Agricultural emergency response with potato and sweetpotato technologies for livelihood restoration of communities affected by conflict and other concurrent crises in Ethiopia

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Abstract

Armed conflicts and other concurrent crises that have been occurring in different regions of Ethiopia in the past couple of years have left behind a legacy of massive displacement and disruption of agricultural activities, exposing millions of people to various challenges, including food shortages, malnutrition, and loss of productive resources such as agricultural inputs. To restore the agricultural livelihoods of the communities affected by multiple crises, the International Potato Center (CIP) has designed and implemented emergency response interventions in collaboration with local partners since 2021. The projects aimed at strengthening farmers access to quality seeds and accompanying technologies of resilient and nutritious potato and sweetpotato varieties, improving the capacity and skills of the targeted households for effective utilization of these crops for food and feed, and strengthening the performance and resilience of local institutions serving these communities. A total of 112,046 households across 124 districts of seven regional states have benefited from the interventions implemented between 2021 and 2024. The interventions enabled access to high-quality seeds of more than 1062 metric tons of seed potatoes and 35 million sweetpotato cuttings by the households most affected by the crises. Moreover, the interventions supported decentralized seed multiplier (DSM) groups through building their capacity and equipping them with skills to produce good quality planting materials to ensure sustainable access to quality seeds by smallholders at a reduced cost and time. These DSMs have developed the capacity to multiply and supply

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over 37.2 million sweetpotato cuttings and more than 4090 tons of potato seed annually. Beneficiary farmers on average harvested 23.7 and 24.0 t ha^{-1} of potato tubers and sweetpotato roots, respectively, which is nearly double of what they used to obtain under traditional practices. These increased yields have contributed to availability of food to support families for four to five months. Farmers have also sold surplus potato and sweetpotato produces and seeds to generate modest incomes. Over twenty-four thousand women and mothers were trained on the utilization of orange-fleshed sweetpotato (OFSP) based products to ensure adequate vitamin A intake for children under two years of age. The practice of seed conservation has shown tremendous improvement among farmers, with those targeted with potato technologies were able to save up to 25% of their produce for seed. Consequently, farmers have started expanding their production on larger fields to reap the benefits of the resilient and cash generating crops in their path to self-reliance and livelihood restoration. This review highlights the major challenges encountered including those related to availability and access to quality planting materials of roots and tubers, inadequate seed market information, and insufficient coordination among seed system actors to timely and adequately respond to the needs of people affected by multiple crises. Key lessons learnt from the emergency response projects include the role of decentralized seed multiplication approach in addressing the needs of farmers in crises prone areas, integrating agriculture and nutrition interventions to enhance the uptake of nutrient dense crops such as OFSP, and the vital role of capacity building and sharing with local partners in sustaining results and ensuring continued implementation and monitoring of activities under conflict situations. Policy implications of the lessons and challenges will be highlighted so that more attention is provided to fully harness the potential of resilient and nutritious root crops in future emergency response interventions implemented by the government and humanitarian agencies.

Keywords: Agricultural emergency, decentralized seed system, multiple crises, orange-fleshed sweetpotato, potato

1. INTRODUCTION

According to the World Bank (2024) report, Ethiopia has been experiencing multiple shocks since 2018. The crisis has affected nearly all households across the country, with about 91 percent of the population experiencing persistent droughts, floods, armyworms and locust infestations, armed conflicts, or some combination of these. The country has been also recently experiencing severe and widespread conflict, particularly in the Tigray, Amhara, and Oromia regions. These conflicts have resulted in significant civilian casualties and the displacement of millions of people. According to OCHA (2024), over 4.5 million people were internally displaced in Ethiopia, conflict being the primary driver. Tigray hosts the highest number of IDPs, with an estimated 950,000 people remain displaced caused by the two-year armed conflict (OCHA, 2024). Other significant causes of displacement include drought and social tensions (IOM, 2023). These displacements have been exacerbated by a combination of natural hazards, such as droughts and floods, and man-made crises, including inter-communal violence and armed conflicts.

The conflicts in Ethiopia have had devastating effects on agriculture, significantly disrupting farming activities and food production. The widespread displacement of farmers has led to the abandonment of farmland, loss of livestock, and destruction of crops, severely reducing agricultural output. Usually, forced displacements caused by insurgency, communal clashes, and natural disasters generally resulted in reduced agricultural production due to lower land and labor productivity (Dhillon and Moncur, 2023). Additionally, the conflict has damaged critical infrastructure, such as irrigation systems and storage facilities, further hindering agricultural operations. A review made by Al Daccache et al. (2024) indicate that complex humanitarian emergencies, including conflicts, damage economic and social assets, limit access to land and water, destroy rural infrastructure, and weaken markets, all of which have a detrimental impact on food production, consumption, and distribution. A post conflict survey conducted in Tigray revealed that more than 75% of smallholder households in the region have lost their crops and livestock due to the conflict, highlighting the extensive damage to agricultural resources and the severe impact on food security (Manaye et al., 2023). In addition, farmers who remain in conflict-affected areas face numerous challenges, including

security concerns, lack of access to essential farming inputs like seeds and fertilizers, and labor shortages. These challenges have collectively resulted in lower crop yields and diminished agricultural productivity, deepening the humanitarian crisis in the region (IOM, 2023; OCHA, 2024). The combined impact of the conflict and other compounding crises have resulted in an estimated 26.3, 22.8 and 15.4 million people to be food insecure in Ethiopia (Statista, 2023; OCHA, 2024).

The frequent and co-occurrence of the manmade and natural crises have exacerbated the challenges faced by the affected populations to manage and recover from concurrent multiple crises. Additionally, the unavailability and rising cost of agricultural inputs, such as fertilizer and seeds, has worsened the situation. For instance, Abay et al. (2024) reported that from 2020 to 2022, fertilizer prices in Ethiopia surged by nearly 170%, making it harder for farmers to afford the essential input. This has led to reduced agricultural productivity, crop yield losses, and heightened food insecurity. The lingering effects of the COVID-19 pandemic have further diminished farmers' resilience, reducing their ability to adapt to these natural and man-made disasters. As a result, millions of people have been facing food shortages, malnutrition, and loss of productive resources, leaving them reliant on emergency humanitarian responses including food aid. The multiple crises have also led to undernutrition and high rates of malnutrition among vulnerable populations owing to disruptions of agricultural activities and limited access to nutritious food. Several studies conducted recently (Gebreegziabiher et al., 2024; Belew et al., 2023; Yehuala et al., 2023) reported high rates of malnutrition among vulnerable groups including PLW and children in conflict areas of Tigray, North Gondar and North Shewa Zones of Amhara region.

To restore the agricultural livelihoods of the communities affected by multiple crises, the International Potato Center (CIP) in collaboration with local partners has designed and implemented crop emergency interventions since 2021. The goal of the projects was to contribute to improved food and nutrition security of farming households most at risk to food insecurity in vulnerable communities across seven regional states of Ethiopia: Amhara, Oromia, Southern Ethiopia, Central Ethiopia, Sidama, Somali**,** and Tigray. The projects intended to support the transition to self-reliance by strengthening farmers' access to quality seeds and resilient, nutritious potato and sweetpotato varieties. The interventions also thrived to enhance the capacity and skills of the target households to effectively utilize these crops for both food and feed. Additionally, the performance and resilience of local institutions and enterprises that serve these communities were strengthened to sustain results and improve their capacity to respond to similar crises in the future.

This paper primarily aims at highlighting how the emergency response interventions were designed and implemented to address the urgent needs of the communities affected by the multiple crises, the key achievements in enhancing smallholders access to inputs, enhancing their skills to produce and utilize potato and sweetpotato, and thereby improve their food security and their transition to self-reliance. In addition, key lessons learnt from the crop emergency response intervention including the role of decentralized seed multiplication approach in addressing the needs of farmers in crises prone areas, integrating agriculture and nutrition interventions to enhance the uptake of nutrient dense crops, and the crucial role played by local implementing partners in ensuring continued implementation and monitoring of activities under active conflict situation will be shared. Finally, policy implications of the lessons and challenges are highlighted calling for more attention to be provided to fully harness the potential of resilient and nutritious root crops in future emergency response interventions implemented by the government and humanitarian agencies.

