

Research

Small-scale egg and orange-fleshed sweet potato production and utilisation in selected communities in Ghana: A mixed-methods study

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Background

Nutrition-related exposures during the first 1,000 days of life are a predictor of health outcomes later in life. World Vision Ghana's 'Improved Feeding practices for the 1,000 days' (IFP) project aimed to improve dietary practices of women and children utilising an integrated intervention approach including nutrition, health, and agriculture strategies.

Objective

This paper reports on the production and utilisation of orange-fleshed sweet potatoes (OFSP) and eggs for improving diets of women in reproductive age and young children during the first 1,000 days of life.

Methods

Primary data from Kassena-Nankana West (KNW), Sekyere East (SE) and Kintampo South (KS) districts were triangulated with project routine data for this analysis. Univariate analyses of quantitative data from baseline and implementation monitoring data were conducted to describe the sociodemographic characteristics of beneficiaries, inputs disbursed, outputs produced, and utilisation of the food commodities. Qualitative interviews from 61 participants were transcribed, coded, and thematically analysed; these were triangulated with the quantitative data to capture main themes and findings.

Results

OFSP and egg production and consumption increased annually across beneficiary communities. In 2021, 100% of OFSP produced was consumed in KS; in SE, 95.0% was consumed and 5.0% lost to post-harvest losses. In 2022, 90% OFSP produced in KNW was consumed and 9.0% sold. In KS, 90.3% was consumed and 9.0% sold. In SE, 82.3% was consumed and 17.1% sold. Egg production at the end of the first production year (2022) was 18,720 crates in KNW, 19,680 crates in KS and 40,128 crates in SE. Egg consumption in sample households was less than 10% in 2022 and showed a decreased trend in the first half of 2023. In SE and KS, egg and OFSP production, respectively, increased, exponentially; sale for income was the most common mode of utilisation in eggs but OFSP was consumed in these districts. In KNW, climate, irrigation and socio-cultural barriers hindered the maximal production and utility of the produce, which was not observed in SE and KS, which did not have any of these identified barriers. Reported unintended benefits of production and utilisation included increased household income, food security, and availability of organic manure as a side-product of poultry.

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Conclusions

The IFP project resulted in increased household level production, use and distribution of Eggs and OFSP across the three focal districts. Similar settings may benefit from this intervention by adapting the strategies to become easier for beneficiaries to better cope with likely potential barriers such as poultry mortality and water scarcity.

INTRODUCTION

There is substantial evidence on the importance of nutrition-related exposures during the first 1,000 days of life (from conception to 24 months after birth), and its implications for subsequent health and nutrition outcomes (UN, 2015; UNICEF, 2019a). During the first 1,000 days, appropriate nutrition is associated with optimal cognitive and physical development and reduced the risk of stunting and wasting (WHO, 2020). In the absence of appropriate interventions, children experience sub-optimal intake of essential nutrients during this critical period of rapid development. This situation of sub-optimal diet can have detrimental health implications including elevated risks of impaired growth, infections, and deficits in neurological development during early childhood, as well as higher risks of later onset of metabolic and cardiovascular disorders (UNICEF, 2019b; WHO & UNICEF, 2021). Unfortunately, a substantial proportion of children, especially in low-resource contexts experience malnutrition in all its forms during this period due to multiple factors including exposure to poverty, suboptimal diets, infections, and inadequate childcare (UNICEF, 2019a).

A combination of nutrition-specific and nutrition-sensitive interventions are necessary for addressing undernutrition, in line with the malnutrition conceptual framework developed by UNICEF (UNICEF, 2018). Nutrition-specific interventions address the immediate determinants of malnutrition, which are diseases, and sub-optimal diet quality and quantity (Gillespie et al., 2013). Nutrition-sensitive interventions, conversely, address the distal underlying determinants of malnutrition, and include strategies for addressing household food insecurity, potable water access, environmental hygiene services, health care services, and social protection services (Ruel et al., 2018). While there is robust evidence on the effectiveness of nutrition-specific interventions in general, evidence on the effectiveness of specific nutrition-sensitive interventions is relatively nascent and insufficient (Ruel et al., 2018).

