

Strengthening food security and resilience through irrigated vegetable production in emergency settings: Key issues and actions

Key messages

- An irrigated vegetable production intervention should be tailored to the crisis type—whether slow-onset, rapid-onset or complex—and its consequences, focusing on strategic priorities such as timing, scale and stakeholder coordination to meet each emergency's unique food security, nutrition and displacement needs.
- Irrigation systems for vegetable production need to be designed with context-specific technologies, adapted to available local resources (i.e., human capacities, water quality and quantity), market access, environmental health and logistical constraints, ensuring resilience to the unique challenges posed by different emergency contexts.
- Local systems in crisis can be strengthened by IVP interventions, which help to diversify diets, improve nutrition and generate income, reducing reliance on external aid and enhancing community resilience during an emergency.
- An IVP intervention should address diverse beneficiary needs, incorporating gender equity and social inclusion for more sustainable and equitable impact outcomes.

Context

The rising number of crises, in particular, complex crises, driven by armed conflicts, political instability and climate-induced shocks, has heightened food insecurity among vulnerable populations in sub-Saharan Africa (SSA). Traditional humanitarian responses to food crises provide food aid and prioritize staple crops such as maize and wheat when agricultural production is promoted. Integrating irrigated vegetable production (IVP) into crisis programs can generate income, provide essential micronutrients and diversify diets, and should therefore be included more often where feasible. There are urgent calls to action to inform policy decisions and improve IVP interventions in crisis-affected areas.

This water issue brief synthesizes findings from literature reviews on irrigated vegetable production interventions in emergencies, conducted by the International Water Management Institute (IWMI) (Singh et al. n.d.) and the World Vegetable Center (Mwambi et al. n.d.).



A man working on an onion farm in Ethiopia (photo: Maheder Haileselassie/IWMI).

Key issues

Humanitarian food-related crises occur when events critically threaten a community's well-being, health or safety and disrupt food systems and security through multiple channels (FAO 2021). In many SSA countries, humanitarian food-related crises damage infrastructure and transport networks, fragment agricultural assets, resources and human capital, impeding farmers' access to land, water and other essential inputs. When coupled with political insecurity or conflict, these crises severely impact food security in the short and long term, necessitating responses that enhance adaptive capacity and resilience.

The crises disrupt food distribution and marketing channels, increasing input costs, market instability and employment loss. Labor shortages and reduced demand due to travel restrictions or forced displacement further impact agricultural production and elevate food prices. Elevated food prices and market disturbances restrict food access, disrupt livelihoods and diminish incomes. These disruptions render food markets nonfunctional or inaccessible, decreasing the overall demand for food and causing shifts in consumption patterns and dietary preferences (Pain and Levine 2012).

Integrating irrigated vegetable production (IVP) into crisis programs offers a promising solution to emergency food security challenges. IVP can diversify diets, enhance nutritional outcomes and generate income, thereby strengthening local food systems, building on the gains achieved by humanitarian efforts, and reducing dependence on external aids (Singh et al. n.d.; Burney and Naylor 2012). In practice, emergency settings involve damaged infrastructure, limiting access to adequate and clean water for irrigation, complicating the transportation of agricultural supplies and hindering farming activities due to safety issues in conflict zones. The design and implementation of IVP interventions are influenced by perceived needs, logistical and technical constraints, institutional understanding and organizational capacity (Singh et al. n.d.). Many interventions, however, fail due to neglecting critical factors such as resource availability, market access and land tenure security, leading to insufficient water supply and ineffective irrigation systems (Singh et al. n.d.).

Irrigated vegetable production interventions in crises

Humanitarian food-related crises occur in different types of emergency settings. **Slow-onset crises**, such as droughts, cause prolonged periods of repeated shocks, exacerbating food insecurity through environmental degradation and resource depletion. Conversely, **rapid-onset crises**, such as floods, cause immediate, high-impact damage to agricultural infrastructure and systems. **Complex crises** often involve prolonged political instability or conflict (Box 1) and necessitate comprehensive and multifaceted approaches that address both immediate needs and long-term recovery, particularly among those in protracted displacement states (urban internally displaced persons [IDPs] and camp and non-camp refugees).