2. DESIGN OF THE INTERVENTIONS AND IMPLEMENTATION MODALITIES

The design and implementation modalities of crop emergency response interventions were based on a structured approach developed following multiple steps. First, a comprehensive needs assessment was conducted through reviewing reports of multi-agency seasonal assessments, the Humanitarian Needs Overview (OCHA, 2024), Famine Early Warning Systems Network (FEWS NET), and Integrated Food

Security Phase Classification (IPC). These assessments evaluate the impacts of conflict and other crises on food security, agricultural production, and community livelihoods, identifying areas most affected by crises and with high demand for emergency seed aid.

The multi-agency seasonal assessment in Ethiopia is led by the regional Disaster Risk Management (DRM) Bureaus, involving government and non-government humanitarian actors operating in the regions. It measures the impact of seasonal rains on crop yield, overall food and nutrition security, and other critical factors. Data collected includes current season/year crop and livestock production, price data, changes in livestock holdings, and resource availability (Amare et al., 2024). The assessment provides valuable insights into areas facing high levels of food insecurity and need for seed assistance, guiding decisions on emergency assistance implementation. It identifies the most affected zones and districts, the number of food-insecure households, and the quantity of seed required, though often in bulk quantities without crop disaggregation. The targeting strategy including beneficiaries of quality planting materials of potato and sweetpotato and the quantities to be delivered was determined through discussions made with the respective regional Bureau of Agriculture (BoA).

Based on the need assessment, CIP identified the types of emergency responses required and estimated the necessary inputs, including seeds for different crops needed to meet the demand in the affected areas. CIP engaged regional and zonal Bureaus of Agriculture to prioritize the districts and kebeles most impacted by the crises, to ensure targeted interventions. The suitability of potato and sweetpotato technologies was evaluated for the prioritized districts and kebeles to ensure maximum performance of the crops and benefits to the target households.

Following project proposal approvals, inception and planning meetings were organized engaging all pertinent stakeholders from target regional states. These meetings primarily aimed at creating sense of ownership through familiarizing the project goal and activities among implementing partners, viz., Bureaus of Agriculture (BoA), Bureaus of Health (BoH), NGOs, research institutes, and seed multipliers. With the active participation of representatives of the implementing partners, work plans were enriched, roles and responsibilities assigned, and resource requirements were determined taking in to account the specific contexts of the target districts. Considering anticipated challenges and potential technical and operational risks, a risk management matrix was developed with partners/humanitarian agencies to help mitigate risk and implement the project in such fragile environments. The inception meetings were also used to validate the appropriateness of crop technologies proposed and target districts and kebeles selected, and criteria to be used for beneficiary household selection are agreed upon among the participants.

The implementation of the emergency response interventions involve collaboration among several partners including, BoA, BoH, research institutions, and the private sector. The regional BoA serves as the main implementing partner facilitating beneficiary selection, seed distribution, and provision of technical backstopping to farmers, whereas the BoH supports in deploying health extension workers to roll out training on nutrition knowledge and preparation and utilization of OFSP based food products. Research institutes such as Tigray and Amhara Agricultural Research Institutes involve in the supply of early generation seed, demonstration of technologies, and provide resource persons and facilities for training activities. Tissue culture centers, seed grower cooperatives, and the private sector were engaged in the multiplication and supply of different classes of seeds of improved potato and sweetpotato varieties. Monitoring and data collection were jointly conducted by BoA structures and CIP to track progress and impact. Baseline survey and final project evaluations were carried out by independent researchers to monitor changes achieved and track key project performance indicators.

The specific objectives pursued by crop emergency interventions were: i) improve access to quality planting material of resilient and nutritious potato and sweetpotato varieties among HHs affected by conflict to resume potato and sweetpotato production and build their resilience against future shocks, ii) improve smallholder farmers' skills and knowledge on the production, post-harvest handling practices, and utilization of biproducts of the two crops, iii) improve nutrition knowledge and disseminate supportive technologies to enhance consumption in households most affected by crises, including lactating mothers and children under two years of age, and iv) coordinate and support the generation, documentation and leveraging of best practices and learnings from the project for application to similar future crises. The **theory of change** of the crop emergency response intervention can generally be summarized as follows. If households affected by drought and conflict in Ethiopia have access to quality planting material of potato and sweetpotato, skills to produce, store and utilize the products and biproducts effectively as food and feed, have knowledge and skills to include nutrient-rich food into diets of particularly women and young children, and have access to quality extension services in a supportive environment, then these households will be capacitated to transition to self-reliance in terms of food and nutrition security, resulting in increased food availability, incomes and improved nutritional status, and a more dignified life (Figure 1).

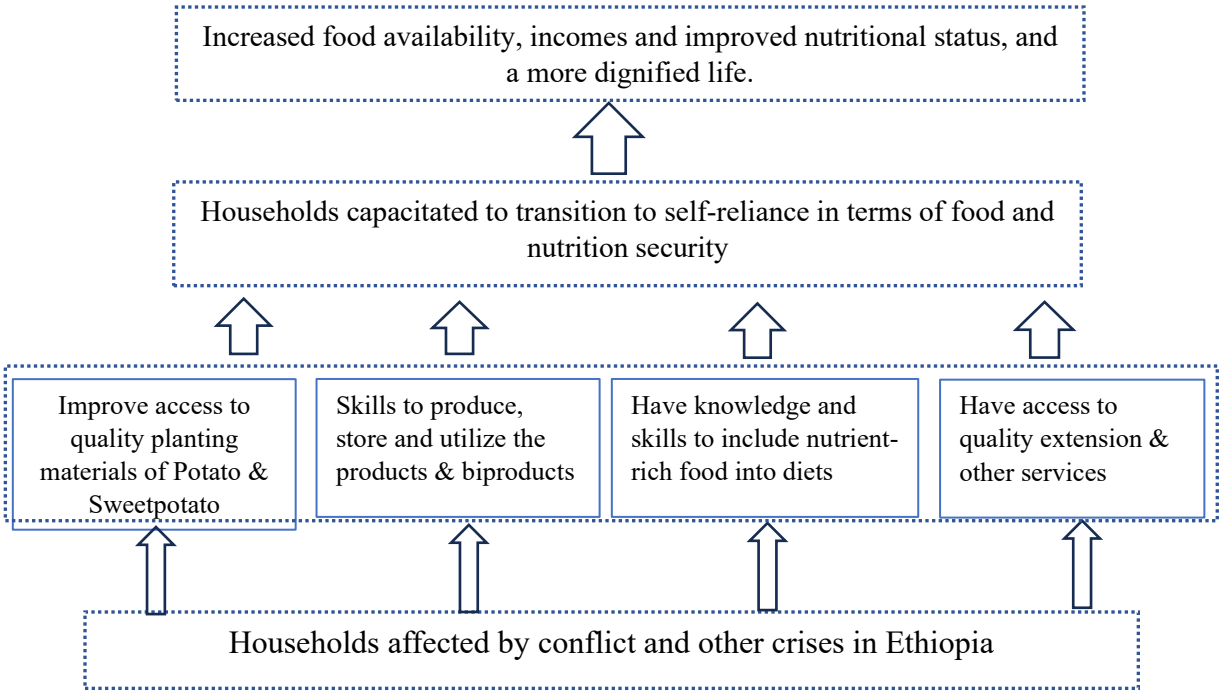

Figure 1: Simplified theory of change of crop emergency response interventions

3. TARGET GROUPS, BENEFICIARIES AND PROJECT LOCATIONS

3.1. Description of the geographic locations targeted by the interventions

Over the past three years (2021 to 2024), the crop emergency response interventions using potato and sweetpotato technologies were implemented in a total of 641 kebeles found in 124 districts of seven regional states of Ethiopia (Table 1, Figure 2). These areas were affected by a single or combination of crises, including conflict, drought, desert locust damage, and floods. For instance, in Tigray, eastern Amhara, southern and southeastern parts of Oromia region conflict has been the main cause of the crises. On the other hand, most districts in Hararghe, Bale, and West Arsi zones of Oromia, Central and South Ethiopia

regions, were affected with varying intensity and frequency of drought. Locust infestation caused significant crop loss and livelihood damage in 2020 and 2021, especially in the lowland areas of the regions that were already affected by either drought or conflict. Flooding has been occurring almost every year, although the adverse impacts on agricultural production has been limited to pocket areas of the target regions.

