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# Irrigated Vegetable Production Interventions in Humanitarian Emergencies: Mali Country Deep Dive





# **Irrigated Vegetable Production Interventions in Humanitarian Emergencies:**

## **Mali Country Deep Dive**

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Cover photo: Irrigating a chili farm in Sikasso, Mali, during the dry season (*photo*: Thai Thi Minh/IWMI)

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# Summary

In the context of Mali, a Sahelian country facing challenges of insecurity, political instability, and climate change, irrigated vegetable production (IVP) interventions have the potential to enhance resilience outcomes and reduce the vulnerabilities of households and communities by increasing incomes and improving nutritional outcomes. The recommendations for IVP interventions presented in this document are informed by an understanding of the complex sociopolitical landscape of Mali and address both challenges and opportunities.

For this study, a comprehensive research process was undertaken involving 19 key informant interviews with humanitarian organizations working in the country. These interviews were supplemented with insights from a wide range of secondary sources including journal articles and project reports. A rigorous approach was adopted to ensure the validity and reliability of the findings and recommendations.

The key recommendations presented here have been carefully crafted to improve the design and implementation of IVP interventions undertaken by humanitarian organizations in emergency contexts in Mali. These recommendations align with the [SEADS \(Standards for Supporting Crop-related Livelihoods in Emergencies\) minimum standards](#) and are intended to complement the SEADS guidance on tools, equipment, and other non-seed inputs as well as impact monitoring and evaluation, thus providing an assurance of quality and relevance.

First, it is important to ensure that the design, planning, and implementation of IVP interventions are contextually relevant while being focused on the unique needs of vulnerable communities. Interventions should be designed to address land access issues, especially for women and internally displaced persons. Security levels (safety risks, political instability, and conflict) should be considered when choosing water-lifting technologies, and interventions must be informed by a gender-sensitive approach.

Second, mobilizing resources and investments is crucial to complement funding shortages for IVP interventions. This can involve measures like promoting space-efficient vertical gardening, supporting domestic vegetable production to procure less expensive and more suitable seeds for local conditions, and strengthening IVP value chains by linking farmers with local seed suppliers.

Third, strengthening organizational capacity for resilience and long-term learning is recommended to enhance the delivery of impactful emergency assistance. This includes adopting a systems approach that considers the socioeconomic and environmental context of the intended intervention and sharing findings among humanitarian actors to foster a learning culture.

Finally, improving data and knowledge management is advised for impactful IVP interventions. This could involve housing all groundwater data within an NGO, promoting the ongoing mapping of suitable irrigation technologies, and ensuring that data is freely accessible to all organizations involved in agricultural interventions.

These recommendations offer a roadmap for humanitarian organizations, donors, and policymakers who aim to enhance the effectiveness and sustainability of IVP interventions in emergency contexts within Mali. They provide a framework for engaging with existing policies and governance structures and contribute to creating an enabling environment for effective interventions.



Unloading sweet potato at a vegetable wholesale market in Sikasso, Mali (photo: Thai Thi Minh/IWMI).

# Emergency Context and Humanitarian Needs in Mali

**The Republic of Mali faces environmental and climatic risks exacerbated by ongoing insecurity and political turmoil** (Box 1). It is susceptible to droughts, flooding, heatwave hazards, and other climate-induced risks. Water resources are under threat due to a 30 percent reduction in rainfall over the last few decades, which has affected agricultural production, largely rainfed, in the country. In some parts of Mali, political turmoil and violence due to the rise of extremism and clashes between ethnic groups have contributed to insecurity. The absence of state institutions in these areas has given rise to illicit trade, including smuggling of weapons and drugs. Coups d'état in 2020 and 2021 have exacerbated insecurity and political turmoil while shocks such as the COVID-19 pandemic and the war in Ukraine have caused a further rise in already high food prices (Caparini 2015; World Bank 2023).

**Climate-related events, conflict, and external shocks have contributed to Mali's food insecurity crisis.** The proportion of undernourished people in the population increased from just over 3 percent in 2017 to nearly 10 percent in 2020. The spread of insecurity into the previously stable southern and western regions of the country has adversely impacted agricultural, fishing, and livestock production, diminishing families' ability to secure food. Prolonged displacement, restricted humanitarian access, and disrupted livelihoods make food insecurity worse for vulnerable families. According to the March 2023 Cadre Harmonisé food security analysis, the number of individuals grappling with irregular access to nutritious food escalates to 1.2 million during the June-September lean season (Tucker 2023; World Bank 2023; Cadre Harmonisé 2023).

**Box 1.** Shocks and stresses contributing to Mali's emergencies.

**Climate and environmental crises.** Mali is susceptible to hydrometeorological hazards including droughts, floods, heatwaves, and sandstorms, and climate-induced risks such as wildfires and locust invasions. Frequent droughts and a 30 percent reduction in average annual rainfall since 1998 have led to chronic hunger, which is forcing communities to migrate (Caparini 2015; Climate Centre 2021). The impacts of climate change in Mali are estimated to be among the most severe in the world with agricultural productivity projected to decline over 40 percent. Mali's farm sector, on which its economy is heavily dependent, is highly stressed due to rainfall decline and increased water demand. The most stressed regions such as Sikasso, Mopti, and Segou are vital for food security and have high population densities and poverty levels (Tucker 2023; World Bank 2023). Climatic and environmental stresses combined with ongoing violence and political turmoil, particularly in the central and northern parts of the country, are major contributors to the crisis gripping Mali.

**Conflict and insecurity.** Longstanding political turmoil has resulted in the retreat of state functions in several parts of the country, contributing to high levels of insecurity. The Tuareg, a minority ethnic group in northern Mali, became increasingly disenchanted with governance from Bamako. In early 2012, the National Movement for the Liberation of Azawad (MNL) sought independence for the northern region of Mali. Two more coups d'état occurred in 2020 and 2021, exacerbating insecurity and political turmoil (ICG 2021; HRW 2022). During this time, the country has struggled in the context of economic mismanagement, corruption and escalating insurgency in the northern and central regions. As of December 2022, approximately 412,000 people were internally displaced, and over 63,000 refugees were hosted in Mali, primarily after fleeing insecurity in neighboring countries (USAID 2023a).

