was conducted in Iwondo Ward located in Mpwapwa District in Dodoma Region, Tanzania. The crop production interventions were introduction of Good Agricultural Practices (GAP) and poultry production interventions were vaccination against Newcastle Disease (ND) based on vaccination calendar and good husbandry. The data in poultry and crop production were collected before introduction of the interventions as the baseline and after introduction of GAP and vaccination of chickens. The harvest of crops was increased as compared to baseline year. The yield of sorghum increased from 200 to 1206.5kg, sesame from 150 to 504kg, and green gram from 80 to 644kg per acre. The proportion of households experiencing hunger for two to three months declined from 58% during baseline to 16% in 2017.The proportion of households keeping chickens increased during the period 2016 to 2018, from 47.3% (n=280) to 82.1% (n=276). The average number of chickens raised by households also increased from 9 to 13, and the average flock structure comprising of chickens of different age categories also demonstrated an increase, adults, 3 to 5, growers, 3 to 4 and chicks, 2 to 4.Most households (89%) reported to provide sorghum, maize/maize bran and finger millet as additional feed to chickens. Adopting interdisciplinary interventions can assist to improve agricultural production and hence increase resilience to food and nutrition insecurity.

Keywords: Good Agricultural Practices (GAP), Newcastle Disease (ND), Food and nutrition insecurity.

Introduction

Iwondo ward is suffering a heavy soil erosion as the result of rain water flow from North to South down the mountain following the inclination of the valley. The top soil has completely diminished due to over grazing, cultivation, forest clearing including along the foot of the mountain resulting into land infertility, desertification and frequent flooding (Bagnol, 2014).

The economy of the ward depends largely agriculture and livestock activities conducted under subsistence farming. According to the data collected qualitatively from the residents, the "richest" households represent a small proportion of the households. The "rich" group represents between 9 and 13 % of the households. The "poor" households represent 30% of the households. "Very poor" households represent the majority of the households (60%) struggling even to get three meals a day.

Women are extremely active and carry out most of the daily activities such as fetching water, firewood, searching for food, cultivating, preparing the meal, taking care of children and the family in general, however, do not receive much benefit from their efforts. Behaviors and cus-toms existing in the area marginalize women from political and economic decision making and hence, the efforts they are investing does not tally with benefits obtained from the daily activities performed. Women in this area have access to land but not ownership and neither access nor ownership for livestock (Bagnol, 2014).

The lack of diversity of the food is an important problem. It is an issue for adults but even more for children, as they are fed only with ugali from the age of 6 months to one year. Most households own village chickens that scavenge around the house. Extra feeding is limited and provision of a specific chicken coop rare. The size of the chicken flock is small during the dry season after the Newcastle Disease (ND) outbreak in October/November and increases during the harvest. Chickens are tended by women although they do not have control over their sale and consumption. Households do not eat many chickens and very rarely eggs. They prefer to sell them due to their relatively high price. Sale is mainly done locally (Bagnol, 2014).

Therefore, this study was aiming at analyzing the farming system existing in Iwondo ward and assessing the impact of ND vaccination and introduction of the GAP on food security in resource poor settings communities.

Materials and Methods

Study location

The study was conducted in Iwondo Ward, Mpwapwa District in Dodoma Region, Tanzania. The ward is located at 6°37' latitude and 35°59' longitude, surrounded by mountains that form part of the catchment area of Mtera Dam reservoir. The mountains run on both borders of the ward from north to south west and south east. The ward is semiarid and receives unimodal rainfall of less than 600mm.

Baseline survey

The baseline survey was conducted in May 2015 to explore the farming system which depicted the crop interventions carried out. The exit survey was conducted at the end of the project to compare the findings with the baseline. A participatory rural appraisal was carried out as part of the baseline to collect information about the socio-economic reality of the ward. With this intent observation, transect walk, interviews with key informants and focus groups were carried out.

Selection of participating communities

A sampling frame was generated from all households with at least one child under two years of age, keeping chickens or intending to keep chickens and intending to remain in the study areas for at least the next five years. Two stage sampling was used to first enrol all eligible households with children under 12 months of age and then enrol additional households with children aged 12–24 months by random selection through a lottery draw using household identification numbers to give the required number of households. A total of 280 households from four communities of the ward were selected to participate in the study.