Table 1: Geographic locations and number of households targeted by potato and sweetpotato intervention from 2021 to 2024

Region	No of zones	No districts	No of kebeles	No of target households			
				Potato	Sweetpotato	Both crops	Total
Amhara	5	30	192	10,160	14,9000	-	25,060
Central Ethiopia	6	12	55	7,400	3,600	-	11,000
Oromia	12	44	239	17,150	28,600	-	45,750
Sidama	1	2	8	800	800	-	1,600
Somali	1	4	16	-	1,600	-	1,600
South Ethiopia	6	8	35	1,600	5,400	-	7,000
Tigray	4	24	96	7,488	6,656	5,892	20,036
Total	**35**	**124**	**641**	**44,598**	**61,556**	**5,892**	**112,046**

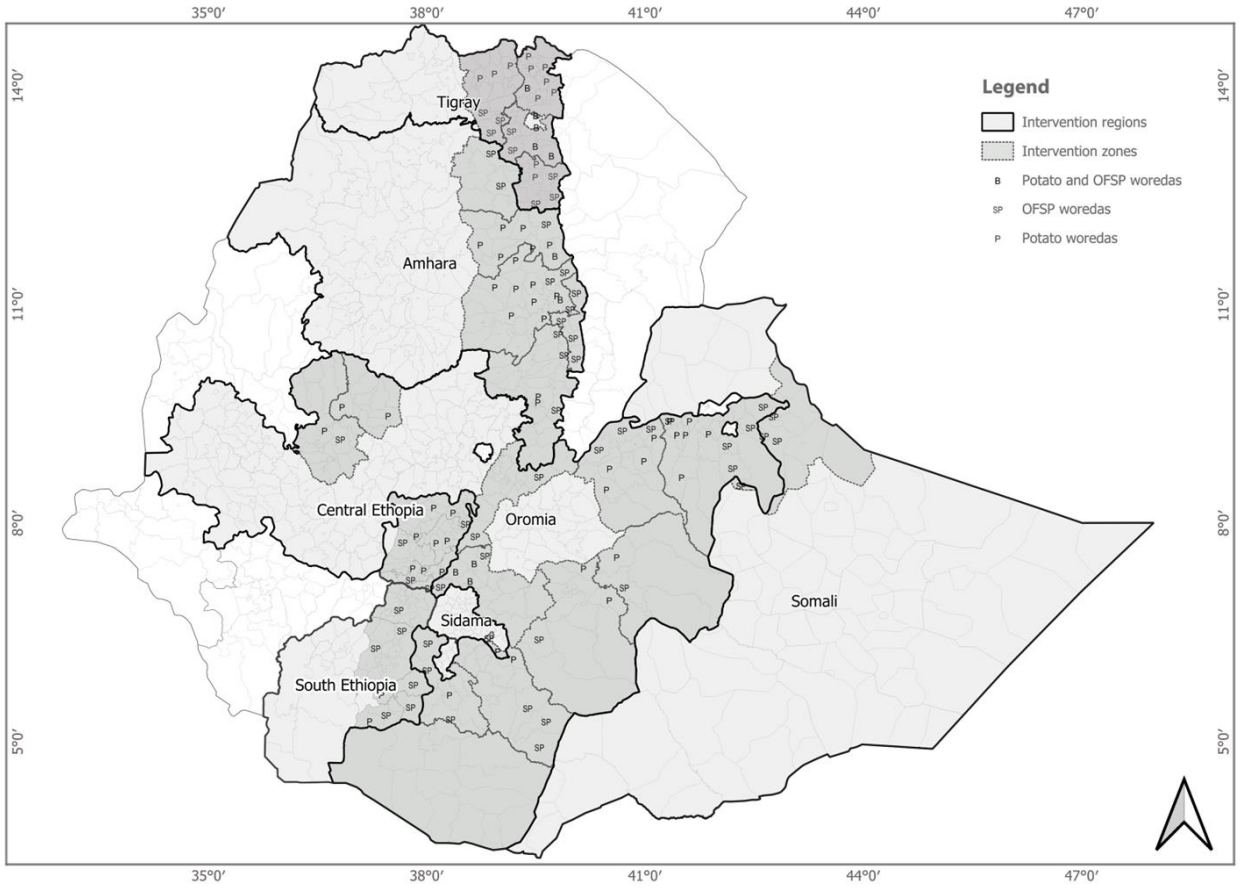

Figure 1: Emergency response intervention target regions, zones and districts between 2021 and 2024

3.2. Description of target groups and beneficiaries

The target beneficiaries were mainly smallholder households that were most affected by the adverse impacts of the crises found in 641 kebeles. The beneficiary households were selected based on clearly defined criteria agreed upon with implementing partners from the respective regions. Accordingly, priority was given to households categorized as acutely food insecure with pregnant and lactating women and children under two years of age emphasized, those that experienced recent loss of crops and planting materials due to drought and/or conflict; those demonstrating willingness to plant potato or sweetpotato, those with access to a minimum area of suitable land for either of the two crops, households with large family size (high dependency ratio), and those headed by females. Vulnerable population groups in the target areas such as returnees from temporarily displacement, elderly and people living with disabilities, received special attention during targeting, community mobilization, training, and implementation of activities.

Other target groups supported through the interventions include BoA experts and extension agents, who were trained on GAP and post-harvest management of potato and sweetpotato. Nutrition experts and health extension workers have been also targeted through OFSP-based nutrition knowledge capacity building activities. Experts from input quality control and regulatory services were also trained on seed inspection and certification of quality declared seeds of potato and sweetpotato. Moreover, seed multipliers received various supports including start up early generation seed (EGS) of improved varieties, seed storage structure (DLS) constructed through a cost sharing arrangements, and training on seed production, handling, and quality assurance, and facilitation of market linkage with institutional and private seed buyers.

4. KEY ACHIEVEMENTS OF THE EMERGENCY RESPONSE INTERVENTIONS

4.1 Improving Smallholders' Access to Quality Planting Materials

The seed system in Ethiopia has been severely impacted due to the conflicts that have been ongoing since 2020 and climatic shocks that have been occurring too frequently in the recent years. These crises have disrupted the multiplication and supply of quality planting materials, particularly for roots and tubers where the system has already been weak. Conflict in traditionally seed growing regions has led to the displacement of seed growers, destruction of field and storage structures, and causing shortage or unavailability of agricultural inputs including early generation seed. The instability has weakened both formal and informal seed systems, making it difficult for farmers to obtain disease-free, high-quality seeds of potato and sweetpotato. Occurrence of drought for consecutive seasons in the past four to five years has profoundly diminished the availability seeds of vegetatively propagated crops, which are usually conserved in the open field year-round. During prolonged droughts, farm-saved crops often dry out, severely impacting the availability of seeds in the local seed system (Mulesa, 2021).

The challenges associated with access to quality planting materials were addressed through strategically designed and implemented crop emergency interventions. One such strategy involved engaging with the existing Decentralized Vine/Seed Multipliers (DVM/DSMs) established through previous CIP led projects. These DVM/DSMs were strengthened through providing technical training and injection of Early Generation Seeds (EGS) of farmers' preferred potato and sweetpotato varieties, to restore their capacity to supply quality declared seed (QDS) of both crops. About 82,285 smallholders farmers in seven regional states, who either completely lost or faced severe shortage of seeds due to the adverse impacts of the multiple crises were supplied with 1062 tons of seed potato tubers and 35.3 million vine cuttings of OFSP varieties between 2021 and 2024 (Table 2).