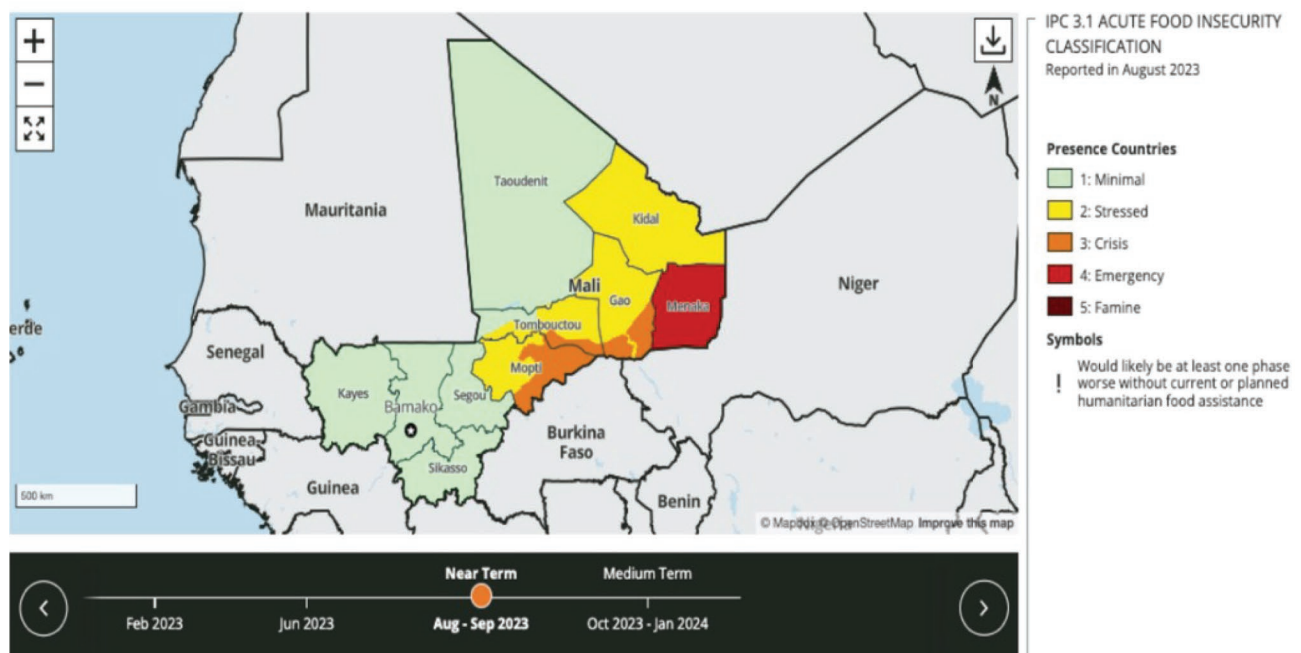
**Geographical disparities and poverty.** Northern Mali is characterized by extreme poverty and limited livelihood opportunities. Political upheaval has contributed to a broader governance crisis and exacerbating vulnerabilities. Land-use conflicts have been exacerbated by the power vacuum created by state withdrawal (HRW 2022).

**Food price inflation and supply chain shocks.** Since 2020, additional pressures due to the COVID-19 pandemic-related supply bottlenecks, sanctions on food imports, and the impact of the Ukraine war on global food supplies have decreased the availability of essential agricultural inputs, which in turn increased food insecurity. A market analysis in February 2023 revealed that prices of staples such as millets, sorghum, corn, and rice have increased significantly compared to five-year averages, exacerbating the plight of impoverished families (WFP 2023). Food prices in late 2022 were approximately 30 percent higher than the 2019 averages, and this trend persisted into 2023. Food items now constitute nearly 60 percent of consumer spending in Mali, and the latest data indicate that about three-quarters of the population has insufficient food consumption (World Bank 2023).

**The impact of food insecurity will likely have profound, long-term consequences.** Extreme poverty has increased rapidly alongside food insecurity in Mali (Figure 1), rising to 19.1 percent in 2022. Additionally, food insecurity may compel households to liquidate physical assets to purchase food, thus eroding their physical capital (Tucker 2023). This is driven by an erosion of purchasing power for the most vulnerable section of the population owing to soaring consumer prices and weak economic growth. Chronic malnutrition can cause irreversible cognitive and physical damage, particularly affecting children’s development and educational outcomes. Given Mali’s young population (median age 15), the ramifications of this could be severe. By mid-2023, 24 percent of the population was projected to face severe food insecurity or be at risk, affecting approximately 1.3 million and 4 million people, respectively (Tucker 2023). Situated within the Sahel, which stands as one of the few global regions where an uptick in the prevalence of undernourishment has been documented, Mali’s average number of undernourished individuals escalated from 1.0 million to 1.2 million between 2014 and 2018 (FAO et al. 2020).

## Mali Acute Food Insecurity

August - September 2023 projected outcomes



**Figure 1.** Food insecurity map of Mali.

Source: FEWS NET 2023.

# Humanitarian Response to Escalating Food Insecurity Crises

**The Malian government and UN entities have responded to emergencies, human security challenges, and food insecurity crises in the Sahelian country in various ways (Box 2).** However, results from humanitarian assistance initiatives have been mixed, for several reasons:

- **The need for external humanitarian assistance in Mali is acute and increasing.** In 2023, it was projected that 8.8 million people require humanitarian assistance in Mali, a 17 percent increase over the previous year (USAID 2023a). However, the response to the humanitarian and food insecurity challenge has not been effective. International development partners fund most of the social assistance programs in Mali and concentrate on providing food support, including food distribution and school feeding. But these efforts are not specifically targeted toward the poorest sections of the people. The existing social safety net system is too limited and fragmented to be an appropriate response to poverty and vulnerability (Cherrier et al. 2011).
- **Central government institutions are non-functioning in several parts of the country.** As a result, local populations, finding that their pastoral priorities are not being addressed by the administration, turn to extremist groups instead. Moreover, without government presence, coordinating and supporting interventions by different humanitarian organizations becomes challenging (Bleck et al. 2016; Benjaminsen and Ba 2018).
- **Humanitarian organizations face serious security risks.** Since the end of 2019, humanitarian organizations working in Mali have had to reckon with the risk of abduction, looting, illegal detention, and intimidation. More than 200 security-related incidents involving humanitarian workers were reported in 2020—a 10 percent increase over the previous year (USAID 2021; IOM 2023).

## **Box 2.** Humanitarian response programs in Mali.

- **Government-led programs**

Mali's social safety net programs fall into four categories: i) programs that provide cash or in-kind transfers, such as food distribution, nutrition programs, or school canteens; ii) programs that distribute global price subsidies in the form of tax exemptions on food products; iii) programs that provide income (e.g.; public works for food or cash payment); and iv) programs that improve human capital and provide access to basic services (e.g.; health fee exemptions) (World Bank 2017).

- **International organization-led programs**

- The regional organization G5 Sahel was established in 2014 to bolster cooperation in security and development to augment household resilience and food security.
- The Emergency Safety Nets project (Jigiséméjiri) and the Sahel Adaptive Social Protection Program (SASPP) were both projects funded by the World Bank to enhance household resilience and decrease poverty in Mali. They started in 2013 and 2014, respectively, and ended in 2022 and 2023 (D'Errico et al. 2021).
- The United Nations Support Plan (UNSP) for the Sahel (2018–2030) was inaugurated in 2017. It aims to strengthen security, governance, development, human rights, and humanitarian aid actions. Agencies of the United Nations, including the Food and Agriculture Organization (FAO) of the United Nations, the International Fund for Agricultural Development (IFAD), and WFP designed the action plan for resilience in the Sahel in 2019.
- WFP planned to provide emergency food and nutrition assistance to 3.8 million people in Mali in 2023. This included targeted aid for 0.65 million individuals during the pre-lean season from March to May and 1.2 million food-insecure people during the June-September lean season.



