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Seed security and conflict-intentional programming: focus on Africa

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Armed conflicts are on the rise in Africa and currently span at least 21 countries. Smallholders are not immune to their effects, often enduring multiple seasons of disrupted production; e.g., farmers in Kivu have navigated conflict since 1993 (60+ seasons). This article focuses on farming during conflict and centers on seed for several reasons: *seed* is an essential farming input and *seed assistance* is a prime humanitarian intervention. Broadly, the article revolves around several central questions: How does conflict affect or change seed system functioning? What types of technical seed-linked interventions have been implemented in conflict contexts? Have these interventions been tailored to respond to seed system changes? And is seed, *per se*, a good entry point for furthering peace-linked or social cohesion work? In framing possible responses, the article goes beyond the basic humanitarian tenet of Do No Harm. The work advances the notion of also Doing Good, and particularly technical good, i.e., supporting responses that are "conflict-intentional," tailored to strengthen systems in unstable periods. Drawing from a review of written documentation (including web-based searches, university library databases, SCOPUS and ResearchGate; 100+ references), the article presents three sets of findings: (1) It identifies some 20 features of seed systems that might shift in conflict-affected contexts; (2) It documents 11 diverse seed security responses, concluding that few have been tailored toward changing needs; and (3) Focusing on social cohesion and peacebuilding programs, the article identifies only three seed-linked approaches, exploring also if seed attributes make it a useful entry point for more socially-oriented work. The article ends with concrete steps for advancing conflict-intentional programming, suggesting actions at both policy and programmatic field levels.

KEYWORDS
Africa, conflict-intentional, conflicts, do no harm, emergency, humanitarian programming, peacebuilding, seed security

1 Introduction

Africa has a longstanding history of conflict, with recent data suggesting that its incidence is on the rise. Currently, armed conflicts span at least 21 countries across the continent (Geneva Academy, 2026) and, in the sub-Saharan region alone, conflicts have nearly doubled within the last decade (Peace Research Institute Oslo (PRIO), 2024). These conflicts are spurred by diverse factors, e.g., resource scarcity, political instability, ethnic diversity, and colonial legacies (Stockholm International Peace Research Institute (SIPRI), 2022).

Smallholder farming areas are not immune to conflict and its impacts, and farmers in conflict zones often endure multiple seasons of disrupted production. For instance, in north Kivu, Democratic Republic of the Congo (DRC), farmers have navigated conflict since at least 1993—more than 60 seasons. Farmers in northeast Nigeria have been similarly plagued on and off since 2011, more than 28 seasons, and those in Tigray, Ethiopia, since 2020—more than eight seasons. While the conflicts may not be continuous or always of high intensity, their effects are wide-ranging. Farmers may face direct shocks such as violence in their area, and indirect effects like generalized uncertainty (Arias et al., 2019). An example from northeast Nigeria provides some insight into farm-level concerns: "Boko Haram attacks significantly reduce[d] total output and productivity…and reduce[d] the outputs of specific staple crops such as sorghum, cassava, soya and yam" (Adelaja and George, 2019 abstract). Notably, smallholder farmers often continue to sow and harvest in the midst of extended and varied instability.

This article focuses on conflict in smallholder farming areas mostly in Africa and centers on an underexplored dimension, seed systems. It homes in on the theme of seed for two reasons: *seed* is one of the most essential inputs of farmers' agricultural production, and *seed assistance* is among the prime interventions humanitarian practitioners implement in conflict-affected contexts. The article revolves around several key questions linking conflict and seed: How does conflict affect seed system functioning? What types of seed-linked interventions have been implemented in conflict contexts? Have these interventions been tailored to respond to possible seed system changes? And, is seed, *per se,* a good entry point for furthering peace-linked or social cohesion work?

This article aims to help improve emergency seed responses in conflict-affected areas, sharpening practice on the ground and fostering more enabling environments for working more effectively in these volatile contexts. The work goes beyond the basic humanitarian tenet of Do No Harm. It advances the notion of also Doing Good, and particularly Doing Technical Good, more consistently. In the case of seed security, this involves promoting responses that are *conflict-intentional*—that have been tailored to reflect conflict-induced seed system changes and that aim to strengthen systems during unstable periods.

The article is organized as follows. After this introduction, Section 2 provides Background on seed security and conflict programming, two humanitarian disciplines that have often been organized separately in discourse and practice. It also describes the Methods used within this research. Section 3 presents Findings and has three major parts. Part 3.1 details the evidence for the effects of conflict on seed system functioning. Part 3.2 presents the range of humanitarian seed security responses implemented in conflict-affected contexts and analyzes whether their design shows signs of being conflict-intentional. Part 3.3 examines seed security interventions linked specifically to furthering peace or social cohesion. Section 4 presents the Discussion for the full body of work, focusing on practical and policy implications and possible next steps forward. This detailed analysis of seed system changes during conflict, and of possible conflict-intentional tailoring of response, is believed to be the first of its kind. An important caveat is that the evidence has been scattered and challenging to find. The nature of working in conflict contexts and emergency settings, often with short timeframes, means that humanitarians may not have documented their processes or results with the depth that might emerge from longer-term development programs. This article aims to help close this gap.