Table 2:Number of households reached and total quantity of potato and sweetpotato seeds distributed to beneficiary households between 2021 and 2024

Region	No of households reached			Quantity of seed distributed	
	Potato seed	Sweetpotato cuttings	Total	Potato (tons)	Sweetpotato (Million)
Amhara	6,960	16,300	23,260	266	10.95
Central Ethiopia	8,200	3,600	11,800	280	2.80
Oromia	12,846	21,263	34,109	476	15.25
Sidama	800	800	1,600	20	0.40
South Ethiopia	1,600	5,442	7,042	20	4.38
Somali	-	1,600	1,600	-	0.71
Tigray	-	3,674	3,674	-	0.80
Total	**29,606**	**52,679**	**82,285**	**1,062**	**35.29**

Source: CIP Monitoring data

Studies show that saving seeds for subsequent planting seasons is among the pressing problems of potato and sweetpotato crops in Ethiopia (Fekadu et al., 2015; Gildemacher et al., 2009). These problems emanate mainly from the lack of skill and access to affordable technologies that can easily be operated by farmers. To improve farmers' capacity to conserve own seed in the subsequent seasons, training was provided on resilient seed conservation methods and through demonstrations of low-cost seed saving technologies such as Triple S for sweetpotato and Diffused Light Store (DLS) for potato. In this regard, the assessment conducted in 2022 showed that farmers in the target districts were able to save 2229.7 tons (out of 8827.2 tons of total harvest) of seed potato for use during subsequent planting seasons (Table 3).

Table 3: Quantities of potato harvest saved for own use and sold as seed by households targeted through emergency response interventions in three regional states of Ethiopia

Region	Varieties	Total tuber yield (t)	Quantity of Seed Stored (t)	Quantity of Seed Sold (t)	Quantity consumed/ Ware Sold (t)
Amhara	Gudene and Belete	3520	668.8	598.4	2182.4
Central Ethiopia	Gudene and Belete	2560	819.2	819.2	921.6
Oromia	Gudene and Belete	2747	741.7	604.4	1291.2
Total		**8827**	**2229.7**	**2022**	**4395.2**

Source: CIP Monitoring data

Most potato and sweetpotato growers in Ethiopia acquire seeds from the informal seed system through farmer-to-farmer seed exchange (Fekadu 20115; Steffen et al., 2013; Gildemacher et al., 2009). The emergency response interventions leveraged the existing practices to support more farmers access seeds of improved varieties. Data collected through regular project monitoring activities indicated that on average each direct beneficiary farmer produced 5000 vine cuttings and 0.5 tons of potato seed. Agricultural extension agents encouraged direct beneficiaries to share these planting materials with neighboring farmers although the farmer-to-farmer sharing happened only in few of the districts targeted with sweetpotato. The high market value of potato tubers and farmers interest to further multiply the new varieties of both crops limited the farmer-to-farmer dissemination. Despite the limitations, sample assessments conducted showed that 9,499 farmers acquired sweetpotato planting material through farmer-to-farmer seed exchange between 2021 and 2024 (Table 4). This approach ensures that the initial seed delivered to beneficiary households gradually diffuses to more farmers, improving availability, access, and affordability of planting materials of the improved OFSP varieties in the local seed system.

Table 4: Estimated number of farmers engaged in farmer-to-farmer seed exchange of sweetpotato

Region	No. of cuttings shared	No. of farmers who shared cuttings	No. of farmers who received cuttings	Average no. of farmers who received cuttings†
Central Ethiopia	154,069	538	862	1.6
Oromia	165,508	1,126	2,092	1.9
South Ethiopia	1,860,877	2,869	6,545	2.3
Total	**2,180,454**	**4,533**	**9,499**	**5.8**

Source: CIP Monitoring data

† Cuttings received from primary recipients of emergency seed

The low multiplication rate of potato and sweetpotato presents significant challenges for emergency response projects aimed at restoring agricultural production after conflicts or drought have occurred. Potatoes typically produce about 6 to 8 daughter tubers per plant, while sweetpotato vines have a multiplication rate of approximately 15:1, which is considerably lower than most cereal crops (CIP, 2019; Otazu 2008). This low propagation rate means that generating sufficient planting materials to meet the needs of affected farmers can be time-consuming and resource intensive. Consequently, the delay in producing adequate quantities of seed tubers or vine cuttings can hinder the timely restoration of food security and agricultural productivity in disaster-stricken areas. Additionally, the perishability of these planting materials further complicates storage and logistics for distribution.

CIP and partners have been working together for more than a decade to establish and/or strengthen decentralized seed multiplication systems to enhance smallholders access to quality seeds of potato and sweetpotato. These DVMs/DSMs were the main source of seed for crop emergency response interventions implemented by government and international humanitarian agencies for the past several years. However, as the complexity and geographic coverage of the crises have rapidly expanded, the necessity for establishing new DVMs and DSMs in new areas became imminent. Alongside establishing new seed groups, the existing ones were also supported through the provision of early generation seed (EGS), training and technical backstopping. These multipliers have been effective in providing farmers with planting materials of improved varieties in a short time, at low cost, with acceptable quality and in required quantities. Between 2021 and 2024, a total of 210,000 mini-tubers of Belete and Gudene potato varieties sourced from Dessie Tissue Culture and Adet Agricultural Research Center, 20.8 tons of generation three (G3) potato seed purchased from farmers' cooperative in West Gojam and South Wollo and six tons of basic seed of Bubu variety purchased from Haramaya University were distributed to 19 potato seed multipliers operating in three regional states (Table 5). Ultimately, the seed multipliers produced an estimated 4,090 tons of quality seed, most of which were sold to individuals and institutional buyers. Cooperatives which received the early generation seed in 2024 kept eleven tons of seed in the first season and they are expected to produce additional 23 tons of quality seed in the coming season, which will leverage efforts to improve access to quality seed in new areas.

Table 5: Quantity of early generation seeds of improved potato varieties distributed to Decentralized Seed Multiplier (DSM)Groups in four regional states of Ethiopia between 2021 and 2024

Region	No. of DSMs	Mini tubers (Number)	EGS - G3 (tons)	Basic Seed (tons)
Amhara	3	60,000	3.5	0.0
Central Ethiopia	7	60,000	8.0	1.0
Oromia	13	90,000	8.8	6.0
Sidama	1	-	0.5	0.5

Total	**24**	**210,000**	**20.8**	**7.5**

Source: CIP Monitoring data

Regarding sweetpotato, the projects introduced 2000 pathogen tested, virus free cuttings of three improved OFSP varieties (Kabode, Alamura and Dilla) from KEPHIS (Kenya) in 2021 and 2022. The materials were further multiplied at Woramit Horticulture Training and Research Center of Amhara Region Agricultural Research Institute (ARARI). More than 300,000 viruses free sweetpotato cuttings harvested from the center were distributed to quality declared seed (QDS) multipliers in Amhara and Oromia regions. Five QDS multipliers supported through the emergency response interventions created the capacity to supply over 37.2 million vine cuttings to institutional and individual buyers.

4.2. Enhancing Food Production and Consumption of Nutritious Diets

Conflict-affected regions often face severe disruptions in agricultural activities, leading to food insecurity, loss of livelihoods, and weakened local institutions. The crop emergency interventions implemented in the past three years addressed these challenges by improving access to potato and sweetpotato technologies, enhancing capacity and skills for the production and effective utilization of these crops, and strengthening local institutions that support smallholders. These interventions generally aimed at doubling the current average yields of potato and sweetpotato, estimated at 8 and 10 tons/ha, respectively. The interventions were thought to rapidly restore food production capacity, enhance food and nutrition security, and support the transition to self-reliance for smallholder farmers affected my conflict and other concurrent crises. In addition to meeting immediate food demands, the project's comprehensive approach also established the groundwork for long-term agricultural resilience and market restoration.

With quality planting materials of potato and sweetpoato distributed through the crop emergency response interventions, beneficiary households were able to cover a total area of 1240 and 821 hectares with potato and sweetpotato, respectively (Table 6). Crop cut estimates indicated an estimated average yield of 23.78 t/ha (for potato) and 23.98 t/ha (for sweetpotato), which was more than double of the average national yields of the two crops indicated above. Significant variations in yields of both crops were reported across the target regions which can be accounted for the variations in growth factors such as climate, soil fertility, and management practices (Dumbuya et al., 2021; Sokoto, 2007). With the yield levels obtained, an estimated additional food production of 19,529 and 29,488 tons of sweetpotato and potato, respectively, were obtained by beneficiary households. These improvements in yields highlight a substantial improvement in food production capacity, contributing to enhanced food security and supporting the transition to self-reliance for crises-affected smallholder farmers, ultimately beneficiating more than 600 thousand individuals.