Solar-based irrigation invested by a farmer in Sikasso, Mali (photo: Thai Thi Minh/IWMI).

- **Funding for humanitarian programs consistently falls short of what is needed.** While addressing the crisis in the Sahel has become part of the global agenda, limited funding has been a constraint. For example, the World Food Programme (WFP) is facing funding constraints that have led to a 50 percent reduction in food rations for host communities (WFP 2023).
- **To cope with food insecurity, households in Mali adjust their livelihood strategies or adopt new ones.** Diversifying livelihood is a common strategy adopted by communities in semi-arid areas to deal with uncertainty and variability and to mitigate everyday risks. In response to a crisis, households often engage with reactive coping mechanisms, or even unplanned reactions undertaken spontaneously, such as selling their productive assets, borrowing money, or consuming less diverse food, which can lead them into a poverty trap. Others may engage with proactive or preventative strategies, or planned, frequently revised, and mainly longer-term actions to increase their long-term resilience. However, due to a lack of assets, market access, and the ability to plan long-term, households take recourse to reactive coping strategies (Brockhaus et al. 2013; Huet et al. 2020). Household economies are usually supplemented through the trade of livestock by-products. Specific members of the household may migrate, engage in small-scale farming, or engage in illicit activities such as smuggling or raiding. Women often sell vegetables or household products on a small scale to buy condiments or small goods for the family (Huet et al. 2020; D’Errico et al. 2021).
- **A viable, long-term adaptation strategy for households in Mali is to adopt small-scale irrigation systems, giving farmers access to water for a greater part of the year (Box 3).** The advantages of irrigation are manifold, including increased crop production and yield, particularly during the dry season, and diminished likelihood of crop failure. Irrigation allows smallholder farmers to diversify crop production and transition to high-value, market-driven crops. Adopting irrigation practices has substantially augmented annual household farm income and asset accumulation. It also helps stabilize food production and can increase food and nutrition security. Irrigation also leads to a decrease in stunted growth and severe underweight conditions among children (Koo et al. 2019; Nkonya 2020; BenYishay et al. 2023).

- **Small-scale irrigation involves several systems.** Gravity irrigation is primarily used in the northern zone and central areas around the Niger River. Motor pumps are used to lift water from rivers, ponds, or lakes to produce cereals and vegetables. Drip irrigation is an emerging practice in Mali, particularly promoted by development programs and services such as NGOs, and research institutes. Wealthy farmers mainly use this technology for fruit and vegetable cropping in urban areas. Manual watering, buckets, calabashes, and watering cans are common in urban and rural areas, particularly for vegetable irrigation (Kergna and Dembélé 2018).
- **Irrigated vegetable production (IVP) has great potential to increase food security by raising incomes and improving nutritional outcomes in rural Mali.** Vegetables are mainly cultivated during the dry season using traditional irrigation systems, often involving shallow wells (Birhanu et al. 2023). Vegetables have high market value and can be sold for higher prices than staple crops. Vegetable consumption is crucial for nutritional well-being. Current vegetable intake levels in Mali are about half of the recommended standards (Dembélé et al. 2021). To build resilience to shocks and help develop long-term coping strategies, humanitarian organizations have carried out IVP interventions as part of their emergency response. IVP interventions often target resource-poor smallholders and vulnerable members of households, equipping them with the skills and technologies to own and operate irrigation systems to produce vegetables.

### Box 3. Irrigation development in Mali.

**Agricultural production provides partial or full livelihood to 80 percent of Mali's population.** However, to supplement their income, many Malians from rural areas migrate to cities for part of the year. A mere one-third of the land in the country is designated for agricultural purposes; a significant portion is allocated to permanent meadows and pastures. Average landholding is approximately 4.87 ha. Arable farming, accounting for about 15 percent of the farmland, is predominantly carried out by small-scale farmers employing fallow rotation methods. Mali's agrarian economy is characterized by cultivation of rice in irrigated fields, while millets, sorghum, and maize are the predominant rainfed crops (Hennings 2022).

**There are abundant water resources, primarily concentrated in the Niger and Senegal river basins and the inland delta in the central region, that can be used for irrigation.** Given that Mali has only one rainy season, developing irrigation infrastructure and adopting irrigation technology could be a critical adaptation strategy for building resilience against climate-induced emergencies (Kergna and Dembélé 2018). Mali's national climate change policy recognizes irrigated agriculture as a key strategy for adapting to rainfall variability, enhancing productivity and incomes, and mitigating the impacts of emergencies on agricultural production (Climate Centre 2021; Tucker 2023).

**The government has made several investments in developing and rehabilitating irrigation schemes.** The 2000-2010 Master Plan of Rural Development (Schéma Directeur du Développement Rural, or SDDR2) was focused on harnessing the country's substantial irrigation potential exceeding 2 million ha, predominantly situated in the Niger Delta and the southern and southwestern lowland plains. The National Rural Infrastructure Program (Programme national d'infrastructures rurales, or PNIR) encompasses three key components: large- and small-scale irrigation, village water supply and sanitation, and rural road networks (Nkonya et al. 2020). For the 2012-2021 period, the Malian government adopted a national local irrigation program (Programme national d'irrigation de proximité, or PNIP) (Ministère de l'Agriculture 2012).

**Development actors also facilitate the adoption of suitable irrigation practices and technologies.** Some of the investments made by development actors in irrigation development focus on cultivating high-value horticultural crops to create new livelihood opportunities and new income sources for farmers. IVP interventions are also aimed at improving the nutritional status of families, particularly of women and children (Kane et al. 2018; BMZ 2023).

**Despite these concerted efforts, irrigation development in Mali has yet to reach its potential.** A mere 34 percent of the country's irrigation potential is currently being utilized (FEWS NET 2023). Moreover, only approximately 235,791 ha (5 per cent) are irrigated; and 41 percent of the total irrigated land is concentrated in the Ségou Region, which falls under the expansive irrigation scheme known as the Office du Niger (Nkonya et al. 2020). Water availability remains a challenge, with 39 percent of rural communities experiencing consistent water shortages and the majority facing periodic shortages (Birhanu et al. 2023).