2 Background and methods

2.1 Seed security programming in humanitarian response

This article focuses on seed security in emergency periods. According to a formal definition, seed security exists when "men and women within the household have sufficient access to adequate quantities of good quality seed and planting materials of preferred crop varieties at all times in both good and bad cropping seasons" (Food and Agriculture Organization of the United Nations (FAO), 2016). So, seed security exists when: seed is available, farmers can access it, and it is of the right type. Seed security programming in emergency periods is referred to by varied terms: emergency seed assistance, seed aid, seed security programming in disaster, etc. Within this article, we use these interchangeably as they generally refer to the same basic types of approaches, even if terminology varies among different actors.

Seed assistance is among the first entry points in agricultural response after a disaster. Its rationale is to help farmers get back on their feet quickly through producing their own food for consumption or sale. Emergency seed assistance can take many forms. It is most commonly conflated with direct seed distribution (DSD), whereby implementers directly provide free seed to farmers. Other seed assistance approaches may include giving farmers cash or vouchers to buy seed themselves—propping up the demand side—or supporting the functioning of formal or informal markets—propping up the supply side (Section 3.2 describes these varied approaches in more detail).

Emergency seed assistance has a relatively recent history compared to food assistance, which largely emerged after World War II. Seed assistance (mainly via DSD) escalated in Africa starting in the early 1990s, with only isolated distributions prior to that, such as in Ethiopia in 1974 in response to drought. Initially, seed aid was seen as an empowering response option, letting farmers take the lead to plant and harvest themselves. It was also deemed cost-effective; for instance, 1 kilogram (kg) of sorghum seed can yield over 100 kg of sorghum food (Sperling et al., 2022a). In recent years, the overall effectiveness of emergency seed assistance has come under scrutiny (SEADS, 2022) as well as the value of select forms like DSD (Smits et al., 2024). One concern is that its use has escalated; for instance, FAO spent approximately USD 470 million on seed assistance in 2023 alone (SeedSystem and Mercy Corps, 2024). Another is that seed assistance—mainly DSD—is being repeated in many countries, regions and even among the same farmers. For example, Ethiopia has received near continuous seed assistance for over 42 years (Sperling et al., 2022a).

Emergency seed aid has been implemented in response to diverse shocks and stresses, in varying contexts. These include natural disasters such as droughts, floods, or earthquakes, and human-induced stressors, such as civil strife and contexts of political instability (Sperling et al., 2008). Additionally, such assistance has unfolded in stable and conflict-affected contexts, with the latter being the focus of this article.

2.2 Conflict programming in humanitarian response

Much has been written about conflict programming and some of its guiding principles (Anderson, 1999 being the classic reference). Guidance is diverse, evolving, and can be quite precise. For example, advice exists on: how to navigate dangers safely (International

Committee of the Red Cross (ICRC), 2015); how to better analyze conflict contexts (United States Agency for International Development (USAID), 2012; Duncan, 2015); and how to use digital interactions that Do No Harm (Burton, 2020). In reference to the terminology used, three terms, in particular, have been applied to guide actions for those working in conflict-affected contexts. All three are important and emphasize slightly different skill sets and actions.

1 *Conflict sensitivity* is aligned with the overall principle of Do No Harm. It generally refers to processes that help ensure that humanitarian work does not contribute to or worsen conflict dynamics. Important literature exists on conflict-sensitive approaches (e.g., CDA Collaborative Learning Projects, n.d.; Food and Agriculture Organization of the United Nations (FAO), 2019) with documents suggesting ways to operate that spur no negative tensions or results. Some definitions also embrace positive activities, such as strengthening and contributing to stability and peace-building or positive gender dynamics (United Nations Sustainable Development Group (UNSDG), 2022). In all cases, the term "conflict-sensitivity" largely centers on the processes of operating in conflict contexts—about *how* to do the work.
2 *Conflict-savvy* refers to a set of skills that help implementers navigate the peculiarities or dangers of the conflict and advance the tasks at hand (Sperling et al., 2022b). Most humanitarians will rely on conflict-savviness to conduct their work in ways that do not put them or the communities they work with in direct danger. For instance, a conflict-savvy informant can advise on which villages are accessible or which roads are mined. In lay terms, "conflict-savvy" might be the equivalent of having "street smarts." Like conflict-sensitive, conflict-savvy refers to *how* work is done—the process.
3 *Conflict integration* or *Conflict-intentional* programming is the newest term (United States Agency for International Development (USAID), 2023). As described in its first publication,

> "*Conflict integration is the intentional effort to improve the effectiveness and sustainability of development and humanitarian assistance…Doing so can move programming beyond conflict sensitivity and the principles of Do No Harm to promote better development outcomes and sustain peace and prosperity*" (2023, p. 22).

Conflict integration or conflict-intentional programming—the term used in this article—goes beyond Do No Harm or having "street smarts." The term puts emphasis on actively *doing good* and driving improvement. Improvement might extend in two directions, socially and technically. One can intentionally improve a system in conflict-affected contexts in social ways, such as through efforts to promote peace or social cohesion. One can also improve a system in technical ways, by improving the design of an intervention's technical elements, e.g., changing the crop or variety type to better support seed security.