To maximize the yields of both crops during large-scale promotion targeting different agro-ecologies, plausible recommendations can be considered. Site-specific agronomic practices that consider local soil conditions, climate, and available resources is crucial (Villalba et al., 2024; Choudhury and Jones, 2014). This includes but not limited to appropriate planting density, irrigation management, and pest control measures (Liang, et al., 2024). Strengthening the capacity of local agricultural extension services to provide timely and relevant support to farmers such as training on good agronomic practices (GAP) and post-harvest handling practices are essential (Pells, 2007). Continued development and dissemination of high-yielding, disease-resistant, nutritious, and climate-adapted varieties of potato and sweetpotato ensures that farmers have access to the best possible planting materials (Lindqvist-Kreuze et al., 2024). Establishing robust monitoring and evaluation systems to track the performance of crops across different regions helps in identifying areas that need additional support and in making data-driven decisions. Creating demand and awareness among farmers on the importance of adopting new technologies and practices, including demonstrating the benefits of improved varieties, quality seed, and agronomic practices through establishing demonstration plots, conducting farmers field days and facilitating farmer-to-farmer exchanges are instrumental in catalyzing the adoption of resilient crop technologies in crises prone areas (Dumbuya et al., 2021).

Table 6:Total area planted and estimated yields of potato and sweetpotato obtained by the beneficiary households targeted by the emergency response interventions between 2021 and 2024.

Region	Potato		Sweetpotato	
	Total area planted, ha	Average tuber yield, t/ha	Total area planted, ha	Average root yield, t/ha
Amhara	538	26.7	300.6	23.6
Oromia	438	22.2	319.0	23.8
SNNPR	254	27.9	194.4	26.6
Sidama	10	18.2	7.2	21.9
Total	**1240**	**23.8**	**821.2**	**23.9**

Source: Monitoring data

4.3. Contribution to household income and market restoration

In post-crisis environments, the income of vulnerable farm households diminishes due to disruptions in local economic activities, which affect both on-farm and off-farm income sources. This reduction in income limits the household's ability to invest in essential needs, such as healthcare services, education, farm inputs, food, and feed (Al Daccache et al., 2024). Therefore, emergency response agricultural projects should aim to enhance the capacity of vulnerable households to restore agricultural production, enabling them to generate income from surplus produce to sustain their livelihoods (SEADS, 2021).

The income generated through the sale of fresh potato and sweetpotato products have been assessed project monitoring tools and from the final project evaluations carried out by independent consultants. Reports of the final project evaluation show that emergency response beneficiary households generated varying levels of income from the sales of surplus fresh potato and sweetpotato roots, with differences observed across locations and between the two crops. In general, the income brought from potato sales was higher than that from sweetpotato. Income generated per household from sales of ware potato ranged between ETB 225 (in Harawalo kebele, Dessie Zuria, South Wollo zone) to ETB 6400 (in Felka kebele, Attote Ulo, Halaba zone). Similarly, income levels that ranged from ETB 250 (in Werebabu, South Wollo) to ETB 4000 (in Boreda, South Ethiopia) were generated by beneficiary households from the sales of OFSP roots. Project field monitoring reports show that farmers often encounter market failure (low price or inability to sell their perishable roots at the time they wanted) in areas that were under active conflict situations (e.g., Tigray and South Wollo zone of Amhara region) (CIPE, 2022). Conflict driven disruptions have likely led to reduced market access and lower demand, impacting the prices farmers could have obtained for their produce. Conversely, the relatively better market fetched by OFSP roots in Boreda district of Southern Ethiopia region signify the crop's economic potential in more stable regions.

Due to the expansion of the armed conflict to their areas, beneficiary households in Werebabu district of South Wollo zone and neighboring districts were displaced between end of October and first week of December 2021. On their return to their home villages in December, most of the displaced farmers were able to get some harvest which they claim have helped them as the only food available for their families and neighbors while the markets were still recovering. According to these farmers, sweetpotato survived looting and damage inflicted on other crops during the war. Beneficiary households consumed the roots and sold part of the harvest in local market generating modest income that was direly needed. This underscores the critical role resilient crops such as sweetpotato can play in supporting food security and economic stability in vulnerable communities during and in the aftermath of conflict and other crises.

4.4. Improving diet diversity and access to vitamin A rich food

Communities affected by drought and conflict are often exposed to malnutrition and related health problems due to insufficient food intake, reliance on a narrow range of staple foods and diets lacking essential micronutrients. The instability and displacement caused by these crises disrupt livelihoods and access to markets, making it difficult for families to obtain a variety of nutritious foods (Gebre et al., 2024; Bahru et al., 2019). In drought and conflict-affected areas, the prevalence of vitamin A deficiency (VAD) is likely higher due to the compounded effects of food insecurity and limited access to diverse foods. These communities face significant challenges in accessing vitamin A-rich foods, making interventions to improve dietary diversity and micronutrient intake even more critical (Gebre et al., 2024; Bahru et al., 2019). The baseline study conducted before the emergency response interventions started in April 2021 reported that no households in the selected kebeles were cultivating OFSP, and subsequently the households lacked about the knowledge on the preparation of OFSP-based recipes for children under two. Households also had no knowledge of portion sizes or feeding frequencies for young children. Consequently, the emergency response projects prioritized improving food security and enhancing access to nutritious food, including orange-fleshed sweetpotato (OFSP). The production and utilization of OFSP aim to address issues like vitamin A deficiency and malnutrition by promoting the cultivation and consumption of the crop, which is rich in beta-carotene, a precursor to vitamin A. Rigorous biomedical research has demonstrated that just 125 grams of most OFSP varieties can meet the daily vitamin A requirements of a preschool-aged child (Mitra, 2012). To promote the effective utilization of sweetpotato for household nutrition, the emergency projects provided training using a stepwise approach, food demonstrations, and child feeding support tools developed and tested in Ethiopia through ongoing and past projects.

To enhance knowledge on nutrition and skills in utilizing the OFSP, the emergency projects started with the organization of a comprehensive training of trainers (ToT) targeting district health and nutrition experts and kebele health extension workers (HEWs) drawn from health and agriculture sectors. As a result, more than 606 nutrition experts and HEWs have been trained on OFSP based nutrition knowledge across seven regions (Table 7). The ToT modules covered topics including dietary diversity, sources of micronutrients in local foods, value-added foods from OFSP, young child diets, complementary feeding, and OFSP-based food preparation and storage. This training was complemented with cooking demonstrations to highlight opportunities for incorporating OFSP into local dishes in ways that are appealing, affordable, and nutritionally beneficial. The HEWs and nutrition experts in collaboration with CIP nutrition experts have rolled out the nutrition knowledge and OFSP based local food preparation skills to 24,758 women and caregivers from 214 kebeles (Table 7). To enhance infant and young child feeding practices a total of 18,156 healthy baby toolkits (HBTs) were distributed between 2021 and 2023 (Table 7).

The independent evaluation conducted at the end of the project interventions revealed positive changes with regards to utilization of OFSP. Beneficiary households have generally appreciated the variety of OFSP incorporated local food recipes demonstrated, such as Kita (flatbread), bread, stew, and "posse" (a local dish common in southern Ethiopia). Some also have begun consuming OFSP leaves, likening them to cabbage. However, the use of healthy baby toolkits (HBT)[3] remained limited, with few households feeding OFSP recipes to children, indicating a lack of understanding and adoption of infant and young child feeding guidelines. To ensure the sustainability of the nutrition activities implemented in the target areas, the emergency response interventions adopted a multi-faceted approach that focused on building local staff

[3] The healthy baby toolkit is designed for use with infants 6-23 months of age to ensure they receive the recommended amount of food at each meal for optimum growth and development. The toolkit includes i) a bowl with lines and symbols that cue age-appropriate meal frequency and volume for children, ii) A slotted spoon to guide optimal thickness/texture of infant foods and complementary foods, and iii) a pictorial counseling card that uses locally adapted images.
https://cgspace.cgiar.org/server/api/core/bitstreams/c758b8b8-b060-498b-a223-f97127c2fd08/content

capacity, promoting practical skills such as enriching common grain products with OFSP puree, and the practices of planting material preservation for long-term use. These strategies work synergistically to create a self-sustaining model where local communities are equipped, motivated, and capable of continuing nutrition activities long after completion of projects.