# Current Design and Implementation of Irrigated Vegetable Production Interventions

The International Water Management Institute (IWMI) has undertaken several significant initiatives in Mali, primarily to bolster the agricultural sector through sustainable irrigation practices and technological innovation. One of the key areas of focus has been the development and promotion of solar-powered irrigation, a response to the country's heavy reliance on rainfed agriculture and its susceptibility to climate variability. The promotion of solar-powered water pumps, which have become increasingly affordable due to the falling costs of solar photovoltaic panels, targets a large segment of Mali's farming population. This initiative enhances irrigation efficiency, increases agricultural productivity, and mitigates the sector's vulnerability to erratic weather patterns and droughts. Additionally, IWMI has conducted comprehensive studies on the implementation and impact of contour bunding technology in central and southern Mali. This land and water management practice, aimed at controlling erosion and improving agricultural productivity, has shown significant benefits in increasing crop yields, conserving soil moisture, and reducing soil erosion, thus positively impacting farm-level productivity and farmers' incomes.

In parallel, IWMI has been instrumental in bridging the demand-supply gap in Mali's solar-powered irrigation value chains. This has been achieved through workshops and field demonstrations, particularly in the Sikasso Region, to make irrigated agriculture profitable for buyers and sellers of solar-powered pumps. These activities involved market segmentation to identify farmers interested in solar-powered pumps and engage with stakeholders, including private-sector pump suppliers, farmers, technicians, and financial institutions. Furthermore, IWMI has strongly emphasized capacity strengthening and technical knowledge sharing. Its efforts to enhance the skills and knowledge of local technicians and farmers include innovative pump sale-and-maintenance solutions and digital tools for credit assessment. These comprehensive initiatives by IWMI are enhancing the resilience of Mali's agricultural sector and contributing significantly to food security, income generation, and climate change adaptation, primarily benefiting small-scale farmers and local communities (IWMI 2023).

However, given the emergency context of Mali, a need has arisen to know more about how humanitarian organizations design and implement IVP interventions and the implications they have for food security and resilience. This is due to three reasons. First, IWMI's research activities have historically focused on long-term development programming rather than humanitarian initiatives; so, this has led to knowledge gaps in how humanitarian organizations carry out interventions. Second, humanitarian initiatives primarily focus on providing immediate relief rather than supporting agricultural activities. Promoting IVP in an emergency context is a recent development; when agricultural support does take place, it has tended to focus on staple crops rather than IVP (SEADS 2021). Third, data on how humanitarian organizations design and implement IVP interventions has not been systematically collected and analyzed.

To fill these gaps, IWMI conducted 19 in-depth and semi-structured interviews with project managers and officers working in the humanitarian sector who were experienced in implementing interventions, including vegetable production with or without irrigation in Mali. The topics covered by the interviews, conducted during May-July 2023, included the type of support provided, the objectives of the intervention, the project components, the type of crisis, the type of beneficiaries, seed and irrigation support, the technical constraints faced by IVP interventions in a crisis setting, and the technical or input support provided as part of the intervention. Based on data analysis, the following sections present the findings on IVP intervention design and implementation.

## Goals and Beneficiaries

**IVP interventions are aimed at building food security through increased income, diversified livelihoods, and improved nutritional outcomes.** Some go further to include adaptation to climate change and dealing with higher food prices as intervention goals. Others aim to intervene in value chains to build local economies and stimulate entrepreneurship. Some organizations implement IVP interventions aimed at rehabilitating internally displaced people (IDPs).

**IVP interventions are carried out in response to slow-onset, rapid-onset, and complex crises.** Following the political turmoil of the last decade, most humanitarian organizations working in Mali respond to emergencies arising from endemic insecurity in some areas. Several organizations also respond to drought-related emergencies. Most work only in rural areas, although a few organizations do intervene in urban areas with a large number of IDPs.

**Most organizations provide free fencing, tools, seeds, and technologies and engage in technical support, financial assistance, and capacity building.** Several of them help communities organize themselves into women's groups, entrepreneurship groups, or cooperatives to make commercial production more viable. These efforts aim to improve vegetable production methods, operate and maintain technologies, and increase marketability. In several interventions, workshops are organized for beneficiaries to share their experiences and engage in peer-to-peer learning. Only two organizations engage with the local agricultural department to support them in capacity-building exercises. Even though most organizations promote IVP for market purposes, only two help beneficiaries set up business plans and financing mechanisms, connect farmers to banks and insurance services, and strengthen linkages between farmers and the private sector.

**Organizations use various tools to identify beneficiaries, and so beneficiary selection varies.**

One organization uses the rapid response mechanism to identify IDPs most in need of help. When responding to seasonal stresses, some organizations conduct a household vulnerability analysis to assess malnutrition among different household members, coping strategies, levels of dietary diversity, and the extent of land degradation. Several organizations specifically target women, elderly, and disabled people. Others choose beneficiaries based on where farmers are already organized into cooperatives or women's groups, making it easier for the organization to conduct training and capacity building. Several organizations select farmers who are already producing certain crops and target them to help improve their skills and their farming approach. Many also target low-income communities with the help of administrative or political leaders. One organization works with Orange, a telephone company that is also their donor, to select beneficiaries.

## Intervention Design

**Vegetables for IVP interventions are chosen based on irrigation requirement and rainfall patterns.** According to seed producers and government organizations, the main vegetables include onions, shallots, and tomatoes, which are mostly irrigated; okra, amaranth, and watermelon, which are mostly rainfed; and African eggplant, chili pepper, and some leafy vegetables such as cabbage and lettuce, which are grown in both rainfed and irrigated fields (Dembélé et al. 2021).

**Most IVP interventions are generally timed for the October to March period, just after the rainy season, which is perceived as the best time to grow vegetables.** From April to June, temperatures in Mali are too high for most crops to thrive. From June to September, most vegetable crops suffer from excess moisture. So, cereal crops are produced during the rainy season. However, in some areas in the north where rain is minimal, vegetable production occurs in the rainy season.

**New varieties of vegetable seeds are emerging that allow production even during a time of excess or scarce moisture.** Several humanitarian organizations said they are promoting new varieties that enable vegetable production year-round. One organization works with seed producers to match beneficiaries with seed most suitable to them, while two organizations consult the local agriculture department for guidance on which seeds to promote.

**Most humanitarian organizations focus on promoting IVP for market purposes.** Beneficiaries are often encouraged to select vegetables for production based on their experience and what they feel will do well in the market. The most common vegetables grown for market production include cucumbers, carrots, okra, peppers, onions, and eggplants. Less popular vegetables are tomatoes, lettuce, cabbage, and beets. Potatoes, celery, lemongrass, chili, and herbs, including artemisia and verbena, are less common. One organization promotes production of pumpkins, melons, sweet potatoes, and cherry tomatoes for export purposes.