Drought-affected village in the Mekoni Tigray Region of Ethiopia. (photo: Michael Tewelde/IWMI).



Box 1: Vegetable and irrigation systems in Tigray, Ethiopia, before and after the 2020-2022 conflict.

This **complex crisis** is marked by conflict and insecurity, combined with rapid and slow-onset crises. Before the 2020-2022 conflict, Tigray's food system relied heavily on smallholder farming, with 80% of the population dependent on agriculture. The region's agricultural backbone was a mixed crop and livestock system, with 90% of households cultivating cereals and 26% growing vegetables and root crops.

The conflict severely disrupted Tigray's food system: 81% of smallholder households lost crops, 48% lost farm tools, and oxen were looted or killed. Agricultural infrastructure was destroyed, leading to 83% of the population experiencing food insecurity and a significant decline in the consumption of nutritious food.

Irrigated vegetable production is crucial for post-conflict recovery, as it offers essential nutrients and has short growing cycles. However, damaged water infrastructure has shifted priorities from vegetable production to cereal cultivation. Priority should be given to restoring irrigation systems, strengthening seed supply, improving agronomic practices and enhancing market links. Multi-actor partnerships are essential for sustainable agricultural recovery.

Source: Mwambi et al. n.d.

Most IVP interventions respond to slow-onset crises, such as droughts where food insecurity is exacerbated by water scarcity, followed by rapid-onset crises such as floods and cyclones and complex crises involving conflict and other disasters (Mwambi et al. 2024). Slow-onset crises allow for more planned and sustained interventions, while rapid-onset crises require immediate, short-term responses.

Objectives of interventions

Once water, sanitation and hygiene (WASH) interventions have been implemented, IVP can become a priority to complement external food supply. The primary objectives of IVP interventions in crisis settings are to improve food security, enhance nutritional outcomes, and increase household income while supporting climate adaptation and resilience among displaced and crisis-affected people. These objectives can vary across different types of crises. Food security is the most frequently emphasized among these objectives, particularly in complex crisis settings (Mwambi et al. n.d.). IVP interventions can also aim to empower women, as many home gardens are managed by women, contributing to gender equity, social inclusion and women's empowerment. Further, IVP has the potential to enhance mental well-being among displaced populations (Singh et al. n.d.).

However, where the crisis results in internally displaced persons, their interest in agricultural activities may evolve only over time, as their immediate needs start to be met. Some may not wish to start growing vegetables, as doing so could create the impression that they have to settle in that location for an extended period of time. Thus, agricultural production might be unlikely during the first phase of emergency relief. However, planning for future gardening, including the identification of possible production sites and the integration of water reuse systems must be considered early in the recovery process (Adam-Bradford and van Veenhuizen 2015).

Key support areas in vegetable interventions include training on good agricultural practices, pest and disease management, soil fertility management, postharvest handling, seed distribution and marketing to enhance beneficiary skills and knowledge. The logistical ease of vegetable seeds over staple crops and the critical importance of irrigation are emphasized due to the high water requirements (Singh et al. n.d.).

Vegetable production support

Diverse garden types, including kitchen gardens and community gardens, are vital for food security and resilience during complex crises (Mwambi et al. n.d.). Kitchen gardens are typically small-scale, home-based gardens that grow vegetables such as cabbage, carrot and kale, focusing on nutrition and adaptability (Mwambi 2024). The Sphere Project highlights the importance of kitchen gardens for immediate household food needs (Sphere Association 2018). Support for kitchen gardens includes the provision of vegetable seeds, agronomic training, irrigation equipment and financial literacy (Mwambi et al. 2024).

Vegetable gardening, which can encompass kitchen gardens, focuses more broadly on income and nutrition enhancement and supports mental health and trauma recovery (Singh et al. n.d.; Millican et al. 2019). It requires limited space and input to be successful. Vegetable gardening requires a minimum seed input to cultivate an optimal garden size of 15 square meters per household (UNHCR 2024). Support for vegetable gardens includes direct seed provision, promoting seed-saving practices, organizing best-garden competitions, seed fairs or exchanges, distributing seed vouchers and establishing community seed banks.