Interventions

Crop interventions

Participatory workshops were conducted in four communities participated in the project in which selection of crops and feedback to farmers was done. The prioritized crops were sorghum, groundnut, sunflower, green gram and cowpeas. The demonstration plots were prepared in near by and easily accessed places by communities.

The training on Good Agricultural Practices (GAP) was conducted prior to cropping season. Improved seeds of selected crops were distributed to project participants and community members who participated in the GAP training. Distributed seeds were Macia for sorghum, Pendo Naliendele for groundnut, Rekodi for sunflower, Imara for green gram and Vuli for cowpeas.

Poultry interventions

The Newcastle Disease control extension package (Alders, 2001) which also includes recommendations concerning appropriate housing and supplementary feeding was given to extension workers and was used to train Community Vaccinators (CV). Community assistants recruited from within the community were monitoring household flock sizes and the status of individually tagged chickens (50 tagged birds per community) every two weeks. The Newcastle Disease antibody titre level of individually tagged birds was monitored by performing haemagglutination inhibition tests on serum samples collected prevaccination and one month post vaccination.

Chicken registrations were conducted by CV two weeks prior to ND vaccination campaigns which were undertaken every four months in the entire communities following the vaccination calendar. The vaccination campaigns were conducted in January, May and September of each year through entire lifespan of the project. A total of eight vaccination campaigns against ND were conducted for the period of May 2016 to December 2018.

Study design

The study was randomized trial design, in which four communities were randomly allocated to receive immediate or delayed ND vaccination (V) and Crop Intervention (C). The two control communities received both interventions and one year later the remained two communities joined the interventions.

Data collection, analysis and interpretation

Data were collected using vaccinators' record books, Farming System Survey, Participatory Research Appraisal and semistructured livelihood questionnaires. Vaccinators' record books were used to gather information on vaccination of the chickens including the number of chickens vaccinated. Farming system captures the level of crop production while the Participatory rural appraisal was used to determine the socio-economic groups of the community and some information on poultry keeping practices. The same criteria used for formulation of socio-economic groups were used to formulate the groups for focused group discussion and the same group names (Richest, Rich, Poor and Poorest) were adopted. The quantitative data were analyzed by using R-commander software whereby a mean, t-test, and chi-square (x^2) statistics were calculated.

Results and Discussions

According to the residents (Table 1) the "richest" households represent a small proportion of the households (between 1% and 2% depending on the group interviewed) they have several houses, more than100 cattle and more than ten acres of land for cultivation and sometimes own a tractor and/or motorbike. They usually have several houses and wives and can afford three or more good quality meals a day. The "rich" group represents between 9 and 13% of the households and have more than 100 cattle, between 10 and 50 acres of land, house with iron sheet roof, motor bike and can afford three meals a day. The "poor" households represent 30% of the households and can afford two meals a day, own houses built by local materials, between 2 to 5 cattle and between 5 and 10 acres of land. "Poorest" households represent the majority of the households (60%) they can afford one meal a day, own houses made of local materials, access land through renting and work as the labourers in other's land.

Livestock keeping and poultry interventions

Most households own animals and this is an important determinant of the wealth of the households. The poorest households only raise a small number of animals and often do not have any. The most common animals are cows, goats, chickens and donkeys and rarely receive animal health services. However, vaccination of chickens against Newcastle diseases as the

Table 1: Characteristics of the Social groups in Iwondo Ward

Groups	General	Meal	Property	House structure	Livestock	Cultivated land (acres)	% of the population
Richest	Enough surplus, cash and food	3 times or more	Tractor, motorcycle	Floor, iron sheet, solar panel	>200 cattle, 200 goats, 50 sheep, 30 to 50 chickens	10 – 100	1-2
Rich	Enough food, good school for chil-dren	3 times	motorcycle	Floor, iron sheet, solar panel	Animal traction, >100 cattle, 200 goats, 50 sheep, 30 to 50 chickens	10 – 100	9-13
Poor	Supply their needs but no quality	2 times		Traditional house	<10 cattle, <20 goats, 4 pigs, 5 sheeps, 50 hens	5 - 10	30
Poorest	Only one meal per day	once		Traditional house	No cattle, no goat, no pig, no chicken	Renting land or getting just for help	60

project intervention resulted into significant increaseof proportions of households keeping chickens in the ward between 2016 and 2018 (P<0.05) (Table 2).