Previous studies have demonstrated the benefits of nutrition-sensitive agricultural strategies for addressing malnutrition in Ghana. In the Upper Manya Krobo District of Ghana, the *Nutrition Links* project implemented an integrated intervention in which women living in households with young children were trained to cultivate a home garden and to rear poultry (Atuobi-Yeboah et al., 2016). Beneficiary households received technical assistance and inputs to cultivate a variety of nutrient-rich crops (including orange-fleshed sweet potatoes (OFSP)). They were also provided with inputs to raise 30-40 chickens for their eggs. Over a 12-month period, beneficiary households reported a higher likelihood of meeting minimum dietary diversity scores, compared to control households who did not receive the intervention. The intervention households also reported a higher availability of eggs in the household compared to control households. Furthermore, children living in intervention households recorded a lower

likelihood of stunted growth compared to those in control households. This, and findings from similar studies in other settings demonstrate good prospects for leveraging nutrition-sensitive agriculture strategies for addressing malnutrition in women and children, particularly, those that involve increased supply of OFSP and eggs (Sharma et al., 2021).

OFSP is regarded as an excellent food source due to its extensive nutritional value, relative low cost in several contexts, and ease of growth (Laurie et al., 2018; Stathers et al., 2018). Nutrients available in OFSP include carbohydrates, vitamin A precursor (beta-carotene), vitamins C and E, several B vitamins, iron, zinc, potassium, and fibre (Neela & Fanta, 2019). Disability adjusted life years (DALYs) saved from consumption of OFSP, as demonstrated by a study conducted in Uganda, are ranked highly cost-effective by World Bank standards (Meenakshi et al., 2010). Furthermore, most OFSP varieties can be cultivated and harvested approximately four months after planting in a wide variety of soils, making it an important food security crop (Stathers et al., 2018). Interestingly, the plant's leaves and stems are edible in addition to the root tubers, and can be consumed in a wide variety of preparations which are appealing to populations of all ages, making it a comparatively high value crop relative to other commonly grown plant food sources in Africa (Nyathi et al., 2019).

The utilization of eggs as a key source of nutrition for pregnant or lactating mothers and their children is supported by robust evidence (Marquis et al., 2018; Iannotti et al., 2014; Lutter et al., 2018; Macmillan, 2019). Eggs are one of the most excellent sources of multiple nutrients in recommended quantities; one boiled 50g egg averagely contains 7g of protein and 5g fat out of which 1.6g is saturated fatty acids at a caloric count of 75. In addition, eggs are rich in key nutrients including essential fatty acids (EFAs), particularly docosahexaenoic acid (DHA), which is critical for early brain and visual development during pregnancy and early childhood (Hoffman et al., 2004; Riediger et al., 2009). The cholesterol provided by eggs during early pregnancy is essential in the biosynthesis, implantation, and vascularization phases of placental development, if eaten in moderate quantities (Lutter et al., 2018).

Additionally, eggs are, demonstrably, a useful source of choline, and vitamins A and B12, which are commonly deficient in diets of low-income populations (Papanikolaou & Fulgoni, 2018; Zaheer, 2017). This is especially important, as the unit price of eggs is relatively low compared to other animal source foods, rendering eggs a much more cost-effective source of nutrients. As a source of income, nutrition interventions that promote the rearing of poultry and consequent production of eggs have recorded positive outcomes among beneficiaries, extending beyond nutritional benefits, to household income and community food security benefits (Atuobi-Yeboah et al., 2016; Dumas et al., 2016). thus, both eggs and OFSP are important sources of nutrients

for infants, mothers and by extension, entire communities. However, there is limited evidence on scaling up the implementation of strategies that involve these nutrient-rich foods.

In 2020, World Vision Ghana (WVG) initiated implementation of an integrated nutrition and agriculture intervention in Ghana across three districts: Kassena Nankana West (KNW), Sekyere East (SE), and Kintampo South (KS). The project, known as '*Improved feeding practices for the first 1000 days (IFP)*,' aimed to improve feeding practices among women of reproductive age (WRA), including pregnant and lactating women, and their children. This integrated intervention included three components as explained in other papers in this series of publications (Kushitor et al, 2024; Donkor et al, 2024; Konlan et al., 2024 forthcoming). This paper describes, in detail, the component which involved promotion of household-level cultivation of fruits and vegetables in backyard gardens, as well as poultry rearing and egg production. Additionally, social behaviour change communication (SBCC) was provided to mothers and community male champions on dietary quality, and capacity building provided at the community level. The objectives of this paper are to analyse the production of OFSP and eggs and their modes of utilisation among the project beneficiaries using both qualitative interview approaches and quantitative data. The paper also details the challenges associated with the production and utilisation of OFSP and eggs in this project.