**Only a few humanitarian organizations promote IVP for home consumption.** Vegetables produced for home consumption include orange-fleshed potatoes, squash, moringa, and baobab leaves. Several organizations try to encourage the use of organic inputs so that produce is healthier and can be sold for a higher price. Most organizations emphasize the importance of fencing vegetable plots to limit destruction by animals. Only a few promote different forms of gardening such as keyhole gardening. One organization said they work with community-based organizations to choose the type of garden most suitable to beneficiaries.

## Irrigation Intervention

**Surface water resources for irrigation are relatively easy to develop.** In the rainy season, there is abundant water for communities close to rivers, streams, or lakes, the main water sources. River basins flood during the rainy season and, as the waters recede, pools of water are left behind that people use for irrigation. In some areas that rivers pass through, the soil is rich and conducive for IVP.

**Developing groundwater resources for irrigation is challenging.** Another major source is groundwater from hand-dug shallow wells. However, water recharging is limited, and wells and ponds dry up very quickly. Deforestation results in decreased water retention and high runoff, leading to loss of soil fertility due to erosion. To ensure sustainable use of these water sources, one organization active in Mali carries out groundwater monitoring to measure variations; another enlists the help of the hydrogeology department to ascertain how much water can be sustainably exploited. Another organization conducted its own analysis to determine how much water could be sustainably used. However, there is a lack of data, particularly on groundwater, due to which many organizations cannot conduct accurate suitability and sustainability assessments.

**Various small-scale irrigation technologies and practices are prevalent.** Manual watering is commonly employed, particularly by resource-poor farmers. In this method, water is manually drawn with a rope and a container from wells, rivers, or other surface water sources. This practice is prevalent in rural areas and is mainly used for vegetable irrigation (Kergna and Dembélé 2018; Birhanu et al. 2023). Mechanical watering involves using various pumping systems such as pedal pumps, electric pumps, and motor pumps. They can be employed in small as well as large irrigation systems and are more commonly used by wealthier farmers (Kergna and Dembélé 2018).

**Targeting irrigation interventions at different socioeconomic groups and designing them for agricultural needs is challenging.** Organizations often overlook the impact that technology adoption can have on intra-household gender dynamics, potentially leading to adverse outcomes for women. For instance, cultivating profitable crops facilitated by irrigation could lead to men asserting control over the production process and the revenue generated from sales. Such a shift in control and ownership could disadvantage women within the household.

**Despite the availability of irrigation technologies and water resources, water scarcity remains a significant challenge because further investment is needed for water-lifting.** Extraction and use of groundwater resources for irrigation are much greater in rural areas (Birhanu and Tabo 2016; DNH 2016). Most organizations intervene in irrigation by developing new water sources and assisting with extraction and application technologies. In addition to existing water sources such as rivers, streams, groundwater, and basins, new ones are developed by drilling boreholes, establishing rainwater harvesting storage structures, and digging new basins by the river. Three organizations said they also promote treated gray water for irrigation. Both solar-powered and petrol-fueled pumps are used for water-lifting; electric pumps are less common. Petrol pumps are desirable as they are less expensive and easier to access than solar-powered pumps.

**The most commonly used technologies for water application are buckets and watering cans.** Only two organizations said they promote drip systems; only one promotes sprinkler systems. The decision on which technology to promote is based on what the beneficiaries already have experience with and are comfortable operating and maintaining, and whether the technology is suited for the prevailing soil quality/characteristics and water resources. For example, some organizations said drip irrigation technologies are challenging to operate and maintain. Organizations also consider whether the technology can be kept secure from theft or destruction and whether it is locally available. Only one organization said it does not plan for irrigation from the start of the project but did admit that the need for irrigation often arises during project execution.

## Implementation and Partnerships

**Several organizations said they have extensive monitoring and evaluation systems in place.** The assessments they carry out include collecting data on production, the type of vegetables grown, changes in income levels, and new job opportunities at the community level. Periodic assessment of intervention impacts is carried out at the household and community levels. Many organizations monitor and evaluate annually or after every season. One organization said it enlists the help of beneficiaries and civil society for such assessments. Only one organization said it assesses impacts at a systemic level, using the Organizational Capacity Assessment (OCA) tool developed by USAID to assess the capacity of

producers' organizations and community structures. Only one organization said it carried out a cash-for-work program in which farmers worked on rehabilitating an area that other farmers in the community could use to produce vegetables.

**Some organizations establish community-level institutions to monitor the impact on water resources.** These include water resource user groups to ensure that water resources are managed sustainably, or monitoring committees to ensure that irrigation infrastructure built as part of the intervention is maintained. Several organizations carry out assessments to measure the uptake of water management and irrigation-related skills and practices during and after the intervention.



Dried chili in a vegetable wholesale market in Sikasso, Mali (photo: Thai Thi Minh/IWMI).

# Opportunities in and Challenges to IVP Interventions

Based on the data collected from key informant interviews, this study outlined opportunities and challenges faced by humanitarian organizations due to the impact of emergencies on the broader enabling environment for IVP (Table 1). This can result in unanticipated complexities for the operations of the organizations. To grapple with these challenges and build on the opportunities, it is necessary for these organizations to develop solid internal capacities to effectively design and implement interventions.

**Table 1.** Overview of opportunities and challenges faced by IVP interventions.

Opportunities	Contextual challenges	Organizational challenges
<b>Goals and beneficiaries</b>		
<ul style="list-style-type: none"> <li>Most communities are familiar with vegetable gardens and routinely purchase vegetables from the market.</li> </ul>	<ul style="list-style-type: none"> <li>Internally displaced people lack access to assets and resources that can help them invest in IVP.</li> <li>Women’s inability to own land limits the amount and range of vegetables they can produce.</li> </ul>	<ul style="list-style-type: none"> <li>Supporting beneficiaries with tools and technologies can increase their vulnerability.</li> <li>Correlation between adopting agricultural innovations and elevated likelihood of exposure to conflict.</li> </ul>
<b>Intervention design</b>		
<ul style="list-style-type: none"> <li>High market prices for vegetables compared to staple crops.</li> <li>Introduction of new seed varieties can facilitate year-round production.</li> <li>Humanitarian organizations invest in inputs and can source them from local, national, or international markets.</li> </ul>	<ul style="list-style-type: none"> <li>Violence and armed attacks are the biggest challenge to IVP market development.</li> <li>Insecure land tenure is a significant barrier to agricultural investment.</li> </ul>	<ul style="list-style-type: none"> <li>Financing is limited and tied to donor commitments.</li> <li>The threat of violent confrontation or kidnapping of humanitarian organization employees.</li> </ul>
<b>Irrigation intervention</b>		
<ul style="list-style-type: none"> <li>The widespread presence of water retention basins following the rainy season offers plentiful water resources.</li> <li>The availability of arable land in some communities enables expansion of IVP production.</li> </ul>	<ul style="list-style-type: none"> <li>Water scarcity in several parts of the northern and central regions limits IVP to a few months a year.</li> <li>A lack of official and verifiable data on groundwater.</li> <li>A lack of policy and institutional support for smallholder irrigation development.</li> </ul>	<ul style="list-style-type: none"> <li>Insecurity limits organizations’ ability to provide water-lifting technologies to increase water access.</li> <li>A lack of data limits the success of water resource development, particularly groundwater.</li> </ul>
<b>Implementation and partnerships</b>		
<ul style="list-style-type: none"> <li>Humanitarian organizations engage in monitoring and evaluation to assess the impact of IVP interventions.</li> </ul>	<ul style="list-style-type: none"> <li>The absence of government institutions to coordinate and support efforts between humanitarian organizations.</li> </ul>	<ul style="list-style-type: none"> <li>A lack of analyses of feedback loops and unintended consequences at a systems level.</li> </ul>