Table 2: Percentage of households keeping the animals by species in Iwondo Ward

	Year			
Species	**2016**	**2017**	**2018**	**P -value**
Cattle	35.5	38.6	42.8	0.221
Goat	37.9	37.1	40.9	0.453
Sheep	27.8	21	24.2	0.352
Donkey	11.7	10.1	8.3	0.691
Chickens	47.3	60.5*	82.1*	0.022
Ducks	2.3	2.7	1.1	0.905
Dog	18.4	17.9	19.3	1.743
Cat	8.3	11.3	12.1	1.389
Others (guinea fowl, pigeons)	1	1.9	0.3	0.865

**Significant different at p<0.05*

The main problem in raising chickens as mentioned by focused group discussion participants was *"Mdondo"* which is ND (Bagnol, 2012). This ranked as the first problem during ranking exercise followed by "coughing" and "enlargement of the liver" (Table 3). In addition, participants mentioned worms, external parasites, swelling of eyes and blindness during the dry season as other problems encountered in poultry. *"We encounter eyes ulceration and enlargement and when we squeeze the enlarged eyes white materials come out"* (women, "poor" group at Igoji community). The mentioned signs are associated with a mixture of vitamin A deficiency most likely due to rarely availability of greens during the dry season and possibly fowl pox.

The focus group participants were able to list the main signs of ND and some of the forms of transmission such as contact between

Table 3: Problems with raising chickens in Iwondo Ward

Mentioned problem	No of votes (by using stones)	Rank
Kideri, Mdondo (ND)	21	1st
Worms	10	4th
Coughing	17	2nd
Enlargement of the liver	12	3rd
Eye problems	2	6th
External parasites	9	5th

the sick and health birds, however, other signs mentionedwere not associated with ND. Lack of clear understanding of the characteristic signs of ND often leads to the chicken keepers thinking that the vaccine is not working as they expected the vaccine to prevent all signs even those wrongly associated with ND. Dead and sick are normally used as the family meal, hence, there is no disposal of the dead chickens as stated by the focus group participants.

During the baseline data collection, most focus group participants were not keeping the chicken for various reasons, ND being dominant (Fig. 1). During and at the end of the project ND was no longer a dominant problem rather swelling of the eyes and problems with the eyes, such as blindness were mentioned as the main current poultry problem.

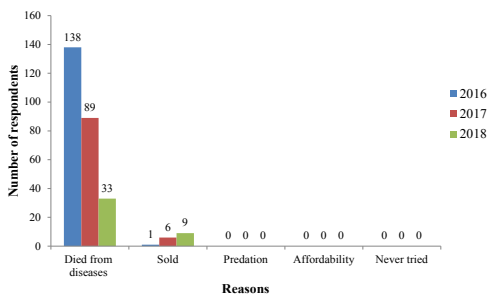

Figure 1: Reasons for not keeping chickens

Most households own village chickens that scavenge around the house. Chickens ownership varies from one family to the other. Some families own chickens jointly while in other families the chickens are distributed between family members. Regardless of the owner, women do most of the work related to feeding and watering. The current situation suggest that the ownership is more concentrated to the family level than individual male or female as shown in Figure 2. Probably this is because the contribution of chickens to the livelihood has been realized at family level.

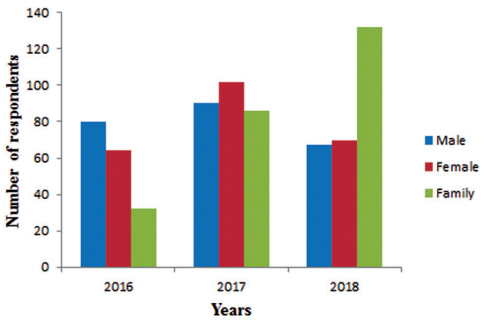

Figure 2: Chickens ownership in the household

Iwondo I and Iwondo II communities started vaccination against ND one year ahead of Igoji II and Chamanda communities which were left as a control. The number of households participating in vaccination campaigns in Iwondo I and Iwondo II varied from one campaign to another while the households participating in Igoji II and Chamanda communities demonstrated an increase (Fig. 3). The variations of household participation in vaccination campaigns is