Table 1 expands on the three terms and provides examples linked to seed security programming. The aim is not to debate existing terminologies or to reify specific definitions. Rather, it is to present three key terms useful for guiding programming in conflict-affected contexts, recognizing that the salient components can be fuzzy, with some overlaps. All three terms—conflict-sensitive, conflict-savvy, and conflict-intentional—are complementary and important for guiding action. Conflict-intentional programming, with a technical focus, is perhaps the least explored and is given emphasis in this article.

TABLE 1 Terminology linked to conflict programming.

Terms	Focus and characteristics	Practical examples
Conflict-sensitive	Do no harm. Using context awareness to ensure that the result of an activity is not increased tension or risk of conflict	Seed distributions are planned to avoid exacerbating social tensions, e.g., engaging diverse local groups who can help ensure equitable delivery
Conflict-savvy	Using "street smarts" to reduce risk to those involved and navigate unstable or potentially dangerous environments	Humanitarian partners connect with local seed traders to find ways to move goods despite roadblocks or landmines
Conflict-intentional	Doing active good: designing and implementing programs to get a specific, better result	
	• Social programming	Seed programs are designed to actively foster social cohesion, e.g., through shared land access, joint garden management, or communal sales
	• Technical programming	Crop selection is changed to adapt to farmers' revised need for short-term crops that also need no processing

2.3 Methods

This article is largely based on review of written documentation (available in English). The authors conducted web-based general searches (using Google search engine), perused several university library databases, and delved into the SCOPUS and ResearchGate's more scholarly collections. Select international non-governmental organizations (INGOs) known for seed aid work were also directly contacted (e.g., International Committee of the Red Cross, Catholic Relief Services, Mercy Corps). Further, the lead author had made extensive collections of seed-conflict publications starting from the time of the Rwandan Genocide, 1994 (when she led one of the first on-the-ground agricultural assessments).

In terms of subject matter, the searches for the article centered on the three general themes, with search terms honed for each. (A) Conflict features that have affected informal and formal seed system functioning: terms related to conflict, war, dispute, and strife, and these then linked to seed broadly (seed, planting material, seed system, agriculture, crops, etc.); (B) Humanitarian seed security responses effected in conflict contexts: terms around disaster, emergency, relief, assistance, aid, and humanitarian, and these tied to seed-linked terms (as above: seed, planting material, crops, etc.). Here, we also added a layer of interventions and response types, including responses such as direct seed distribution, seed vouchers and fairs, cash and seed, drones and

seed, etc. and (C) Seed security responses specifically linked to fostering more social cohesion and/or peace. Search terms included: peacebuilding, social cohesion, and relieving tensions, and these then linked to seed, planting material, and seed interventions. We also explored specific intervention types, such as community gardens and seed sharing. Overall, the search terms were wide-ranging and aimed to capture entry points from different perspectives (conflict, peacebuilding, seed, aid, and humanitarian interventions).

The literature review focused on African countries with modest use of unique cases from elsewhere (e.g., Syria). It eventually covered work spanning about 30 years with the reference section now containing over 100 items. The cases selected for eventual review are not deemed good or bad, or more or less interesting; the selection simply presents examples for which substantive written information could be located. Admittedly, the inventory is slim: finding documents on specific seed-linked work implemented in conflict contexts has proven challenging. Implementers working in emergencies prioritize immediate action and may not have time to document in detail the process and results. Also, reports submitted to donors or posted in specific project files may not appear in the public domain. We do hope that this initial collection of cases might stimulate the collection of additional examples or spur further dissemination of informal reports not currently distributed in the public domain. The hope is to contribute to a growing and iterative evidence base on these themes.

Note that the theme of conflict itself (not tied to seed) has long been the subject of substantial scholarly analysis with two types of frameworks helping to differentiate among conflict and its effects, including in agricultural areas. First, there exist a range of conflict classifications that differentiate types of conflict themselves: for example: by cause: resources, rights, ideology, etc.; by scale: intrastate vs. interstate; by actors: state or non-state; by nature: physical violence vs. structural violence; by duration: protracted vs. emergency; and intensity; by phase: latent vs. hot (Jehn, 2014; Bonn International Center for Conversion (BICC), n.d.; Vité, 2009 (for ICRC); Lyamouri-Bajja et al., 2012). Second, a number of overviews have focused on conflict and agriculture *per se* (e.g., Food and Agriculture Organization of the United Nations (FAO), 2023; Longley and Maxwell, 2003).

This particular work goes well beyond these useful, but general, reviews. Its focus is squarely on seed systems and seed security to better inform targeted policy and actions in this key area of humanitarian response.

3 Findings

The findings of this article are presented along three distinct, yet interlinked themes: (3.1) Conflict features that affect seed system functioning; (3.2) Humanitarian seed security responses effected in conflict contexts; and (3.3) Humanitarian seed security responses aimed specifically at promoting more social cohesion and/or peace in these unstable contexts. Each is explored below, analyzing clear sets of field cases.

3.1 Conflict features that affect seed system functioning

Conflict can affect seed and agricultural systems functioning at the most fundamental levels. Farmers may not be inclined to farm at all (e.g., too much insecurity) or may not have the agency to farm as they choose (e.g., top-down, state-controlled agriculture imposed during unrest). Also, conflicts might affect farmers' access to key means of production (land, labor, inputs, etc.) to such a degree that continuing to try to farm just does not make sense. Only if farmers can sow and harvest somewhat reliably—and if they are inclined to do so—does more focused attention become relevant to the specific crop and seed system features that might be affected.