Table 7: Number of nutrition experts, health extension workers, women and caregivers trained on OFSP based nutrition, and healthy baby toolkits distributed across seven regions of Ethiopia, 2021 to 2024

Regions	No of ToT attendees			No. kebeles reached	No. of women & caregivers reached	No. of HBT distributed
	Nutrition experts	HEWs	Total			
Oromia	49	153	202	103	8427	7184
Amhara	80	129	209	50	6450	6392
Central Ethiopia	11	38	49	18	3679	1080
South Ethiopia	15	55	70	27	5528	1620
Sidama	3	4	7	4	674	200
Somali	9	24	33	12	-	576
Tigray	13	23	36	0	-	1104
Total	**180**	**426**	**606**	214	**24758**	**18156**

Source: CIP monitoring data

4.5. Strengthening local institutions and enterprises

Among the key objectives of the emergency response interventions were strengthening the capacity of local institutions and enterprises to sustainably provide agricultural inputs and knowledge support to vulnerable communities during future crises. Therefore, the interventions have emphasized the development of seed systems and extension capacity within the targeted zones and districts. The regional BoA have been the main implementing partners, which on account of their extensive reach and established presence, are well-positioned to deliver services effectively to a large number of beneficiaries. The capacity of BoA has been enhanced through organizing training sessions relevant to the staff across the ladder, engaging in joint project monitoring activities, and ensuring participation in regular biannual review and planning meetings. The staff of BoA were involved in a variety of tasks, including beneficiary selection, annual work plan preparation, rolling out training on GAP, seed and vine distribution, provision of technical backstopping to target households and inspection of the construction of water harvesting structures and installation of small-scale irrigation systems. These skills and knowledge acquired by the staff have proven to be useful in providing effective support and technical services amid ongoing conflicts as demonstrated by recent experiences in South Wollo zone of Amhara region. The importance of strengthening local government actors' capacity to enhance integrated local development planning and governance have been previously highlighted by UNDP (2020). The partnership approach adopted by the project requires regular planning and exchange meetings where information and knowledge are shared. This helps to ensure complementarity, exploit potential synergies, and create ownership.

In the past three years alone, the emergency response projects have provided support to six Decentralized Vine multipliers (DVM) and 19 Decentralized Seed Multipliers (DSM) for sweetpotato and potato, respectively. In addition, the project enhanced the capacity of local potato and sweetpotato seed multipliers through technical support, provision of early generation seed, creating linkages with government organizations, and facilitating market connections. For sweetpotato, the project facilitated licensing of vine multipliers, provided technical and in-kind support, imported and delivered virus-cleaned sweetpotato vines

of improved varieties, and supplied Early Generation Seed (EGS) that resulted in the multiplication of over 37.2 million sweetpotato cuttings between 2021 and 2023. For potatoes, the project provided EGS and training on Quality Declared Seed (QDS) production, inspection, and certification processes. Overall, 23 Diffused Light Stores (DLS) were constructed with a capacity to store 1,380 tons of seed potato tuber. Such efforts as a step to improve seed systems that enhance resilience and productivity among smallholder farmers in Ethiopia have recently been also elaborated by Beyene and Urrea-Benítez (2024).

Overall, the project's comprehensive approach to strengthening local institutions and enterprises significantly enhanced the capacity of the BoA, improved partners staff and farmer knowledge on nutrition sensitive agriculture (NSA), good agronomy practices and established robust local seed multiplication and supply systems. These efforts not only addressed immediate needs but also contributed to the long-term resilience of conflict-affected smallholder farmers in different regions of Ethiopia. The successes of the interventions so far underscore the importance of local capacities in effective emergency response and building resilient communities. Ma et al. (2023) similarly highlighted the significance of localized strategies in enhancing community resilience to natural hazards and public health challenges.

5. CHALLENGES AND LESSONS LEARNT

5.1. Challenges encountered during implementation

The persistent and sporadic conflicts which have been occurring in Tigray, Amhara, Oromia and pocket areas of southern Ethiopia have presented substantial obstacles to the implementation of the emergency response interventions since 2021. These challenges can generally be categorized in to two: technical and operational (Table 8). Most of these challenges were overcome through contingency plan designed with partners during project inception meetings and careful implementation of risk management plan developed through comprehensive analysis of the anticipated security situations in each region. However, the challenges faced in the face of multiple crises have led to either delay or suspension of some activities and relocation of interventions to areas where security situations were extremely difficult for project and partners staff to travel and facilitate field work.

Table 8: Summary of operational and technical challenges faced in the implementation of emergency response interventions across different regions of Ethiopia

Technical	Operational
Delay in delivery of planting materials to beneficiary households due to hinderances during transportation enroute to the delivery sites	Restricted movement and risk of kidnapping of CIP and partners staff traveling to facilitate the implementation and monitoring of project activities in conflict prone areas of Amhara and Oromia regions
Relocation of project activities on account of lack of safe and secure operational environment.	Restricted access to seed multiplication and supply sites by project staff to inspect the quality and whether other minimum standards for emergency seeds have been met prior to procurement and distribution to beneficiary households
Unavailability/shortage of quality seeds from local sources due to collapse of seed multiplication and supply systems in conflict affected areas	Lack of interest among transport service providers to deliver planting materials to areas that are already under active conflict or likely risk exists for break out of conflict
High prices and inflated transportation costs when seeds are procured from distant areas	Difficulty/risk of gathering beneficiary HHs for meetings and training events due to either restrictions imposed by state of emergency declared by government or misperceptions that such events could

	be used for political mobilization by the warring groups
Delay in reporting and unreliability of data and information collected and shared by local implementing partners from areas where persistent and sporadic conflicts occur	Difficulty for partners staff invited from project target districts to attend meetings and training sessions due mainly to unexpected road blockade encountered enroute to regional or zonal centers where the events are organized.
Weak seed inspection, quality control and law enforcement by the regulatory bodies to curb the widespread distribution of fake or poor-quality seed due to lack of logistics and technical capacity	Inadequate manpower deployed and supplementary logistics available in some regions (e.g., Somali) to effectively implement emergency response interventions in accordance with the roles and responsibilities agreed among implementing partners
Diminished capacity of TARI and ARARI research centers to multiply and supply early generation seeds (EGS) and subsequent difficulties faced by seed multipliers groups to access EGS needed to renew their seed stocks	Frequent disruption of telephone and internet connections to validate the appropriateness of beneficiary targeting, provision of remote technical backstopping to local implementing partners and timely delivery of reports to project coordination

5.2. Key lessons learnt

Direct seed supply to beneficiary households has multiplier effect and decentralized vine/ seed multipliers have played a key role in improving availability at the local level. From the direct emergency seed supply farmers on average saved up to 25% of the original quantity of seed delivered to be used for the forthcoming seasons. Some of them were able to generate modest income from sales of vines and seed tubers to neighboring farmers. Besides, establishing decentralized vine/ seed multipliers has proven to be crucial in improving farmers access to seeds of the resilient crops in a time and cost-efficient manner. To ensure farmers continued access to seeds of potato and sweetpotato in areas where critical gap exists in the seed supply system, several DVMs/DSMs were established in Oromia, Amahara, Sidama and SNNPR regional states with the support of the emergency response projects. These DVMs multiplied more than five hundred thousand OFSP cuttings that was distributed to farmers through various local seed supply channels. Awareness creation events and promotion of small bundle marketing activities (in local markets) were carried out to create a sustainable demand for quality planting materials of improved OFSP varieties among farmers.

Apart from addressing the immediate needs of affected communities, emergency responses activities have enormously contributed to the promotion of improved crop technologies in new areas, which have never been reached before. Climate smart technologies such as solar pumps and small-scale water harvesting ponds coupled with small-scale irrigation systems (e.g., drip irrigation) that were either demonstrated at Farmers Training Centers or directly supplied to DVMS for the conservation of sweetpotato vines during the 3 to 4 months of dry spell received high acceptance among farmers, vine multipliers and local extension officers for their efficient use of water and preservation of vines that can be planted immediately with the onset of rain in the respective localities.