METHODS

STUDY DESIGN AND SETTING

This study used a mixed-methods implementation research approach to describe activities and outcomes of the IFP project. The IFP project was implemented between September 2020 and August 2023. The three districts were prioritized by WVG due to their nutritional vulnerability.

STUDY POPULATION & SAMPLING

The project's direct beneficiaries included 5,520 targeted women of reproductive age including pregnant and lactating women, and 4,900 children who were selected based on predetermined criteria including their nutritional vulnerability and socio-economic status.

RESEARCH VARIABLES

Cross-sectional quantitative assessments were conducted at baseline, midline and endline to examine several indicators. In this paper we report only on those related to production and utilization of eggs and OFSP.

STUDY INTERVENTION

Following the baseline assessment, an integrated intervention was implemented which included distribution of nutritional supplements, cultivation of fruit trees, behaviour change communication and cooking demonstrations. In this article, we focus on aspects of the intervention related to the cultivation of sweet potatoes and poultry production. At baseline, an average of twenty (20) day-old layer birds were supplied to 1,318 direct beneficiaries in addition to inputs including poultry feed and Aluzinc materials for roofing the poultry pens. Egg production was measured in crates with each crate being equivalent to 30 eggs. OFSP inputs were delivered in the

form of vines, farming equipment and weedicides. Output of OFSP was weighed in kilograms. The input and output data were recorded as part of routine project data utilising an electronic monitoring and evaluation system.

DATA COLLECTION

Data analysed in this manuscript included routine program data collected over the duration of the project. The routine data relevant for this study included data on the number of participants reached, and the inputs provided for OFSP cultivation, and poultry rearing towards egg production. Routine project data retrieved also included the amounts of OFSP and eggs that were produced and their individual utilization data.

In addition, qualitative data were collected using in-depth interviews with both direct and indirect beneficiaries of the IFP project, as well as key WVG project implementation staff, and district level staff of government agencies. In addition, direct intervention beneficiaries, indirect beneficiaries, male champions, mother-to-mother support group facilitators, and community health volunteers were interviewed to understand the production processes of eggs and OFSP as part of the project. Data collection for the qualitative component of the study was conducted between June and July 2023, as described by Kushitor et al, 2024. These interviews aimed at understanding the theory of change of the project, roles of key stakeholders, design and implementation of the intervention, and perceived changes in dietary and nutrition status.

In addition to obtaining other data, the interviews with beneficiaries focused on the utility of the eggs and OFSP by the primary producers as well as secondary beneficiaries within the project communities. Interviews also focused on challenges experienced during implementation of the project and the lessons learnt from the production of OFSP and eggs.

The in-depth interviews were audio-recorded with permission from the interviewed participants. The interview guides were administered by a trained interviewer, with translation assistance from an expert translator, if the interview respondent could not speak English. A note-taker participated in each interview to document nuanced proceedings of the interviews as well as to audio-record the proceedings.

DATA QUALITY ASSURANCE

Data from the qualitative interviews were transcribed verbatim. The transcripts and interview notes were iteratively read by the authors for thorough immersion and understanding of the explicit and nuanced responses of participants. Field notes which were documented by a notetaker during the interviews were also consulted to comprehensively to understand the nuances of the themes and quotes. The use of both quantitative and qualitative data served to triangulate the information from both sources as a form of validation and to provide a better contextual understanding of the data.

DATA ANALYSES

The various sources of data were triangulated and synthesized to validate findings. The quantitative data were analysed using STATA version 16. The analyses investigated the quantities of agricultural inputs disbursed to beneficiaries, the quantity of produce harvested, and the

different ways in which it was utilized. The interview transcripts were exported into ATLAS.ti data analysis software for coding and thematic analysis. Codes were organized according to the implementation framework and grouped according to major recurrent themes. Outlier and divergent themes were also identified from the coding process. Where relevant, compelling verbatim quotes from the transcripts were retrieved to illustrate themes from the qualitative data and trends from the quantitative data.

ETHICS

Ethical approval for this study was obtained from the Noguchi Memorial Institute for Medical Research (NMIMR) Institutional Review Board (Ref: 073/22-23).