## Opportunities for IVP Interventions

### Goals and Beneficiaries

**Most beneficiary communities are familiar with vegetable gardens and routinely purchase vegetables from the market.** This establishes a foundational understanding of and demand for IVP in the community. This familiarity can catalyze the successful implementation and adoption of IVP interventions, particularly in emergency contexts where rapid uptake is essential.

## Intervention Design

**Vegetables can be produced year-round where there is access to irrigation and get higher prices in the market compared to staple crops.** So IVP can be a lucrative venture for households, offering them an avenue for livelihood diversification and enhanced income. Urban areas have high vegetable demand, which can make IVP a profitable enterprise for households. Seasonal variations further accentuate this profitability. Vegetable prices tend to escalate during the hot and rainy seasons, presenting lucrative opportunities for farmers seeking to diversify their income streams. Such seasonal price fluctuations can be strategically leveraged to enhance the economic resilience of vulnerable communities.

**Another significant development is the introduction of new seed varieties to the market that can facilitate year-round production.** These new varieties are adapted to different seasons, which would allow farmers to have multiple production cycles in a year. This adaptability not only maximizes returns for the farmer but also mitigates the need for vegetable preservation, thereby reducing postharvest losses and associated costs (Dembélé et al. 2021).

**Humanitarian organizations invest in inputs and can source them from local, national, or international markets.** This is often enough to provide several types of technologies and seeds to beneficiaries and carry out training and capacity building for IVP.

## Irrigation Intervention

**The widespread presence of water retention basins following the rainy season offers a valuable resource for IVP.** These basins enable water storage for extended periods, benefiting communities located near rivers or streams. The availability of this stored water can significantly enhance the sustainability and resilience of IVP interventions, particularly in regions prone to water scarcity or seasonal variations in water availability.

**The availability of arable land in some communities provides a conducive environment for the expansion of IVP production.** This availability alleviates land-use conflicts and enables more extensive cultivation, increasing the potential for higher yields and income.

## Implementation and Partnerships

**Humanitarian organizations engage in monitoring and evaluation to assess the impact of IVP interventions.** This enables organizations to determine the impact of their interventions on various indicators such as yield improvement, income generation, and livelihood diversification. The data generated through monitoring and evaluation can serve as a valuable resource for adaptive management, allowing organizations to make timely adjustments to their interventions based on emerging evidence and feedback loops.

## Contextual Challenges

### Goals and Beneficiaries

**Internally displaced people lack access to assets and resources that can help them invest in IVP.** Migrant populations, including IDPs and pastoralists displaced by climatic conditions, find themselves in precarious positions due to their reliance on host communities for land allocation. Conflict between indigenous populations and migrants or displaced persons over land and water resources is on the rise.

**Customary denial of land ownership rights to women limits the amount and range of vegetables produced in IVP interventions.** Women are major producers of vegetables, particularly for home consumption. However, they traditionally do not own land but can cultivate or use it temporarily. The lurking possibility of the land being taken away from them discourages investment in land improvements, including irrigation (LaLumia and Alinon 2010).

## Intervention Design

**Violence and armed attacks present the biggest challenge to IVP market development.** Insecurity in the northern part of Mali is exacerbated by the lack of governmental presence, resulting in a power vacuum (D’Errico et al. 2021). As a result, the costs of all agricultural inputs are higher due to the difficulties of moving goods across the country. Fuel, for example, is extremely expensive. High levels of insecurity also deter private sector involvement, which could otherwise contribute to the availability and maintenance of IVP technologies. Communities have unreliable access to input and output markets and technological services.

**Insecure land tenure is a significant barrier to agricultural investment.** Most of the titled land in Mali is in urban and peri-urban areas. Very few smallholder farmers or agro-pastoralists own the land they work on. Since untitled land is owned by the state, almost all rural areas come under state ownership but with customary use rights exercised by sedentary farmers, agro-pastoralists, and transhumant pastoralists (USAID 2023b). The costs of acquiring or renting land for agricultural use are substantial (Govoeyi et al. 2022). People are often unwilling to invest in irrigation technologies and practices if land tenure is not secure (Totin et al. 2021).

## Irrigation Intervention

**Water scarcity in several parts of the northern and central regions limits IVP to a few months in a year.** One of the biggest challenges for humanitarian organizations is to promote IVP where water scarcity is high. Particularly in the northern part of Mali, growing crops during the hot season is extremely difficult. Nothing can be produced for several months of the year. Historically, sedentary and nomadic communities coordinated to share water and pasture in common locations. However, these ties were severed due to the conflict, making access to water difficult for both groups (D’Errico et al. 2021).

**There is a lack of official and verifiable data on groundwater.** Since so much of northern Mali is located away from the country’s primary surface water resources, communities there rely on groundwater for irrigation. However, the lack of official data limits the potential for exploitation of groundwater for irrigation and makes it difficult to draw firm conclusions that can inform water management and irrigation development (Climate Centre 2021).

**There is a lack of policy and institutional support for smallholder irrigation development.** Efforts to advance irrigation in line with the policy framework and strategic plans have been impeded by Mali’s socioeconomic and political crises and due to a significant investment gap in the agricultural sector by the government.

## Implementation and Partnerships

**The impact of IVP interventions is limited by the fact that government institutions are not present in some areas to coordinate efforts between humanitarian organizations and provide support to sustaining outcomes.** Given the limited or total absence of government in several affected areas, there are no formal institutions for humanitarian organizations to work with to ensure that their efforts are aligned with the work of other humanitarian or development organizations. Organizations also face more difficulty sustaining project outcomes without support from local governments.

## Organizational Challenges

### Goals and Beneficiaries

**Supporting beneficiaries with tools and technologies as part of an IVP intervention can increase their vulnerability.** Introducing water-lifting technologies, especially those that are more sophisticated or costly, may inadvertently increase the vulnerability of communities by making them targets for theft or looting.