Irrigation support

Irrigation support is the second most prevalent type of vegetable intervention after the use of dams and ponds for irrigation interventions, as cited in related literature (Mwambi et al. n.d.). A variety of irrigation technologies and practices are utilized in crisis settings, though there is limited guidance on selection and suitability. Identified examples of irrigation practices include drip irrigation systems, bucket watering and the construction of small dams and ponds. The type of support varies significantly depending

on the context of the crisis. Small dams and ponds are common in slow- and rapid-onset crises as effective water storage solutions, serving to store or capture and manage excess water, respectively. Approximately 20% of projects utilize bucket watering, and diesel/petrol pumps are the predominant pumping technology, with minimal use of electric, hand and solar pumps, particularly in slow- and rapid-onset crises. Notably, there are limited examples of solar pumping technologies reported in complex crisis settings, with a greater reliance on mechanized pedal pumps, electric pumps and motor pumps. Hence, integrating and contextualizing various irrigation technologies is critical for vegetable production in crisis settings. Tailor-made, context-specific irrigation strategies are needed to ensure the sustainability and success of IVP in humanitarian settings. Special care has to be taken where water reuse is needed and promoted (Drechsel 2024).

Designing and implementing IVP interventions

There is limited evaluation of how different types of crises affect the potential for building resilience through IVP. Organizations often require help in balancing the need for quick action with the need for comprehensive assessments (Knox Clarke and Campbell 2020; SEADS 2022).

Recommendations

An assessment of the enabling environment is needed to determine whether irrigated vegetable production interventions are suitable for a given emergency context. A rapid assessment can be conducted to:

- tailor the IVP project to the crisis-specific impacts on food, land and water systems, guiding IVP design to fit local contexts;
- ensure strategic timing of IVP implementation within the crisis timeline, focusing on immediate food security in rapid-onset crises and resilience building in protracted situations;
- incorporate community input to ensure interventions meet local needs and preferences; and
- adapt IVP interventions based on real-time data, allowing for adjustments as a crisis evolves, maximizing impact and reducing risks.



Urban agriculture holding within an IDP hosting community in Mekelle, Tigray, Northern Ethiopia (photo: Mitchell McTough).

Context analysis

Understanding the emergency contexts, including how crises affect the enabling environment, livelihood aspirations and the potential for IVP to support these aspirations, is crucial for designing effective interventions for crisis-affected groups such as refugees, IDPs, host communities or returnees (Millican et al. 2019). For example, market disruptions and labor shortages caused by crises can significantly impact agricultural production and the availability of necessary inputs such as irrigation technologies and spare parts (Jagtap et al. 2022).

However, intervention design often overlooks the effects of crises on the enabling environment for IVP. Limited understanding and consideration of enabling environments can increase gendered labor burdens and reduce women's control over IVP-generated incomes, leading to unintended or negative outcomes (Singh et al. n.d.). Before designing an IVP intervention, it is essential to evaluate how crises impact short- and long-term factors such as value chains, markets and infrastructure. When locally unavailable or markets are disrupted, irrigation technologies are often imported. As a result, spare parts or maintenance services may not be available post-implementation, leading to the abandonment of IVP projects when equipment starts to fail.

Interventions might impact other food, land and water systems, as well as other members of the communities in the area. Assessing the risks of interventions that could potentially increase beneficiaries' vulnerability is crucial, as reducing vulnerability in one dimension may increase vulnerability in another. Analyzing the potential trade-offs of vulnerabilities' dynamics helps identify strategies that limit them and achieve Pareto improvements¹. This can help to mitigate the unintended negative consequences of IVP interventions.