RESULTS

SOCIO-DEMOGRAPHIC CHARACTERISTICS

A total of 1,318 direct beneficiaries were included in the OFSP and poultry component of the IFP project. The age range of direct beneficiaries was between 15 and 49 years with an average age of 30 years across the three districts.

INPUTS

POULTRY

Table 1 presents the poultry-related inputs disbursed to beneficiaries and losses to mortality from 2021 to mid-2023.

Table 1. Poultry inputs and losses to mortality (2021-2023)

Community	Chickens starting year	Mortality (n)	Mortality (%)	Chickens ending year
2021				
KNW	3600	0.0	0.0	3600
KS	3150	63.0	2.0	3087
SE	3750	112.0	3.0	3638
Total	10500	175	1.7	10325
2022				
KNW	5200	1376	26.5	3824
KS	6750	1312	19.4	5438
SE	7500	1317	17.6	6183
Total	19450	4005	20.6	15445
2023				
KNW	3824	1973	51.6	1851
KS	5438	1382	25.4	4056
SE	6183	1058	17.1	5125
Total	15445	4413	28.6	11032
Overall Total	45395	8593	18.9	36802

KNW- Kassena Nankana West; SE- Sekyere East; KS- Kintampo South

ORANGE-FLESHED SWEET POTATO

Table 2 presents the disbursement of vines across the three districts. There was no production of OFSP vines for KNW in 2021 as the planting season in the district had passed when the vines were procured. Overall, the project disbursed 645,050 vines across the three districts between 2021 and mid-2023.

Table 2. Orang-Fleshed Sweet Potato vine distribution in the three districts (2021-2023)

	Communities			Total
	KNW	KS	SE	
Vines received				
2021	0	34650	41,250	75,900
2022	39,650	100,000	150,000	289,650
mid-2023	104,500	96,000	79,000	279,500
Total				645,050

KNW- Kassena Nankana West; SE- Sekyere East; KS- Kintampo South

The capacity of beneficiaries was enhanced to enable them construct poultry pens and farm beds for rearing chickens and cultivating OFSP, respectively. Beneficiaries received inputs including roofing sheets, poultry feed, vaccines, dewormers and weedicides to support these activities. They also received training and technical guidance from the district agricultural extension officers towards completion of these tasks, and to mitigate any challenges that arose. Two beneficiaries shared information on the tangible and intangible inputs they received:

“The support we received was in the form of roofing sheets to roof the structure, but I did the building and plastering myself.” - Direct Beneficiary, KNW

“Yes, we received feed for the poultry on two (2) occasions. Thereafter, I used the money from the sale of the eggs to buy feed for them.” -Direct Beneficiary, KS

PRODUCTION

EGGS

Egg production commenced in 2022 as the chickens received were not at laying maturity when they were distributed in the latter part of 2021. A total of 78,528 crates of eggs (30 eggs per crate) were produced in 2022 but only 17,256 in 2023. Figures 1 and 2 describe egg and OFSP production trends, respectively, across the project life time.

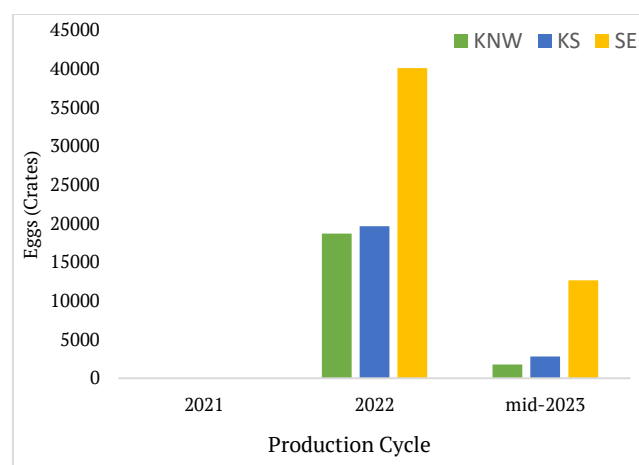


Figure 1. Egg production trends across the three intervention districts (2021-2023)