**In various regions, there is a notable correlation between adopting agricultural innovations and an elevated likelihood of household exposure to conflict** (D’Errico et al. 2021). Specifically, the probability of exposure to conflict escalates by 40 percent when agricultural inputs are adopted, and by 24 percent when diversified cropping strategies are adopted. Households engaged in agriculture may be particularly susceptible to conflict due to their fixed geographical locations. Land tenure, a frequent catalyst for conflict, is also linked to agricultural production. Additionally, combatants often exploit local agricultural resources for their sustenance.

## Intervention Design

**Financing is limited and tied to donor commitments.** Limited funding means that all needy beneficiaries cannot be reached as part of the intervention. Since funding is linked to project cycles, there is also not enough funding to finance beneficiaries’ investments or conduct monitoring and evaluation of the intervention in the long term.

**The threat of violent confrontation or kidnapping by armed groups limits the ability of humanitarian organizations to support IVP, even if market potential is high.** Insecurity limits humanitarian groups’ ability to reach affected populations or monitor and assess the intervention. In some areas, community tension puts humanitarian organizations in a vulnerable position.

## Irrigation Intervention

**Insecurity limits organizations’ ability to provide water-lifting technologies to increase water access.** The inability of humanitarian organizations to safely access certain areas hampers the distribution and installation of technologies that could significantly enhance IVP water access. Moreover, the lack of a secure environment complicates the logistics of transporting these technologies to the intended locations, often inflating costs due to the need for security measures or alternative, longer transportation routes.

**A lack of data limits the success of water resource development, particularly groundwater.** Several organizations cited examples of trying to drill for water—even going 100 meters deep—and being unable to find any. Since drilling borewells is an extremely expensive endeavor, a lack of data on groundwater resources means that organizations may spend significant funds without being able to increase access to water. Even when water is found, a lack of data about aquifer characteristics limits organizations’ ability to set appropriate monitoring and usage systems, coordinate between different organizations, and establish rules to use the water sustainably in the long run.

## Implementation and Partnerships

**A lack of systemic analyses means that organizations need to account for feedback loops and unintended consequences at a system level.** Most organizations focus only on household and community-level indicators, such as increased vegetable production or the number of people adopting a practice. They do not systematically analyze the longer-term effects of the IVP intervention on livelihoods, adaptation strategies, and value chains.

In summary, IVP interventions adopt different strategies in seed distribution, training models, irrigation support, and partnerships. The impact of interventions can be both positive and negative. IVP interventions benefit households economically through income obtained by selling the harvest and nutritionally through home consumption. Technology adoption impacts on intra-household gender dynamics are often overlooked, potentially leading to outcomes that are adverse for women. Catering irrigation interventions to different socioeconomic groups and agricultural needs is challenging. Water scarcity remains a significant challenge despite the availability of water resources and irrigation technologies.

# Recommendations

The analysis above of challenges and opportunities influencing IVP interventions highlights several pathways to achieve the overarching goals of IVP interventions. These goals include diversifying livelihood opportunities, creating a new source of income, and improving nutritional outcomes, particularly for women and children. Both aim to increase the resilience of vulnerable households and communities affected by crises. To achieve this vision, humanitarian interventions can aim at:

1. Targeting beneficiaries and selecting IVP interventions;
2. Ensuring contextually relevant IVP design, planning, and implementation;
3. Strengthening organizational capacity and complementing the funding shortage; and
4. Improving learning through data and knowledge management.

The recommendations presented in this section are aligned with the SEADS standards. The first two contribute to the section on “Tools, equipment, and other non-seed inputs.” They provide additional information on considerations relevant to IVP interventions and link to the section’s five minimum standards: assessment and planning, identifying technical options and timing, market-based services and systems support, choice of tools, equipment, and other non-seed inputs, and input quality. The final two recommendations contribute to the “Impact-oriented monitoring and evaluation” section and link to minimum standards of participatory approaches, project objectives, process monitoring and indicators, impact indicators, participatory end-of-project review, and participatory impact evaluation.

## 1. Targeting Beneficiaries and Selecting IVP Interventions

The focus of this recommendation is on selecting the right beneficiaries and determining whether the IVP intervention is relevant to the emergency context and to the communities most vulnerable to it. It is linked to the SEADS minimum standard for initial assessment for crop-related crisis response and choice of tools, equipment, and other non-seed inputs. The following recommendations are suggested for **humanitarian organizations**:

- **Select beneficiaries that will benefit from and sustain IVP intervention outcomes.** This involves identifying the neediest crop producers through an initial assessment. This requires community engagement to develop appropriate targeting criteria. These inclusion and exclusion criteria, which may vary significantly across regions and sociocultural contexts, should be clearly defined. Community participation is crucial to ensuring a transparent and impartial selection process. Various targeting methods can be employed, including blanket targeting, specific category targeting, and self-selection. The affected communities should have substantial control over the targeting process to ensure equitable distribution of benefits. Continuous monitoring during project implementation is essential to ensure that vulnerable groups remain a priority and are not put at risk.
- **Interventions could incorporate a systems approach, while considering the broader socioeconomic and environmental context, and share findings among other humanitarian actors.** By incorporating indicators that capture broader systemic issues into the monitoring and evaluation (M&E) framework, organizations can gain insights into the political, economic, and social dynamics that influence the success or failure of interventions. This enriched understanding can inform the design of future interventions, ensuring that they are better aligned with the target communities’ contextual realities and systemic constraints. The dissemination of such findings through a central source can contribute to a shared understanding of what works and what does not, fostering a culture of learning within the humanitarian sector.
- **To be relevant to the targeted beneficiaries, the intervention should consider multiple dimensions of how people choose their livelihood strategies and whether the current emergency context has changed their desired livelihood outcomes.** These dimensions include, but are not limited, to:
  - Beneficiaries’ needs, preferences, and long-term livelihood opportunities: The perceived needs of the affected population, organizational knowledge and capacity to meet those needs, and logistical and technical constraints in the organization and the enabling environment.

- Emergency context: Effect of the emergency on prices, types of producers most in need of assistance, the ability of a community to participate in selecting beneficiaries, and the creation of new vulnerabilities.
- Sustainability and inclusivity of the IVP intervention: Water and land resources, seed markets, availability of irrigation technologies and equipment, input and output markets.
- **Reflecting on the existing institutions to source land from the government that communities can use is essential to selecting the IVP intervention.** A new agricultural law passed in 2017 expanded communities' right to own and use land and added special provisions to increase women's access to land (USAID 2023b).
- **Consulting with and engaging vulnerable communities in selecting IVP interventions is critical for greater impact.** Vegetables such as okra, shallots, tomato, chili pepper, onion, lettuce, squash, eggplant, cucumber, and cabbage are highly economical. Consulting with vulnerable communities ensures more equitable outcomes and minimizes market, economic, and conflict risks between communities when supporting IVP interventions.