Tables 2 and 3 draw on cases where farmers have continued to farm. The tables summarize initial learnings around changes in crop and seed systems that can be spurred in conflict-affected contexts, with Table 2 focusing on input supply and processing facility and Table 3 centering on broader production strategy. Both tables are based on site-specific observations documented by practitioners and research analysts. Cases are drawn from populations-in-place so do not include analysis of possible changes for those who may be displaced or resettled in camps, for instance.

Table 2 specifically documents how conflict can affect changes in input supply and processing facilities in multiple ways, leading to pronounced shifts in crop and seed system management. Supply channels may stop functioning entirely; only select crops may become available; prices may soar; select inputs (possibly tied to violence) may be banned, etc. These conflict-linked features spur basic changes: e.g., in type of crop farmers sow and where they source seed. While the cases in Table 2 largely involve changes that might be seen as negative or closing options, a small number of the induced changes opened possibilities, for example, introducing new varieties and novel links with seed production groups.

Conflict can impact multiple and wide-ranging aspects of the production cycle, from shifts in processing to shifts in government policy. All of these can consequently influence farmers' choices and options related to seed management and use.

Table 3 explores broader conflict-linked features that may affect fundamental production strategies, across crops and farming management techniques. The types of changes prove to be diverse, specific, and wide-ranging. Land and labor access may change; the length of stable sowing and full production windows may shift; financial support may collapse. The changes documented in Table 3 embrace phases of crop and seed management from the beginning of production to the end: what type of land will be used, what plot size, which crop, which variety, planting time, non-seed input use, crop management, post-harvest management and more. Interestingly, both Tables 2 and 3 show that the direction of change can vary by context: in some conflict-affected contexts, farmers move away from cash crops toward consumption crops and, in other contexts, the reverse happens—they move toward crops that can generate income. The full set of identified conflict-induced changes prove to be profound and wide-ranging, but not necessarily predictable.

Conflict can often lead farmers to reprioritize their planting efforts. They might value things like low risk, short cycle production or ability to store crops in a more significant way than in times of stability.

3.1.1 Varied rationale for conflict-induced shifts

Tables 2 and 3 detail the scope of possible crop- and seed-system changes that can occur in conflict-affected contexts.

TABLE 2 Conflict-linked features that have affected input supply and processing facilities.

Conflict-linked features	Crop/seed-system change	Case examples	References
Formal government seed sector functioning (availability)	Seed supply channel for multiple crops (formal)	Mali: government seed institutions collapse across crops. Breeder, Foundation, and other standards of formal seed become scarce.	Kimenyi et al., 2014
	Seed supply channel for one key crop (formal)	Rwanda: potato seed and production collapse due to stalling formal seed supply systems. Breakdown causes scarcities of clean seed, fungicide, and fertilizer.	Sperling, 1997
Private seed sector functioning (availability)	Seed supply channel for multiple crops, especially those linked to value chains (formal)	South Sudan: seed companies shut down as soon as conflict escalates.	Sperling et al., 2022b
		NE Nigeria: Select national seed companies closed remote offices at height of conflict (2010). This prompted other national companies to stop supplying conflict areas.	Rural Resilience Activity (RRA), 2024
Informal seed sector functioning (availability and access)	Seed supply channel for multiple crops (informal)	Farmers sporadically are unable to travel to local market, leading to scarcity of food, and, by extension, local seeds in some areas.	Insecurity Insight, 2024
		Change in farmers' freedom of movement.	
Informal market functioning-outputs	Crop shift	Sierra Leone: farmers shift from cash crops to focus on rice (largely for consumption).	Longley, 1997
Non-seed inputs (availability and access)	Input supply: linked to crop choice/variety choice	Nigeria: government restricts use of inputs such as urea that can be converted into explosives.	Mercy Corps, 2018
Non-seed input (availability)	Input supply: linked to specific land use	Sudan: shortages of fuel and equipment mean that irrigated areas cannot be utilized, esp. larger fields that might require mechanization.	Mercy Corps, 2023c
Non-seed input (access)	Input supply: linked to freedom of movement goods	Mali: transport/supply chains disrupted. Fertilizers delivered to Mopti, 500 km from conflict zones. Farmers retrieved them in compliance with rebel rules.	Kimenyi et al., 2014
Non-seed input (access)	Input supply: linked to prices	Sudan: prices skyrocket for seeds, fertilizers, and pesticides as supply chains are disrupted (especially from capital).	El Safty et al., 2023
Processing and processing facilities functioning	Processing facility or processing efforts linked to crop choice	Central African Republic (CAR): farmers move away from crops that require extra processing, such as cassava, sunflower, millet, and sorghum. (Note, The opposite also occurs: Where theft is high, farmers move *toward* crops that need processing.)	Bauer, 2024
		Sudan: key processing facilities may collapse	Kirui et al., 2023
Positive changes			
Variety use (single crop)	Variety expansion	Sierra Leone: rice diversity increased due to influx of aid (although this may be partly negative as farmers may have needed to import non-local types from outside region).	Longley, 1997
Seed supply channel (single crop)	Channel expansion	Mali: farmer cooperatives organize and respond to relief seed calls producing adapted pearl millet seed.	H Guindo, *pers. comm.*, 2021 Dalohoun et al., 2011
			Sperling and Almekinders, 2023