Enhancing the capacity of local partners such as the BoA staff at district and kebele levels, especially in conflict-affected areas was instrumental for the successful implementation of the emergency response activities. On the accounts of the travel restrictions imposed on CIP and other partners staff based outside the project areas, it would not have been possible to facilitate field work and meet the targets of the emergency interventions without the dedication of the local partners staff to support farmers with remote supervision from CIP staff. Conclusively, investing in the capacity of local implementing partners has really paid off.

Potato and sweetpotato have proven to be among the most resilient crops suitable for production and consumption among rural and urban communities during active conflict periods and in the aftermaths of such crises. For instance, OFSP was one of the very few crops that were grown by farmers and urban dwellers in Tigray region when food in local markets became scarce and unaffordable due to high prices and supply disruptions. This forced households to grow part of their diet at home. Sweetpotato offered a practical solution because it could thrive in small backyard spaces. Compared to other common vegetables, sweetpotato planting materials, along with seeds for local vegetables like kale (habesha gomen), were more accessible and affordable when the region was completely cutoff the supply chains. Sweetpotato was also highly preferred by households because it could be consumed with minimal preparations. The root did not require expensive seasoning or oil, both of which were either unavailable or unaffordable during the conflict. This made it a cost-effective and vital food source, significantly reducing household food expenses. Similarly, OFSP roots were the only food available for households in Worebabu district of South Wollo zone, who returned to their villages six weeks after displacement following the expansion of the northern Ethiopia war to the area. Potato was the first crop to be harvested by households, who were supplied with emergency seeds in 2022 following the commencement of agricultural activities in Soth Wollo zone of Amhara region. Lastly, IDPs in Tigray and drought-affected community in Borena zone, who were supplied with fresh roots of OFSP have expressed their satisfaction and interest for the crop as they could easily and quickly boil and serve the roots, which was also very much liked by children due to its softness and taste.

6. SUSTAINABILITY AND POLICY IMPLICATIONS

The exit strategy of crop emergency projects implemented in the past three years have been firmly anchored to strengthening the capacity of local institutions and enterprises to sustainably provide agricultural input and knowledge support to vulnerable communities in the events of similar future crises. This approach ensures that the benefits of the project extend well beyond its duration. One of the key sustainability factors is the enhancement of seed multipliers' capacity through the provision of early generation seed (EGS), training on GAP, and market linkage (both for seeds and produce). The willingness of multipliers to invest in EGS, through in-kind or cash contributions, underscores the potential for commercializing seed production and marketing in crises prone areas. The strong linkages created among seed value chain actors (Tissue Culture Labs, Agricultural Research Centers, QDS multipliers) had profound influence on stimulating the multiplication and marketing of seeds of improved varieties of both crops. A good example of such linkage sustained over the past couple of years are i) sweetpotato seed grower cooperatives in Sidama and Gedeo zones, which purchased EGS from Hawassa Research Center, and ii) Haile Wako Integrated Farm, which sourced EGS from Hawassa and Bahir Dar Tissue Culture Centers for further multiplication of Quality Declared Seed (QDS).

The support provided to enhance skills on seed conservation has started showing promising results, with farmers retaining and multiplying OFSP varieties to cope with the adverse impacts of climate shock in some drought prone areas of southern Ethiopia (Wolaita, Gamo). Similarly, the construction of communal and household level Diffused Light Stores (DLS) through cost sharing mechanisms has significantly enhanced farmers' capacity to keep potato seed for own use or sell to other farmers. In some areas, farmers have started replicating the construction of their own DLSs to avoid reliance on poor quality seeds that are sourced from local market or supplied through ware potato traders.

With the experience gained from the extensive nutrition messaging, awareness creation and cooking demonstrations activities implemented engaging BoA and BoH structures, the food and nutrition units in the former SNNPR, Oromia, and Amhara regions have been organizing successful events on their own in collaboration with NGOs and ongoing initiatives such as the Seqota Declaration Program. These events are primarily aimed at promoting the importance of nutrition sensitive agriculture and the nutritional benefits

of OFSP and other nutrient dense foods. To compliment the considerable roles played by potato and sweetpotatao in ensuring food and nutrition security and income of smallholders, the need to diversify crop options through a food basket approach cannot be overemphasized.

Experiences from the emergency response interventions pinpoint the critical importance for more attention (policy support) and investment in research, extension, and market development of root and tuber crops (RTCs), which are vital for livelihood recovery and building the resilience communities affected by multiple crises. Investment in research is needed to develop baskets of options of improved RTC technologies that are resilient to climate change and contribute to food and nutrition security of communities vulnerable to the adverse impacts of disasters. Strengthening the extension services in crises prone areas help farmers to be proactive in coping with the adverse impacts of the potential crises and build the skills and knowledge of communities in effectively cultivating, handling, and utilizing resilient and nutritious crops. Market development efforts can create demand for RTCs and improve supply system that connect producers with consumers, thereby stabilizing prices and providing reliable income sources which can be reinvested to consolidate sustainable coping strategies.

Emphasizing local, decentralized RTC seed systems can facilitate cost-effective and timely emergency responses in disaster-prone regions by ensuring a timely and cost-effective supply of seeds during emergencies. This approach also promotes the use of locally adapted varieties that are better suited to regional conditions. Integrating RTCs into national crop emergency packages and incorporating fresh roots and processed products, such as sweetpotato puree, into national food emergency aid programs can significantly bolster food security by providing a reliable source of nutrition when other options are in limited supply.

Furthermore, policies must ensure the quality assurance of seeds distributed during emergency responses by establishing or enforcing existing standards for seed quality, including germination, purity, and freedom from diseases and pests. Addressing the unprecedented rise in seed and fertilizer prices is also crucial, which can be achieved through subsidies, financial assistance, or promoting low input or climate smart farming practices that reduce dependency on external inputs. Finally, harmonizing intervention strategies among humanitarian actors operating in the same geographic areas is essential to avoid duplication of efforts and ensure efficient use of resources. These measures, if implemented collectively, could strengthen the resilience of agricultural systems and improve food and nutrition security of vulnerable communities exposed to or living in crises prone environments.

7. REFERENCES

1. World Bank. (2024, October 8). *Ethiopia overview*. World Bank. Retrieved December 13, 2024, from https://www.worldbank.org/en/country/ethiopia/overview
2. United Nations Office for the Coordination of Humanitarian Affairs. (2024). *Ethiopia: Internal Displacement Overview (as of June 2024)*. OCHA. Retrieved December 13, 2024, from https://www.unocha.org/publications/report/ethiopia/ethiopia-internal-displacement-overview-june-2024
3. International Organization for Migration. (2023). *National displacement report*. IOM. Retrieved December 13, 2024, from https://ethiopia.iom.int/news/more-345-million-people-displaced-ethiopia-more-half-due-conflict-new-iom-report
4. Dhillon, R., & Moncur, Q. (2023). Small-Scale Farming: A Review of Challenges and Potential Opportunities Offered by Technological Advancements. *Sustainability*, 15(21), 15478. https://doi.org/10.3390/su152115478