## 2. Ensuring contextually relevant IVP intervention design, planning, and implementation

The focus of this recommendation is on improving the relevance and best fit of IVP interventions to the emergency context and to vulnerable communities. It is linked to the SEADS minimum standard of choice of tools, equipment, and other non-seed inputs. The following recommendations are suggested for **humanitarian organizations**:

- **Ensuring the presence of and access to input and output markets, including the availability of expertise and knowledge regarding production will enable sustained adoption.** Certain technologies can make IVP more lucrative, and farmers may be more willing to further invest in innovations that can increase yields. Investing in solar-powered pumps for IVP without providing security and market access is not sustainable.
- **The prevailing level of security should determine which type of water-lifting technologies are promoted.** In areas with low levels of insecurity and high market access, humanitarian organizations may more reliably invest in advanced technologies such as solar-powered pumps. In areas of high insecurity, investment in solar-powered pumps must be limited. In areas of low insecurity but with limited access to input/output markets, petrol-powered pumps may be promoted.
- **Organizations may also try to encourage the use of anti-theft technologies such as security fasteners and anti-theft bolts** (Agrawal and Jain 2018). Knowledge and skills around the maintenance of water-lifting technologies can be relatively easily housed in communities, and the probability of theft is lower. A lack of value chains makes sustained investment in solar-powered pumps difficult and increases the probability of theft.
- **Increasing domestic vegetable production capacity can help farmers procure less expensive seeds that are more suitable for local hydrological conditions.** The informal sector—comprising seeds saved by farmers for personal use and local exchange—serves as the primary seed source for more traditional vegetables. IVP interventions should support local seed production and link farmers with existing local seed suppliers. The formal vegetable seed sector comprises local and foreign seed companies and farmer cooperatives. Vegetable seeds are predominantly sourced through imports despite imported varieties being less suited for local growing conditions. Local seed production can contribute to strengthened IVP value chains and increased likelihood of agricultural input adoption (Dembélé 2021). Depending on the presence of markets and livelihood opportunities, formal and informal seed systems can be strengthened for increased local production.
- **Organizations can promote vertical gardening to deal with the challenge of insecure land tenure while reducing competition for land.** Sack gardening, for example, is a form of vegetable production that involves transplantation of vegetables into biodegradable sacks filled with soil. This practice is especially prevalent in areas with limited access to productive land. It allows for easy implementation and supervision within household premises and offers a viable solution for maintaining a balanced diet, particularly in a rural setting. This technology has been operational since 2018 under the Africa-RISING project in specific regions of West Africa that aim at sustainable intensification of farming systems (Govoeji et al. 2022).

- **Interventions should include gender-sensitive approaches that empower women to gain access to land through community-based agreements.** Female-headed households are less likely to adopt new coping strategies, suggesting the need to provide dedicated support to such households (D’Errico et al. 2021). Yet, women are often the main members of a household engaged in vegetable production. If not money, investment in time and labor could increase if women could own land or have unrestricted and long-term access.
- **Choice of technologies and irrigation systems differ among men and women and should include gendered preferences.** Interventions should pay close attention to the impact of technology adoption beyond increasing water for irrigation. Certain technologies may contribute to labor burdens, increasing daily challenges for women. More expensive technologies may affect intra-household dynamics in unexpected ways. Evaluation of the effects of technology adoption beyond nutrition or income generation increases the impact of an intervention.

### 3. Strengthening Organizational Capacity and Complementing the Funding Shortage

This recommendation focuses on developing the capacity of humanitarian organizations to deliver impactful emergency assistance while improving resilience to escalating crises and mounting humanitarian needs and mobilizing resources and investments from the public and private sectors to fill the gap in funding for humanitarian emergency assistance. Organizations draw from their experiences in designing and implementing interventions; so improved organizational capacity for long-term learning can provide a structure for documentation, dissemination, and learning in different emergency contexts. It is linked to the SEADS minimum process monitoring and indicators standard and the market-based service and system support standard. Some suggested recommendations for **donors and humanitarian organizations** are:

- **Organizations can develop specialized training programs for their staff.** These could focus on the technical aspects of IVP and the socioeconomic and environmental contexts in which these interventions are implemented. Training should cover sustainable irrigation practices, crop selection, climate-smart agriculture, and market dynamics. This will enhance the capacity of staff to design and implement more effective and context-specific interventions.
- **Integrate gender and social inclusion training in organizational capacity-strengthening measures.** This is necessary to understand better and address different needs, roles, and potentials of men and women in agricultural production and consider the impacts on marginalized groups such as IDPs.
- **Organizations can facilitate access to microfinance and credit schemes by working with financial institutions and tailoring schemes to the needs of smallholder farmers.** These schemes can provide the necessary capital for farmers to invest in improved irrigation systems, quality seeds, and other inputs. Ensuring that these financial products are accessible and affordable is crucial for encouraging uptake among farmers.
- **The national database of social protection beneficiaries provided by the Unified Social Register (Registre Social Unifié, RSU) will help if it is regularly updated.** The RSU is an information system housing a national database of social protection beneficiaries. It can help identify the most vulnerable beneficiaries in an emergency context and enable more accurate and efficient targeting of social protection programs. By consolidating data on vulnerable populations, the RSU can help ensure that assistance reaches those who need it most, reducing the risk of exclusion or misallocation of resources.

### 4. Improving Learning through Data and Knowledge Management

This recommendation focuses on building knowledge systems and an interactive learning culture to ensure the impact of IVP interventions with joint efforts, collaboration, coordination, and cost-efficiency. It is linked to the SEADS minimum standard of participatory approaches. Suggested recommendations for **the government, donors, and humanitarian organizations** are:

- **Humanitarian organizations may benefit from a non-governmental organization housing all the data available on groundwater.** Several decentralized sources of groundwater data in Mali already exist (Gómez-Escalonilla et al. 2022; Henry et al. 2022). **A certain percentage of donor funds could go toward updating, maintaining, and improving groundwater data every year.** Based on this data, an ongoing mapping exercise could be developed to identify the most relevant and suitable irrigation technologies organizations can promote in different locations.
- **NGOs could take the lead in collecting this data and making it freely accessible to all organizations involved in agricultural interventions** since government presence is lacking in many parts of northern Mali, and the capacity for data collection is limited. A potential organization could be the Climate Centre, which supports the Red Cross/Red Crescent Movement in reducing the impacts of climate change and extreme weather events on vulnerable people and already has an office in Mali.
- **Donors could develop a centralized online platform or repository to store, update, and access all relevant data.** This repository should include groundwater data and information on soil types, climate patterns, crop suitability, market trends, and socioeconomic data. The platform should be user-friendly and designed to cater to the needs of various stakeholders, including government agencies, NGOs, farmers, and researchers.
- **Donors could also implement standard data formats and collection protocols to ensure consistency and comparability of data across different regions and periods.** Standardization will facilitate easier data sharing and integration, making it more accessible and useful for decision-making. Donors could also establish feedback mechanisms that allow community members and end-users to contribute to and validate the data.

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