However, to provide good technical support to crop and seed management in conflict contexts, one must understand the underlying reasons for the shifts. Table 4 suggests how complex the underlying factors for even a single change can be, drawing from a single conflict-induced shift: change in crop choice. The table shows that for one conflict-induced shift—change in crop choice—there may be varied rationales, identifying six distinct reasons. Understanding the reasons (the underlying factors) for each shift should have practical implications and lead to a more targeted response strategy. For instance, if there is little security or freedom of movement, crops that can be left basically untended may be favored, like cassava. If processing facilities have been destroyed, a shift away from soybean may seem wise, even if the crop generated important income prior (e.g., for processed oil or chicken feed). Hybrid vegetables, perhaps reliant on scarce fertilizers, may be left temporarily aside or swapped for less input-demanding crops if the input markets have collapsed.

3.1.2 Shifts that can be managed by farmers' own adaptive strategies and those that might require outside support

Tables 2 and 3 suggest diverse lead actors in responding to the conflict-induced shifts in crop and seed system management, from farmers to private sector to humanitarian actors. That noted, many of the shifts can and have been managed within the specific realm

TABLE 3 Conflict-linked features that have affected farmers' production strategies.

Conflict-linked features	Crop/seed-system change	Case examples	References
Length of stability period	Crop management (planting time)	North Kivu, DRC: farmers plant crops earlier to not coincide with rebel attacks.	Baributsa et al., 2021a
Length of stability period	Crop choice (shift)	Farmers move to shorter duration crops.	Amare et al., 2025
		Nigeria: farmers move away from longer-term crops (protracted crisis).	
Land and plot sizes	Cultivation plot sizes	Angola: vast areas of cultivation may be "lost", e.g., to mines/explosives.	Food and Agriculture Organization of the United Nations (FAO), 2000
Land and plot access	Cultivation plot sizes	Nigeria: fighting may cut off plot access or lessen incentives to cultivate larger areas (short- and longer-term). Areas planted are reduced.	Amare et al., 2025
Land and plot access	Crop choice (shift)	Fighting may cut off plot access intermittently. Farmers shift to perennial crops that need less tending, especially when there are violent shocks.	Arias et al., 2019
		Nigeria: cases of decreasing allocation of perennial crops.	Amare et al., 2025
		Tigray, Ethiopia: fighting may take place during particular crop planting period, so specific crops are shifted/suppressed. Few lands planted with sorghum, as active warfare during planting window.	Ghebreyohannes et al., 2022
Theft	Crop choice (shift)	North Kivu, DRC/Sudan: farmers change crop choice to those less susceptible to theft: crops that require further processing before consumption (e.g., soybean, sunflower, millet) or take more time to harvest (e.g., groundnuts).	Mercy Corps, 2018
Labor (access to labor and labor sharing arrangements)	Crop loss (linked to labor availability)	South Sudan: workers/children no longer scare away birds because it makes too much noise and attracts enemies, leading to a loss of sorghum.	Food and Agriculture Organization of the United Nations (FAO), 1996
Population displacement (or risk of displacement)	Storage methods	Ethiopia: farmers change to smaller sized vessels which are put underground to hide seed stored and to be able to move vessels quickly.	Mengistu and Garrand, 2014
Military stipulations	Crop management (plant height)	Northern Uganda: military controlled the height of field plants such as cassava so that rebel fighters cannot easily hide.	J. March, *pers. comm.*, Feb, 2022
		Nigeria: government restrictions on the height of maize to keep insurgents from hiding.	Mercy Corps and USAID, 2017
Financial institutions	Credit means linked to crop choice	Sudan: credit collapses. Move away from crops that need inputs.	El Safty et al., 2023
Changing government policy	Government policy directives tied to crop and agriculture strategy	Nicaragua: Government during war emphasized scaling up of food production, at the expense of mainly cash crops.	Guhuray and Ruiz, 1997
Changing farmer priorities	Crop shift	Sierra Leone: farmers move away from crops that may be especially desired for sale and toward key consumption crops.	Longley, 1997
Changing farmer priorities	Crop shift	Sudan: farmers move toward cash crops and away from food crops (to get quick income).	Hoffmann et al., 2024

of farmers' own adaptive strategies, such as changing the timing of planting or moving toward crops that need less tending (although often at some cost). The importance of farmers' own adaptive strategies needs to be made very visible in any discussion of agriculture in conflict zones. Farmers may routinely shift to shorter-duration crops or change the functioning of storage pits (e.g., Mengistu and Garrand, 2014) or move to a whole new set of more conflict-wise strategies. It is revealing that a great deal of the humanitarian response literature focusing on conflict contexts emphasizes conflict-sensitive, conflict-resilient, or conflict-intentional activity, with the central actor assumed to be the humanitarian. While much of this article also focuses on humanitarian action, we emphasize that it is farming communities themselves who have often taken on the onus of adopting and adapting novel strategies in periods of instability and violence.