Beneficiary and partner selection

Effective beneficiary targeting ensures that the funding and resources invested in the intervention produce the desired outcomes. However, there are significant coordination and data disaggregation gaps in the selection of beneficiaries and partners. A lack of disaggregated data on beneficiary needs hampers the design of suitable interventions (for example, in terms of vegetable choice and irrigation technology suitability), particularly in urgent settings where quick action is prioritized over thorough needs assessments. Understanding the specific needs of different groups, such as women, children and the elderly, is crucial for conflict-sensitive, targeted and effective IVP interventions that address gender equity and social inclusion while adhering to the 'Do No Harm' principle.

¹ An enhancement to a system where a reallocation of goods benefits at least one person without causing harm to anyone else.

Recommendations

The selection of beneficiaries should align with the intended outcomes of interventions and be based on the following:

- Assessing household vulnerabilities, dynamics, capacities and access to different assets in emergencies.
- Understanding how the emergency changes beneficiaries' priorities, affecting willingness to adopt, own and use innovations.
- Coordinated data sharing among organizations operating in the environment, including government entities, to select beneficiaries and avoid duplication of activities.
- Analyzing costs and benefits of market-oriented irrigated vegetable production.

As self-reliance strategies that align with neoliberal development approaches can sometimes engender inequity (Singh et al. n.d.), more nuanced and context-specific research is needed. The impacts of IVP interventions on gender dynamics and livelihood aspirations remain underexplored, particularly given that many home gardens are maintained by women. Focused studies are needed to better understand these dynamics and their implications for vegetable production.

Unrealistic partnership goals and inadequate consideration of institutional capacity hinder IVP implementation in humanitarian settings. Transferring projects to government authorities is challenging where institutional capacity is weak (Singh et al. n.d.). Effective partnerships must be context-specific. Private partnerships work well with strong private sectors but struggle in emergency settings with weak infrastructure and institutions. International nongovernmental organizations (NGOs) bring expertise but need clear roles to avoid redundancy and duplication of activities. Local partnerships ensure sustainability by leveraging local knowledge, but they often require substantial capacity building.

Designing and implementing irrigation support for vegetable production

Emergency interventions primarily focus not directly on IVP but on rehabilitating the broader infrastructure to enhance institutional capacities (Singh et al. n.d.). Irrigated vegetable production is often one part of a larger project. Detailed information on the decision-making processes behind IVP design and implementation is rarely provided (Singh et al. n.d.). Significant gaps in the design and implementation of irrigation systems and technologies, including, for example, insufficient community consultation regarding technology design, pose substantial threats to the sustainability of interventions.

Recommendations

The IVP intervention design should focus on enhancing value chain resilience and adapting to market changes for sustainable investments. Comprehensive assessments of irrigation value chains and the private sector should:

- evaluate disruptions to financing, infrastructure and production to identify bottlenecks;
- identify commercial opportunities for high-cost technologies; and
- improve macro-, meso- and micro-level consultations on technologies to enhance the sustainability of IVP.

Implementation should stabilize markets and strengthen value chains by:

- rebuilding critical infrastructure (e.g., irrigation systems, markets, roads) to enable IVP;
- partnering with and incentivizing the private sector to reach vulnerable populations; and
- limiting direct provision of irrigation technologies to reduce donor dependency.

Additionally, inadequate value chain analysis and the lack of data or the fragmented and dispersed data on water resource availability often result in flawed irrigation designs and technology malfunctions. These problematic interventions might negatively affect food systems and the sustainability of water resources in the long run and, in a worst-case scenario, lead to water-related conflicts within communities. The lack of context-specific and target group-specific value chain analyses limits the understanding of how value chains function and who benefits from higher or lower prices, further exacerbating the challenges faced in IVP intervention design and implementation.

Understanding how systemic issues that have existed prior to a crisis affect IVP intervention outcomes is crucial for designing effective programs. For instance, the interaction between climate change and political instability can compound the challenges faced by IVP interventions, requiring a more integrated, holistic approach to intervention design, particularly in complex crisis settings (Pain and Levine 2012). Furthermore, the ability of communities and stakeholders to tailor their responses to novel crises such as the COVID-19 pandemic is an essential factor, as crises have unusual and unpredictable effects on the enabling environment for IVP. The need for such tailored responses to novel and emergent crises further complicates effective intervention planning and implementation.