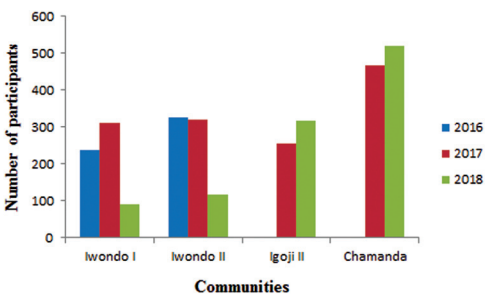

Figure 3: Households participated in vaccination campaigns

subject to different reasons which include low awareness about ND, willingness of the farmers to vaccinate their chickens, ability to pay for vaccination fee, reluctance of the farmers to pay for vaccination, the period of ND outbreaks and other diseases killing chickens like fowl pox and Avitaminosis. Bagnol, B. (2010) revealed that the adoption of communities to vaccinate against ND is between 20–25 % as it has been found in Zambia, Malawi and Mozambique.

The total number of chickens vaccinated against ND in Iwondo I and Iwondo II communities demonstrated a decrease (Fig. 4) from baseline year 2016 to end year 2018, while total number of chickens vaccinated in Igoji II and Chamanda communities demonstrated an increase from year 2017 as compared to 2018. The ups and downs of number of chickens vaccinated depends more on commitment of community vaccinators, size of the area to be covered by a vaccinator, distance from one house to another, willingness of the farmer to vaccinate and pay for the service and support from community leaders. Furthermore Igoji II and Chamanda communities started vaccination campaigns a year later because they were control group of which had an advantage of learning and getting experience from their fellow communities.

While the number of chickens vaccinated in Iwondo I and Iwondo II communities decreased in year 2017 (Fig. 4) the average number of chickens vaccinated per household increased especially in September when there is plenty of food for chickens and when the flock is at increase (Fig. 5).

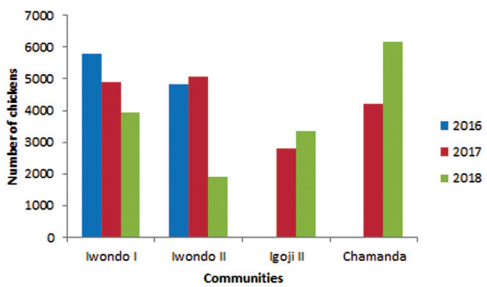

Figure 4: Number of chickens vaccinated

The average number of chickens raised by households increased from 9 to 13,and the average flock structure comprising of chickens

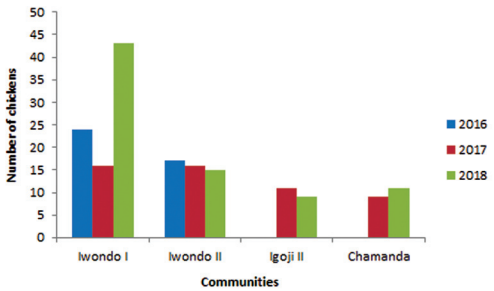

Figure 5: Average number of chickens vaccinated per households

of different age categories also demonstrated an increase, adults, 3 to 5, growers, 3 to 4 and chicks, 2 to 4 (Fig. 6).

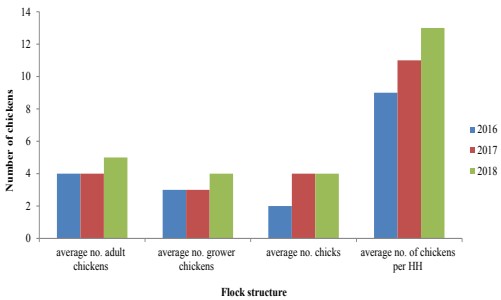

Figure 6: Chicken flock size and structure by year in Iwondo ward

Sorghum, maize or maize bran, left overs / table scraps and finger millet being used as the main feed supplements to chickens (Fig. 7) and 89% of Iwondo households reported to provide additional feed to their chickens.