In terms of humanitarian action, there are multiple challenges in responding effectively to conflict-induced shifts. Sequentially, responders need to: (1) recognize the shifts clearly; (2) discover their causes; (3) determine what farmers themselves can mollify or alleviate; and (4) identify if or what kind of outside humanitarian support might be warranted. The next section discusses outside humanitarian support.

TABLE 4 Select examples of changes in crop choice in conflict periods, and reasons (extracted from cases in Tables 2 and 3).

Conflict-induced shift	Reason for shift
Crop choice (shift)	*Stability period*: farmers need shorter duration crops
	Security: farmers need plants that require less constant tending
	Timing of planting: farmers missed planting window for X crop and move to Y
	Inputs: farmers need crops that do not require select inputs
	Processing: farmers need crops that do not require processing to realize their value
	Priorities:
	• *Food:* farmers move away from crops that may be especially desired for sale and toward key consumption crops.
	• *Income:* farmer move toward cash crops and away from food crops to get quick income.

3.2 Conflict and seed systems: humanitarian responses effected short-term

Humanitarian interventions in conflict contexts often target farmers' seed-related constraints and aim to improve seed system functioning. The findings below center on the types of seed security responses implemented and are divided into two broad categories. The first (3.2.1) reports on responses aiming mainly to alleviate specific seed security constraints, so *technically-oriented, conflict-intentional* responses. The second (3.2.2) focuses on humanitarian interventions that have been designed to further peace or social cohesion, so *socially-oriented, conflict-intentional* programs that have a seed component. (Note that the second set, responses tied to peacebuilding or furthering social cohesion, is much slimmer than the first simply because field cases are scarce).

The cases analyzed across this section focus on shorter-term seed security interventions, i.e., those likely to be implemented by humanitarians. Seed might also be included as a routine component in multi-year, multi-sectoral responses linked to complex crises. For instance, seed programming might be linked to agroenterprise/value chain development, financial inclusion (e.g., Village Savings and Loan Associations [VSLA]), agriculture technology improvement, and more. These multi-sectoral, multi-year programs are often implemented in protracted crisis regions and may combine emergency and developmental approaches. See examples of two integrated programs implemented in South Sudan: Food and Nutrition Security Resilience Program-South Sudan (SeedNL, n.d.) and the five-year Agricultural Markets, Value Addition, and Trade Development Project (African Development Bank Group, 2024). While multi-sectoral, multi-year programs can be quite effective, their review is beyond the scope of this article.

3.2.1 Humanitarian seed security interventions: do good—technically

Humanitarians implement numerous types of seed security interventions in conflict-affected contexts with the main aim of improving farmers' seed security, i.e., with a technical focus. As a base, we recognize that such seed assistance can be challenging to implement technically even in non-conflict contexts and can even pose real risks to farmers, if done poorly (Sperling and McGuire, 2010). In fact, the practice of seed assistance is littered with aid doing technical harm. As examples, agencies provided long-maturing varieties when fast-maturing varieties were needed; introduced serious new weeds (Gebre-Medhin, 1992); introduced tons of seed unadapted to the stress area (Rohrbach et al., 2004); and distributed seeds so unacceptable that farmers used the subsequent crop as fodder (Food and Agriculture Organization of the United Nations (FAO) & World Food Programme (WFP), 2004).

In reference to this article's discussion on seed security interventions in conflict areas, the authors share a recent reference on good practice, the "*Ten Guiding Principles for Good Seed Aid*" ("10P"). These widely reviewed guidelines were developed with the aims of minimizing bad—or even dangerous—technical practice, and also of significantly improving it (SeedSystem and Mercy Corps, 2024). Implementors working on seed security programs in a conflict area might have the dual challenges of building on standard better practice (e.g., "10P") and additionally of tailoring the response toward conflict-induced changing needs.

Drawing on extensive literature review, two tables below (Tables 5 and 6) document the range of technically-oriented seed security interventions implemented in conflict contexts, e.g., those aiming to stabilize production or promote better nutrition. Both tables provide examples of where and when the interventions were implemented with the last column detailing the select technical features that have been tailored to respond to the instability (i.e., conflict-intentional changes). The tables contain important detail (including exact reference source) as the evidence base for this type of humanitarian work needs to be deepened. The tables are presented as two since they cluster broadly different types of response actions.

Table 5 presents the varied interventions revolving around the direct production and transfer of seed. Direct seed distribution and organized seed productions are standard humanitarian responses. Stimulating seed-sharing networks and employing drones or air drops to transfer seed are more unusual. Table 5 also groups some of the cross-cutting actions that may be associated with multiple types of responses, such as improving storage and seed information access, and the occasional incorporation of conflict-resilient crops.

Table 6 presents technically-oriented seed responses that aim to bolster the markets farmer might use, both the formal and informal seed markets. On the demand side, farmers might be given paper or digital vouchers that can be used to buy seed at specific vendors. Direct cash might also be transferred to increase farmers buying power more generally. On the supply side, varied approaches might be used to support existing markets: e.g., financial help to private seed or local seed villages to bolster production; help with transport costs. Table 6 summarizes a range of seed security-linked market-based approaches used in conflict zones. Following the table, a commentary section describes in more detail each of response types (including Tables 5 and 6) and elaborates on the tailoring features.

TABLE 5 Seed security interventions (shorter-term) implemented in conflict settings (general, non-market based).