KNW- Kassena Nankana West; SE- Sekyere East; KS- Kintampo South

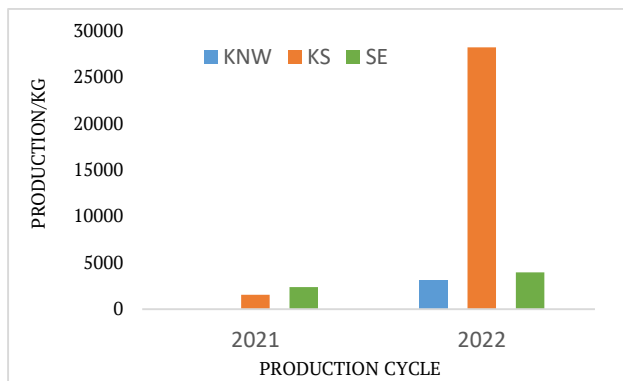


Figure 2: OFSP Production across districts (2021-2023)

KNW- Kassena Nankana West; SE- Sekyere East; KS- Kintampo South

UTILISATION

EGGS

A visual presentation of the various means of utilization of eggs is presented in Figure 3.

Egg production began in 2022. A total of 6,840 (8.7%) crates of eggs were consumed by the beneficiaries and their households. As shown in the figure, in addition to sales and consumption, some eggs (a total of 2.4%) were donated to Child Welfare Clinic participants who are mostly pregnant or post-partum women with young children.

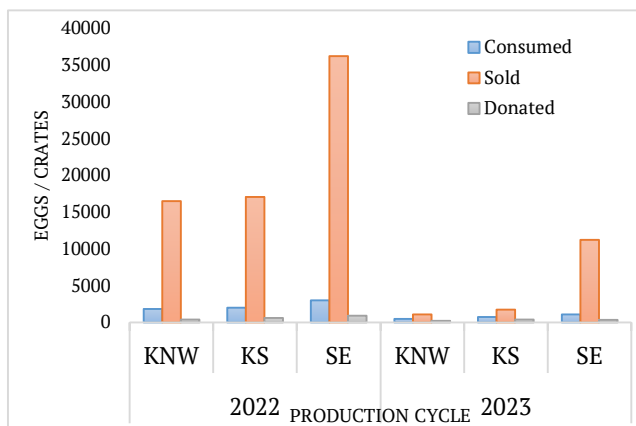


Figure 3: Utilisation of eggs in KNW, KS & SE districts (2022-mid 2023)

KNW- Kassena Nankana West; SE- Sekyere East; KS- Kintampo South

Beneficiaries described the different means by which they utilised the eggs. Some of the beneficiaries prepared the eggs in a variety of recipes for household consumption. A woman from KS said:

“I cook some for my children and sometimes for us the adults. I also give some to my relatives and sell the rest so that I can use the money to buy feed for them. I also use money from the sale of eggs to support household expenditure and to foot hospital bills if any of my children falls sick.” - Direct Beneficiary, KS

Reported egg use was confirmed by the health providers. In the health provider interviews, some professionals described the following situations:

“... for my place we have our big gatherings on Tuesdays and Thursdays, so the eggs were brought sometimes on Tuesdays and Thursdays and were given to the women directly, not for cooking demonstrations.” -Community Health Nurse, KNW

“Since the beneficiaries started sharing eggs in the communities, especially at the weighing centres, people now have access to eggs and use them or incorporate them in their diet.” -Agricultural Extension Officer, KS

Orange Fleshed Sweet Potato

Figure 4 presents the different forms of utilisation of OFSP in the districts. Out of the crops harvested in each district in 2021, beneficiaries from KS consumed the entire harvest whilst SE beneficiaries consumed 2280 kg (95.0%) of the harvest with their households; the remainder was lost to post-harvest handling losses. None was produced in KNW due to delays in receiving inputs in time for the growing season. A small proportion then went for sale in 2022.