Addressing gaps in practical interventions (“what we do”) and research and evidence (“what we know”) is necessary for better decision-making and enhancing resilience in crisis-affected populations. For long-term institutional support, donors require a more detailed needs assessment and design justification closely aligned with government policies and development programs. Additionally, relevant actors along value chains, including financing institutions, must be included early to co-identify and develop potential intervention areas. Community consultation, participation and engagement are essential in designing and implementing the intervention to mitigate the risks that threaten the sustainability of the IVP.

Monitoring and evaluation

Weak monitoring and evaluation (M&E) frameworks limit the assessment of intervention outcomes in crisis settings. Most evaluations focus on immediate outputs rather than long-term effects or changes in resilience, constraining understanding of broader impacts. Robust methods are needed to capture changes in food security, nutritional outcomes, income generation and community resilience. For example, the sociocultural and mental health benefits—such as therapeutic effects in humanitarian settlements—should be captured and included in intervention evaluations alongside conventional metrics such as crop yields and income (Millican et al. 2019).

Recommendations

To strengthen the monitoring and evaluation of intervention outcomes in crisis settings, design and implementation should seek to:

- develop robust monitoring frameworks that focus evaluations on long-term impacts, including food security, nutrition and community resilience;
- incorporate metrics that capture sociocultural and mental health benefits in evaluations, moving beyond traditional indicators such as crop yields and income;
- utilize quasi-experimental designs that implement rigorous evaluation methods to accurately assess intervention effectiveness;
- analyze systemic vulnerabilities to align evaluations with organizational capacity, focusing on understanding systemic vulnerabilities in crisis contexts; and
- enhance research on crisis impacts to investigate how different crises affect IVP outcomes, thereby improving intervention strategies.



Urban farmer in the conflict-affected Oromia Region of Ethiopia (photo: Desalegne Tegegne/IWMI).

The lack of rigorous evaluation designs further limits the evidence base. In humanitarian contexts, “sense-making” often neglects critical evidence, leading to misinterpretations (Knox Clarke and Campbell 2020). Singh et al. (n.d.) stress the importance of analyzing emergency contexts, focusing on systemic vulnerabilities, and aligning outcomes with organizational capacity to enhance intervention theories of change.

While vegetable production is believed to enhance nutritional outcomes and generate income, further research is needed to understand how these benefits are achieved (Singh et al. n.d.). As emphasized in the previous section, coherently disaggregated and well-disseminated data can contribute to addressing outcome-level reporting gaps. Furthermore, understanding how different types of crises—ranging from slow-onset to complex crises—affect IVP outcomes remains a critical research gap (Singh et al. n.d.). Enhanced M&E practices are essential to addressing these gaps and validating the effectiveness of IVP interventions in diverse crisis contexts.

Long-term M&E can validate assumptions, identify contextual variances and clarify links between food security, resilience and IVP, thus strengthening the evidence base for specific nutritional outcomes. This approach provides a more realistic and responsive framework for effective intervention design and implementation.

Limitation of data and knowledge management

Literature highlights significant gaps in data and knowledge management for IVP in emergency settings. Humanitarian responders often lack administrative data and face short timelines for identifying beneficiaries (Knox Clarke and Campbell 2020). In addition, knowledge gaps regarding access, functioning and maintenance of specific irrigation technologies, as well as irrigation supply chains, limit the design and implementation of context-relevant IVP interventions.

More evidence is needed to enable effective design, implementation and evaluation of IVP interventions. There is a clear need for more rigorous evaluations of the impacts of different crises on IVP outcomes, comprehensive assessments of beneficiary needs and the integration of value chains and market analyses in intervention design (Mwambi et al. n.d.; Singh et al. n.d.).

Limited data collection beyond basic agricultural metrics is a significant gap in knowledge management. To address this, more comprehensive data collection should include sociocultural and economic indicators to better understand intervention impacts (Mwambi et al. 2024). There is a need for detailed reporting on the decision-making processes behind intervention design and implementation. Understanding why specific seeds, technologies and practices were chosen is essential for improving future interventions.