#	Type of intervention	Location	Date	Organization/ reference	Salient technical feature
Direct seed interventions					
1	Direct seed distribution	South Sudan (Northern Bahr el Ghazal)	2014	Food and Agriculture Organization of the United Nations (FAO), 2014	Moved adapted seed from local farmers' organizations in non-conflict zone to conflict area.
		DRC (North Kantanga)	2007	International Committee of the Red Cross (ICRC), 2007	Focused on seed of nutritional crops due to malnutrition concerns.
2	Seed production	DRC (Kivu) Chad	2016 and ongoing	International Committee of the Red Cross (ICRC), 2016	Stimulated high quality seed production with select farmers in conflict areas.
		Sierra Leone (N & S provinces)	1995	Longley, 1997	Focused on community seed production of very local rice varieties, which were highly desired for sale.
			2000	Kent and Mokuwa, 2001	
		Mali (Douentza district)	c. 2015 and ongoing	H. Guindo, *pers. comm*., 2022; Sperling and Almekinders, 2023	Leverages existing indigenous/local villages that are known for seed production of highly adapted (local) pearl millet varieties for farmer customers and relief supply.
		DRC (Kivu)	2023 and ongoing	Kajunju et al., 2024	Supports women seed entrepreneurs to produce and themselves sell seed to other farmers in active conflict zones (spans emergency-dev)
3	Seed-sharing networks	Syria	2011 and ongoing	Grüne Liga, 2017	Swapped and reproduced open pollinated seeds in and around Syria via seed sharing networks within and outside country. Initial locus: a network of German farms.
				The 15th Garden (also below in Table 7)	
4	Drones to deliver seed (?)	Western countries and South Africa, primarily	Recent innovation and ongoing	Hassan, 2022	Seed delivery presently tied more to forestry and restoring degraded lands than seed delivery to stressed farmers in conflict areas.
	Airplane drops	South Sudan	2014	UN News, 2014	Humanitarian organizations have emergency seed via airdrops from airplanes. Roads may be impassable due to flooding or insecurity.
Cross-cutting seed interventions					
5	Improved storage	DRC (North Kivu)	c. 2020 and ongoing	Baributsa et al., 2021a	No change. Existing lightweight hermetic bags for seed and grain are easily movable.
		Ethiopia (South and East)	c. 2012	Mengistu and Garrand, 2014	Modified traditional storage pits toward improved ventilation and drainage. Some vessels put underground to deter looting.
6	Seed-related information (extension and advisory)	Sierra Leone *(countrywide)*	2014-2015	Baributsa et al., 2021b	Catalyzed novel multi-media information campaign that encouraged farmers to save the seed they already have had. Due to highly restricted movement during Ebola, interventions dramatically shifted away from bringing in seed (DSD).
7	Conflict-resilient crops	Many African countries	Ongoing	Choose crops that are difficult to steal, process, or convert to cash. See Box 1.	

3.2.1.1 Commentary on seed security interventions (shorter-term) implemented in conflict-affected contexts: technical focus

There is an array of seed-linked activities implemented in humanitarian settings and, more specifically, in conflict-affected contexts. The material is nuanced enough that full books have been written on many of these intervention types (e.g., DSD (Overseas Development Institute (ODI), 1996); cash transfer programming (International Committee of the Red Cross (ICRC), 2018; Longley et al., 2023); and agricultural vouchers and fairs (Catholic Relief Services (CRS), 2017)). Below, we share brief summaries of what each intervention type broadly entails before highlighting any novel features in conflict-intentional design. We share these brief sketches to establish a common basic understanding of the types of seed-related activities often implemented. These basic approaches are those that might be further shaped for application in conflict settings. We list them in order of use.

TABLE 6 Seed security interventions (shorter-term) implemented in conflict settings, market-based approaches.

#	Type of intervention	Location	Date	Organization/ reference	Salient technical feature
1a	Agricultural vouchers to client farmers: *Paper vouchers*	Sudan (south Kordofan; Gadaref)	2023-2024	Mercy Corps, 2024	Linked voucher use to agrodealer shops which had been supported prior to the conflict and which continued to function during the instability.
		Nigeria (eastern)	n.d.	International Committee of the Red Cross (ICRC), 2018	Tied commodity vouchers to certain suppliers where quality had been assured. Used one-off commodity vouchers as the organization was concerned about the quality of market seed.
1b	Agricultural vouchers to client farmers: *Digital transfer*	Syria	2020	Mercy Corps, H. Rasho, pers. comm., 2022 (also in Sperling et al., 2022b)	Linked digital vouchers to small scale vegetable seed suppliers in target markets (private sector suppliers). Seed samples screened for physical checks and germination tests.
2	Cash transfer assistance	Sudan (South Kordofan; Gadaref; South Darfur)	2023-2024	Mercy Corps, 2023a,b	Encouraged private microfinance institution to facilitate direct cash transfers. Ebdaa bank pivoted to this role from a traditional mobile transfer way of operating.
		Nigeria (Biu, Northeastern)	n.d.	International Committee of the Red Cross (ICRC), 2018	Transferred cash via existing digital platform, Teasy Mobile. Market in target area was assessed as functioning, with adequate seed quality. Transport costs and 10% inflation contingency built into vouchers.
3	Market support to supply side: formal seed sector	Sudan (Kassala; Gedaref; Gezira)	2024-2025	Abdalla Omer et al., 2025	Worked with private sector seed companies to intensify quality seed production (in non-functioning government context) and "sold" to farmers with subsidy.
4	Market support to supply side: *informal seed sector*	Mali (Douentza district)	c. 2018 and ongoing	H. Guindo and E. Weltzien, *pers. comm.*, 2023	Linked farmer-managed seed villages, known to produce high quality seed of very adapted pearl millet varieties, to NGOs working in conflict zones to supply for relief seed.
		Chad	2013	Solidarités International, 2013	Technically supported traders in field seed selection, sorting, and storage—tied to DSD and fairs.
		Burundi	c. 2005	CRS & S. Walsh, *pers comm.*, 2025	Provided transport subsidies to traders for bringing local seed to fairs.
		South Sudan	c. 2005		