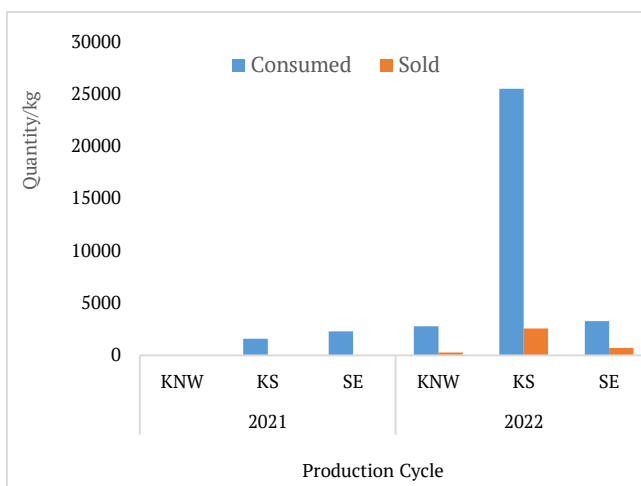


Figure 2: OFSP Utilisation in KNW, KS & SE districts (2021-2022)

KNW- Kassena Nankana West; SE- Sekyere East; KS- Kintampo South

DIETARY DIVERSITY

To promote improved feeding practices, training of service providers, and food demonstration activities were implemented in the communities to encourage adaptation of locally available ingredients to improve dietary diversity and nutrition. The OFSP was used in a variety of ways by beneficiaries including as sweetened drinks and teas, cooked alone in a variety of methods, or incorporated as an ingredient in common local dishes. Both beneficiaries and health providers shared their experiences with dietary diversity promoted by the availability of OFSP and eggs in the community saying:

“They taught us that when we able to plant the Abrojuma [OFSP] and it’s able to grow successfully, the leaves can be cooked and used as tea for the children to drink. Also, the seed can also be sliced in pieces and added to oil, when the rice is about to be ready on fire the sliced pieces will be placed on it and when the rice is ready, you then stir the sliced pieces with the rice. It is very nutritious compared to eating of the rice raw

which is not good. Secondly when you are preparing soup you can grind it and mix it with the soup. It looks exactly like ground cocoyam leaves, and one will not notice it's Abrojuma that was used in preparing the soup" -Direct Beneficiary SE

"Since the beneficiaries started sharing eggs in the communities, especially at the weighing centres, people now have access to eggs and use them or incorporate them in their diet. They have now gotten used to using eggs in their meals so even when no eggs are shared, they get some for themselves. Additionally, the poultry intervention under the project has ensured that there is abundant supply of eggs in the community so people now have easy access to it, and they can now incorporate them in their diet. Even when the project ended, people are willing to continue rearing the poultry so there is an assured supply of eggs even in the future. Also, the introduction of the OFSP has proved very beneficial. They have been trained to use it to prepare their local dishes, so for instance, they use it to prepare banku (a fermented maize meal dish), and they add it to their rice dishes. Even the leaves are used for soups and stews and it's very nutritious. This was not known to us before the project. The good thing is that they cultivate it themselves so even after the project, they can continue using it to improve their diet."

-Agricultural Extension Officer, KS

IMPROVED NUTRITIONAL STATUS

Reports of improved nutritional status stemming from the consumption of the OFSP, and eggs were shared by both the beneficiaries and implementing staff. Beneficiaries indicated how the consumption of the OFSP had led to improved health and healthy weight gain among their children. The community-level health providers also attested to how nutritional status among community members has been elevated directly because of consuming eggs from the poultry production:

"The eggs and the leaves and crops of the OFSP has led to improved health of my children, especially, the younger one who has now gained a lot of weight ever since we started feeding him these foods. Our family now has food in abundance, and we make some extra income from the sale of eggs." -Indirect Beneficiary (Husband), KS

"They now eat nutritious food because World Vision and World Bank brought a project, so because of the project they brought, they were made to plant potatoes, they brought them fowls. So due to that, initially when a child is eating, it is difficult for the mother to buy the child egg, but due to the fowls they brought, their nutrition status has become good. In a week, they can eat about 3 eggs, so when they come for weighing, it is good, they also use the potatoes to prepare food for them to eat, same as the leaves."

-Community Health Nurse, SE

UNINTENDED CONSEQUENCES

In addition to the dietary and nutritional benefits, there

were unintended beneficial consequences that arose out of the poultry production. Whilst some beneficiaries encountered emotional benefits expressed as a sense of personal fulfilment and pride from their produce, others also received tangible benefits from using manure from the poultry as organic fertilizer for their farms and gardens. A beneficiary shared:

"... I collected the droppings and applied them on my maize farm. The maize grew well. I even demarcated a small portion, sowed maize, and applied the droppings, which yielded very well. The place was too small, yet I harvested two basins. I believe the droppings have more benefits than anything." – Direct Beneficiary, KNW