Addressing these gaps is crucial for enhancing the effectiveness of IVP interventions and ensuring that they contribute to building resilience in crisis-affected communities such as refugees, IDPs, host communities and returnees. Adherence to established standards and best practice guidelines can significantly bolster these efforts.

Recommendations

Effective data and knowledge management is crucial for enhancing learning and optimizing humanitarian interventions. To improve these processes, the following strategies should be considered:

- Integrating multi-source data and creating unified platforms that consolidate data from academic institutions, NGOs and other entities
- Enhancing accessibility to data platforms to facilitate better IVP design through data sharing between sectors (including the private sector) on water resources
- Developing internal databases to track and analyze data, particularly for uncommon and highly disruptive crises (i.e., pandemics)
- Implementing mandatory documentation of intervention design, decisions and outcomes to build a comprehensive repository of best practices (i.e., seeds, technologies) for informed, sustainable interventions.

SEADS standards and best practice guidelines for improving intervention design and implementation

The Standards for Supporting Crop-related Livelihoods in Emergencies (SEADS) provide a robust framework for designing and implementing agricultural interventions across different crisis contexts. These standards categorize crises into rapid-onset, slow-onset and complex forms, each necessitating tailored approaches (SEADS 2022). Although vegetable production is advantageous for emergency interventions, its inclusion often requires more adequate support and a comprehensive framework. SEADS standards offer a structured methodology for integrating applicable crop types into crisis response plans, addressing immediate nutritional requirements while fostering long-term resilience, although they do not strictly target irrigated vegetable production.

The best practice guidelines produced by the Bureau for Humanitarian Assistance (BHA), United States Agency for International Development (USAID) (Pincus et al. 2024) address the critical need for structured project designs incorporating

a clear theory of change and contextual relevance for introducing IVP in crisis settings. These guidelines delineate common project approaches, objectives, challenges and best practices. Additionally, they include exercises for evaluating the feasibility, impact and effectiveness of vegetable interventions, particularly in terms of food and nutrition security and income generation. The guidelines underscore the significance of irrigation and seed, drawing from an evidence review, field data and virtual workshops with local agricultural experts, humanitarian practitioners and researchers. Humanitarian and development practitioners are advised to employ these guidelines during the initial project design phase, considering the local context, available resources and constraints. This ensures the development of comprehensive, impactful proposals that adhere to the ‘Do No Harm’ principle and advocate for sustainable, market-based solutions.

The way forward

The design and implementation of IVP interventions are significantly influenced by the enabling environment, logistical and technical constraints and organizational capacity—factors that are often overlooked but are crucial for IVP success (Singh et al. n.d.). While these factors are common in many types of interventions, IVP design must be particularly thoughtful to ensure successful and sustainable interventions due to their reliance on specific agricultural, water and market systems in emergency contexts. The next phase involves testing practical guidelines with humanitarian organizations and developing a web-based [toolkit](https://vict.itechmission.org/toolkit/)² to operationalize them for diverse crisis contexts. This toolkit will include investment maps and [best practice guidelines](https://avrdc.org/vegetable-interventions-as-a-humanitarian-response-best-practice-guidelines-and-assessment-tool/)³ to facilitate localized investments in irrigation for vegetable production in humanitarian crises. It will feature a user-friendly interface co-created with humanitarian organizations, drawing on desk-based reviews, field data, geospatial analysis and prediction models. IWMI is working with partners to ensure the toolkit addresses key factors such as water resource availability and irrigation technology, enabling environment analysis and supporting the design and implementation of effective IVP interventions in emergency settings.



Connecting hoses to pump groundwater for irrigation in Ethiopia (photo: Maheder Haileselassie/IWMI).

² <https://vict.itechmission.org/toolkit/>

³ <https://avrdc.org/vegetable-interventions-as-a-humanitarian-response-best-practice-guidelines-and-assessment-tool/>



A woman working on a cabbage farm in Bochesa around Ziway in Ethiopia (photo: Maheder Haileselassie/IWMI).

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