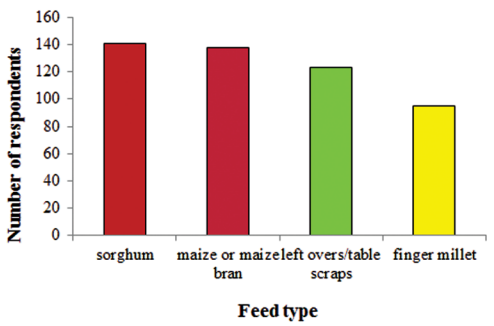

Figure 7: Feed types used in Iwondo ward

Crop interventions

Farmers invited to participate in feedback, intervention plan and GAP workshops of which

fe-males responded more than males in every invitation especially mothers enrolled in the project. As Figure 8 shows, females constituted 66.3% of the total participants in feedback and intervention plan workshops while in GAP training, 68.5% of the participants were female. The active engagement of women in agricultural activities indicates their sole responsibility in household's food security.

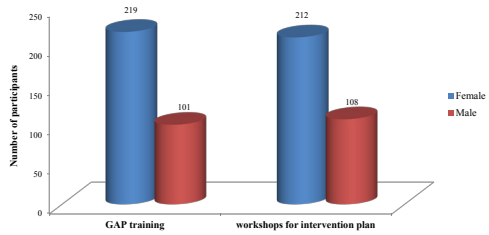

Figure 8: Farmers participation in crop activities

The harvest of crops was increased as compared to baseline year. The yield of sorghum increased from 200 to 1206.5kg, sesame from 150 to 504kg, groundnut from 250 to 446 and green gram from 80 to 644kg per acre (Fig. 9).The yield performances of selected crops under farmer's management after introduction of the GAP were comparable to the yield under Agricultural Research Institutes (TARI's) management. The increase in crop yield observed were more likely attributed to introduction of the GAP.

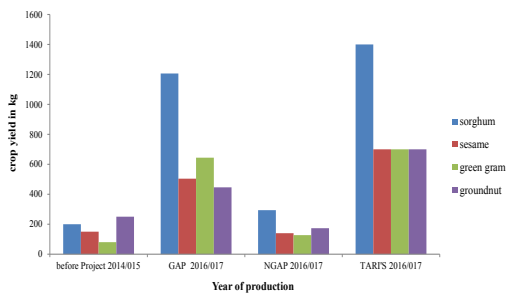

Figure 9: Average crop production in kg/ acre

The proportion of households experiencing hunger for two to three months declined over the period of five years from 58% during baseline to 16% in 2017 most notably during the years when the GAP were introduced by the project 2015 – 2017 (Fig. 10).

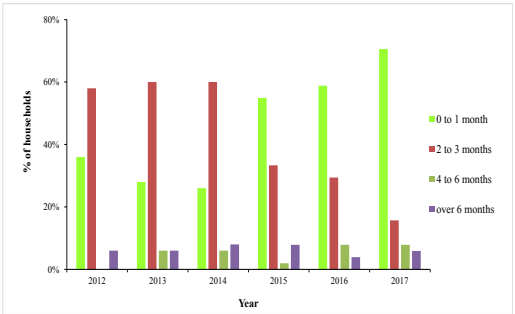

Figure 10: Number of months in a year where households experienced hunger

Conclusions

The current study provide an insight on usefulness and adoption of the technology in addressing the nutrition and food security problem existing in rural resource poor settings. Introduction of improved seed resilient to poor rainfall condition including sorghum, green gram and ground nuts as observed in this study can rescue a substantial number of the households suffering from food insecurity. Reduction in the number of months the households experience hunger from 2-3 (60%) to 0-1 (71%) after intervention is substantial evidences on how simple technology like GAP can contribute in reduction of food and nutrition insecurity in areas experiencing log dry period and poor rainfall. Increase in crop production indicated an improvement in nutrient cycling whereby a good number of households fed the chicken with crops as the supplements to meet the need of the increased number of chickens following reduction in chicken mortality.

Chicken vaccination against ND reduced significantly the morbidity and mortality attributed to ND leading to an increase in flock size kept by the households. In addition at the end of the project, ND was no longer predominant reason for most of the household not keeping the chicken as mention by most participants. This further indicates ND as the important bottleneck towards improvement of village poultry in the country though the available solution to the problem which has been tested in this current study is effective and produce immediate and remarkable results.

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