Another unintended consequence was shared by a beneficiary in KS who described how the rearing of birds had expanded into a full-scale business which yields additional income for her husband:

"My husband now rears his own birds because he took some of the eggs my chicken laid, had it incubated and hatched, and so he now has an additional source of income. If you see the birds he has, it's a sight to behold. That is a thing of joy to me." -Direct Beneficiary, KS

IMPLEMENTATION CHALLENGES

The production of eggs and cultivation of OFSP were linked with some challenges. Those most often described were mortality of the poultry, the cost of feeding the birds and unfavourable weather conditions which made irrigating the OFSP crops necessary. Mortality of the birds generally increased across the districts from 2021 to mid-2023 (Table 1). In 2021, only SE reported losses of OFSP (120 kg: 5.0% of the district production). These losses were due to theft and/or spoilage. However, these losses were a very small proportion of production. A beneficiary shared her experience of the losses:

"The major challenge with poultry was their feed. If you don't feed them well, they will not lay eggs as they are supposed to... the main challenge associated with sweet potatoes is the lack of water to sustain them all year round, especially during the dry season. It is difficult to get enough water." -Direct Beneficiary, KNW

This was also confirmed by an agricultural extension professional in the KS district

"It was good. The first batch, it was good. It was the poultry that we had some issues with the mortality in the first batch. When we received the birds, they were supposed to be vaccinated at various stages of growth, but I believe because of the stress of transportation and the uncertainties of implementing their newly gained knowledge, we experienced some mortality across the district. But we didn't experience any such incidents in the second batch of birds distributed because the beneficiaries learnt from the earlier experience. The vaccination was timely so there were no deaths." - Agricultural Director, KS

There were also challenges faced during the initial implementation of the intervention, particularly in KNW, due to existing socio-cultural myths concerning the consumption of eggs and OFSP, especially with reference to diets of children and pregnant women. In most of the communities, OFSP was thought to be detrimental to the health of pregnant women and children. Consumption of eggs was also believed to be associated with theft in children. This was expressed by a direct beneficiary and male champion in the interviews:

“Whenever potatoes were mentioned, people used to say they were bad for children and pregnant women. We didn’t know the benefits of potatoes until they were introduced in our community.” -Direct Beneficiary, KNW

“But apart from that, we don’t; it has now, some tradition has been broken when they say if you give the child an egg, he becomes a thief is no more there.” -Male Champion, KNW

DISCUSSION

This paper reports on the production and utilisation of eggs and OFSP by beneficiaries in the IFP project as well as to document the lessons learned during implementation. Nutrition-sensitive agricultural interventions, involving the production and consumption of eggs and OFSP were conducted in this study. Prior studies on similar strategies have demonstrated improvement in maternal health and child development, especially in LMICs (Iannotti et al., 2014; Lutter et al., 2018; Macmillan, 2019; Nyathi et al., 2019).

Trend analyses from the quantitative program data revealed a general increase in the production and consumption of eggs by children and mothers, over time, across districts, with substantial regional variations. The increase in production and consumption was also corroborated by the beneficiaries in explaining how they utilised the produce and its observed effect in their diets and health. The increase in egg consumption has potentially rewarding implications for the direct and indirect beneficiaries, as egg consumption has been associated with health benefits among diverse populations. In addition to dietary improvements, egg production conferred an additional benefit of income generation for the beneficiaries and their households. Egg production in the second year of the intervention was generally high, especially among beneficiaries in the SE district who recorded exponential scale ups in production, and a commensurate increase in household consumption and sale of the leftover produce. The beneficiaries in this district, especially, shared how they had expanded the household production to small-medium scale agribusinesses. However, current trends from the earlier half of the third year show a declining production of eggs especially in KNW and KS, with corresponding increasing proportions of poultry mortality in those districts. The multiple benefits of improved household diet and increased earnings stemming from the production of eggs resonates with earlier intervention studies which also recorded both improved dietary, and household financial security from the production of laying birds, without any additional food provision interventions (Adams et al.,

2018; Marquis et al., 2018).