5. Al Daccache, M., Abi Zeid, B., Hojeij, L., Baliki, G., Brück, T., & Ghattas, H. (2024). Systematic review on the impacts of agricultural interventions on food security and nutrition in complex humanitarian emergency settings. *BMC Nutrition*, 10(1), 60. https://doi.org/10.1186/s40795-024-00864-8
6. Manaye, A., Afewerk, A., Manjur, B., & Solomon, N. (2023). The effect of the war on smallholder agriculture in Tigray, Northern Ethiopia. *Cogent Food & Agriculture*, 9(1), 2247696. https://doi.org/10.1080/23311932.2023.2247696
7. Statista. (2023). *Number of people facing food insecurity in Ethiopia*. Retrieved December 13, 2024, from https://www.statista.com/statistics/1236832/number-of-people-facing-food-insecurity-in-ethiopia/
8. Abay, K., Assefa, T. W., Berhane, G., Abate, G. T., & Hebebrand, C. (2024). *Grappling with compounding crises in domestic fertilizer markets in Africa: The case of Ethiopia*. International Food Policy Research Institute (IFPRI). Retrieved December 13, 2024, from https://www.ifpri.org/blog/grappling-compounding-crises-domestic-fertilizer-markets-africa-case-ethiopia/
9. Gebreegziabiher, G., Baykemagn, F. T., Gebrehiwet, T. G., Gebru, Y. T., Gebreyowhanes, A., & Mulugeta, A. (2024). Burden of acute malnutrition in the conflict-affected urban communities of Tigray, Northern Ethiopia: A cross-sectional study. *Discover Public Health*, 21(1), 1-13. https://doi.org/10.1007/s12571-022-01305-9
10. Belew, A. K., Awoke, T., Gelaye, K. A., Atnafu, A., Guadu, T., Azale, T., ... & Molla, A. (2023). Determinants of malnutrition and its associated factors among pregnant and lactating women under armed conflict areas in North Gondar Zone, Northwest Ethiopia: A community-based study. *BMC Nutrition*, 9(1), 102. https://doi.org/10.1186/s40795-023-01024-8
11. Gebreegziabiher, G., Baykemagn, F. T., Gebrehiwet, T. G., Gebru, Y. T., Gebreyowhanes, A., & Mulugeta, A. (2024). Burden of acute malnutrition in the conflict-affected urban communities of Tigray, Northern Ethiopia: A cross-sectional study. *Discover Public Health*, 21(1), 1-13. https://doi.org/10.1007/s12571-022-01305-9
12. Yehuala, G. K., Orcho, A. H., Gebresilassie, M. H., Meshesha, H. A., Amera, T. G., & Tariku, E. Z. (2023). Undernutrition and associated factors among children aged 6–59 months in nutrition-sensitive agriculture intervention implemented Basona district, North Shewa Zone, Amhara region, Ethiopia. *PLOS ONE*, 18(4), e0284682. https://doi.org/10.1371/journal.pone.0284682
13. United Nations Office for the Coordination of Humanitarian Affairs. (2024, March 1). *Ethiopia situation report*. OCHA. Retrieved December 13, 2024, from https://www.unocha.org/publications/report/ethiopia/ethiopia-situation-report-1-mar-2024

14. Amare, A., Zewdu, B., Mekonen, A., Gion, E., Mihretie, G., Golla, K., ... & Melse, N. (2024). *Multi-agency Belg season food security & agricultural assessment report for Amhara region*. Retrieved December 13, 2024, from https://fscluster.org/sites/default/files/documents/Amhara%20Region%20Multi-agency%20Food%20and%20Agriculture%20Belg%20Seasonal%20Report.pdf
15. Mulesa, T. H. (2021). Politics of seed in Ethiopia's agricultural transformation: Pathways to seed system development. *Frontiers in Sustainable Food Systems, 5*, 742001. https://doi.org/10.3389/fsufs.2021.742001

16. Fekadu,G., Hussein, S., Laing, M. 2015. Diagnostic assessment of sweetpotato production in Ethiopia: Constraints, post-harvest handling and farmers' preferences. Research on Crops. Mar 1;16(1). DOI: 10.5958/2348-7542.2015.00016.9
17. Gildemacher, P. R., Demo, P., Barker, I., Kaguongo, W., Woldegiorgis, G., Wagoire, W. W., ... & Struik, P. C. (2009). A description of seed potato systems in Kenya, Uganda and Ethiopia. *American journal of potato research*, *86*, 373-382.
18. Steffen, S., Woldegiorgis, G., Hailemariam, G., Aliyi, A., van de Haar, J., & Shiferaw, W. (2013). Sustainable seed potato production in Ethiopia: From farm-saved seed to quality declared planting material. In G. Woldegiorgis, S. Schulz, & B. Berihun (Eds.), *Seed potato tuber production and*

dissemination – Experiences, challenges and prospects (pp. 60-71). Ethiopian Institute of Agricultural Research (EIAR).

19. International Potato Center. (2019). *Sweetpotato handbook for seed multiplication and inspection*. Lima, Peru: International Potato Center. ISBN 978-92-9060-536-2.
20. Otazu, V. (2008). *Potato seed systems in the tropics: A manual for farmers, seed producers, and researchers*. International Potato Center (CIP). Retrieved December 13, 2024, from https://core.ac.uk/download/pdf/132667408.pdf
21. Dumbuya, G., Alemayehu, H. A., Hasan, M. M., Matsunami, M., & Shimono, H. (2021). Effect of soil temperature on growth and yield of sweet potato (Ipomoea batatas L.) under cool climate. *Journal of Agricultural Meteorology*, *77*(2), 118-127.
22. S Sokoto, M. B., Magaji, M. D., & Singh, A. (2007). *Growth and yield of irrigated sweet potato (Ipomoea batatas (L.) Lam.) as influenced by intra-row spacing and potassium*. Journal of Plant Sciences, 2(1), 54-60. https://scialert.net/abstract/?doi=jps.2007.54.60
23. Villalba, A., Martínez-Ispizua, E., Morard, M., Crespo-Sempere, A., Albiach-Marti, M. R., Calatayud, A., & Penella, C. (2024). Optimizing sweet potato production: insights into the interplay of plant sanitation, virus influence, and cooking techniques for enhanced crop quality and food security. *Frontiers in Plant Science*, *15*, 1357611. https://www.frontiersin.org/articles/10.3389/fpls.2024.1357611/full
24. Choudhury, A., & Jones, J. (2014). Crop yield prediction using time series models. *Journal of Economics and Economic Education Research*, *15*(3), 53-67. https://www.alliedacademies.org/articles/crop-yield-prediction-using-time-series-models.pdf
25. Pells, D. (2007). Project management for disasters and emergency response. PM World Today, 9(9). Retrieved from https://pmworldlibrary.net/wp-content/uploads/2016/10/PMWL-Pells-PM-for-Disaster-ER-Editorial-Sep2007.pdf
26. Liang, Q., Chen, H., Chen, Y., Kumar, S., Chang, H., Wu, J., ... & Zhu, G. (2024). Appropriate Planting Density Can Improve the Storage Root Yield and Commercial Features of Sweet Potato (Ipomoea batatas L.) by Optimizing the Photosynthetic Performance. *Agronomy*, *14*(11), 2579.
27. Lindqvist-Kreuze, H., Bonierbale, M., Grüneberg, W. J., Mendes, T., De Boeck, B., & Campos, H. (2024). Potato and sweetpotato breeding at the international potato center: approaches, outcomes and the way forward. *Theoretical and Applied Genetics*, *137*(1), 12. https://link.springer.com/article/10.1007/s00122-023-04515-7
28. SEADS (2022), Standards for Supporting Crop-related Livelihoods in Emergencies, Rugby, UK: Practical Action Publishing. http://dx.doi.org/10.3362/9781788532419
29. (2022). The Impact of the War in Northern Ethiopia on Micro, Small and Medium-Sized Enterprises (MSMEs) and Marginal Economic Actors (MEAs). *Center for International Private Enterprise*.
30. Bahru, B. A., Bosch, C., Birner, R., & Zeller, M. (2019). Drought and child undernutrition in Ethiopia: A longitudinal path analysis. *PLOS ONE*, 14(6), e0217821. https://doi.org/10.1371/journal.pone.0217821
31. Gebre, T., Abraha, Z., Zenebe, A., & Woldegebrial, Z. (2024). Food security intervention mechanisms in the drought-prone rural areas of Tigray. *Frontiers in Nutrition*, 11, 1413017. https://doi.org/10.3389/fnut.2024.1413017
32. Mitra, S. (2012). Nutritional status of orange-fleshed sweet potatoes in alleviating vitamin A malnutrition through a food-based approach. *J. Nutr. Food Sci*, *2*(8), 160.
33. UNDP (2020). Case Evidence on Local Development Planning. *United Nations Development Programme*. https://www.undp.org/sites/g/files/zskgke326/files/publications/Integrated-LDP.pdf

34. Ma, C., Qirui, C., & Lv, Y. (2023). “One community at a time”: promoting community resilience in the face of natural hazards and public health challenges. *BMC Public Health*, 23, Article number: 2510. https://bmcpublichealth.biomedcentral.com/articles/10.1186/s12889-023-17458-x