Incorporation of OFSP into the communities’ diet has also been credited with improved dietary diversity in the community, from shared viewpoints of both provider and beneficiaries. It is also apparent that the communities associate OFSP with optimum nutrition, consider it a delicious food which is relatively easy and stable to cultivate, and can be incorporated into diets in numerous ways. This was especially remarkable in KNW where the crop is not a local staple and prior to the implementation of the intervention, was not typically consumed. This positive adaptation of OFSP as a staple food has also been recorded in previous studies in other contexts (Laurie et al., 2018; Nyathi et al., 2019; Stathers et al., 2018). The crop has also become associated with desirable nutritional and health benefits for community members of all ages, consistent with existing literature from other developing countries (Neela & Fanta, 2019; Nyathi et al., 2019; Stathers et al., 2018).

Production and consumption of OFSP across the districts were facilitated or hindered by various localised factors. In KNW, the slips were not received in time for the planting season in 2021, leading to no production in the first year. Moreover, the crop is not traditionally consumed in this district, as there are cultural dietary perceptions about consuming the crop. This may be an underlying factor why the district produced the least amount of OFSP and consumed the least relative proportion, compared to the other two districts, where no such socio-cultural restrictions exist. Contrastingly, OFSP is very similar to the indigenous tuber crop of KS, yam, which is one of the district’s biggest contributions to Ghana’s economy. Indeed, OFSP has relatively less growth requirements than yam, possibly making it a preferred cultivar for the beneficiaries. It is evident that this contributed to the relatively exponential growth in OFSP cultivation and consumption in KS.

In SE, several of the beneficiaries adopted a breeding strategy, as described in the qualitative interviews, allowing them to multiply the quantity of poultry, and consequently, the number of eggs produced. This is a contributing factor to the impressive increase in poultry and egg production observed in the district in the second year of production. Indeed, the district has ideal geographical conditions for the sustenance of the breeds of poultry provided, being in the relatively temperate regions of Ghana’s lower belt. Farther up north in KNW, the dry and arid climate proved unfavourable to the sustainability of the birds, which was a major complaint of the interviewed beneficiaries in that district. This is evident in the increasing mortality of the birds in that district across the project period.

These interventions have additionally helped to address and overcome existing myths in the communities about OFSP and egg consumption which also exist in many developing contexts and are found to be a hindrance to early childhood nutrition and development (Iannotti et al., 2014).

STRENGTHS AND LIMITATIONS

The strengths of this manuscript lie in the adaptation use of a participatory approach in its development, utilising technical input from various stakeholders to ensure that the diverse aspects of the program were captured. The study also utilised a mixed-methods design which promoted the validity of data collected by triangulating the results from both quantitative and qualitative sources of data. Additionally, the

qualitative component included participants who were direct and indirect beneficiaries as well as members of the implementation team, further strengthening the validity of the data employed. However, the study is not without limitations. Qualitative data from beneficiaries may have been biased by courtesy, which was mitigated by conducting the interviews in a confidential manner.

CONCLUSION

Overall, the egg and OFSP production and utilisation increased across the three districts following intervention, with geographic variations. Household consumption of the produce was high across the districts, with OFSP being highest in KS and eggs being highest in SE, both of which had favourable agrarian characteristics to support the production of these food elements. In KNW, however, irrigation challenges presented difficulties in producing OFSP whilst the climate was found to be quite harsh and unfavourable for the breed of poultry supplied, leading to high mortality rates. Apart from the household consumption of the produce, most of the beneficiaries were able to sell the excess produce for income or donate to community health centres as food support for infants and children from non-beneficiary households. Future programs should take into consideration the geographical and climatic profile of intervention regions in the design stage when procuring inputs. Interventions involving the provision of animals to communities where they are uncommon must include steps to avoid factors known to cause mortality, including veterinary services if possible. In the case of poultry, beneficiaries should be taught how to raise new layers from eggs to help them overcome problems of mortality. Future research would also be valuable in observing the longer-term effects of the intervention in

terms of sustainability for both nutrition and economic security.

AUTHOR CONTRIBUTIONS

The research question was conceived by RA. PB, SA, and RA contributed to the study design. Data collection tools were designed by HHH, WESD and RA. Initial analysis and coding were conducted by HHH, WESD, MK and RA. HHH wrote the first draft of the manuscript with routine critical reviews by RA. All authors then critically reviewed the following versions. All authors have read and approved the final version of the paper and its submission.

CONFLICT OF INTEREST

This research was funded by World Vision Ghana Country Office through the Improved Feeding Practices Project. RA was a member of the National Steering Committee of the Improved Feeding Practices Project. The authors declare that they have no conflict of interest.

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