direct seed distribution (DSD)

What is it?

DSD involves the procurement of quality seed, often from outside the agroecological region, for free delivery to farmers. It is the most common form of seed security response in both normal and conflict periods and is perceived as among the logistically-easier responses. DSD assumes that farmers need seed brought in as it is not available locally. Also, DSD is sometimes used as a mechanism to get new (modern) varieties to farmers, to help increase their productivity, resilience, or nutrition.

How has it been tailored to conflict?

- There is often a recognition that patterns of conflict are uneven within a region. While the conflict zones may lack sufficient seed, there are zones outside the immediate ones that produce sufficiently. In one DSD response in South Sudan (2014), FAO arranged for seed to be moved from non-violent zones to stressed ones.
- DSD responses may be tailored toward specific crops for clear purposes—e.g., in war zones where poor nutrition may be marked. In north Katanga, DRC, ICRC gave vegetable seed and promoted eggplants and tomatoes to bolster nutrition via seed interventions (International Committee of the Red Cross (ICRC), 2007).

More generally, some experts have noted that special care is needed in choice of varieties destined for war zones, including via DSD. Prendergast (1996, p. 74) writes:

> "*When providing seeds, part of the equation for selection of particular varieties should be their value to looters, their storage capacity, their time to germination (fast-yielding varieties in situations of chronic insecurity are often favored) and their quality (better, more adaptable seed is mobile in the sense that mobile populations take it with them). Seed programs can create problems if they begin to dilute the rich [variety] heterogeneity that allows communities to survive. In Rwanda, there are 300 types of bean seed…*"

seed production

What is it?

Activities are specifically organized to encourage increased seed production in the areas where farmers are actually sowing. The production might focus on producing good quality seed and/or modern varieties or adapted local varieties. The seed production can be organized in different ways but usually has a group focus. Working on seed production—and especially on producing quality/healthy seed—can be a multi-season or even multi-year process. While done in conflict areas, there may be need for lengthy periods of stability.

How has it been tailored to conflict?

- Much of the seed production work seems not to be tailored to conflict, technically, as seen in the ICRC Chad and DRC cases (International Committee of the Red Cross (ICRC), 2016).
- There is some recognition that existing local villages—rather than commercial seed companies—can be leveraged for very adapted types, such as in the Mali case (H. Guindo, *pers. comm.*, 2022).
- Steering seed production toward very local varieties, as in the case of Sierra Leone (Longley, 1997; Kent and Mokuwa, 2001), can be done—as prices may be linked to precise adaptation needs and conflict-induced scarcity.
- Bolstering local farmer entrepreneurs in north Kivu, DRC (Kajunju et al., 2024), has proven useful. These market-oriented women continue to do business in quite volatile times.

agricultural vouchers

What is it?

Vouchers (coupons) are provided physically or digitally (an e-voucher) to increase farmers' purchasing power to buy seed themselves. The approach assumes farmers' main seed constraint is access and that the right seed is available locally. Vouchers might be programmed to be redeemed at formal seed outlets, such as agrodealer stores, or sometimes at informal sources, such as local traders or community-based seed suppliers. Vouchers (vs. cash) are sometimes preferred by implementers or donors as vouchers can be explicitly tied to what are deemed quality sources of seed (International Committee of the Red Cross (ICRC), 2018). Vouchers (paper or digital) may be programmed *unconditional*—where farmers can buy any crops—or may be *conditional*—e.g., tied to buying certain types of crops (such as amounts allocated for maize, legumes, or vegetable seed). Digital vouchers (e-vouchers) can be used only in contexts where digital financial providers and client mobile money use are both well-developed.

How has it been tailored to conflict?

- Paper voucher use in Sudan was possible only because agrodealers supported prior to the conflict continued to function during conflict periods. The response was highly subsidized; farmers paid 20% of the price and the NGO supported 80% (Mercy Corps, 2024).
- In Syria, 2020, with the decline in government subsidies, more small, private sector vegetable seed sellers emerged. Mercy Corps, after-market assessments, provided e-vouchers that were redeemed in specific supplier shops (H. Rasho, *pers. comm.*, 2022).
- Voucher use in Michika, northeastern Nigeria, was tied to select suppliers where quality had been assured. Seeds were put on offer such as sorghum, maize, and cowpea, as well as fertilizer (International Committee of the Red Cross (ICRC), 2018).

cash transfer assistance (multipurpose cash)

What is it?

Cash transfer assistance involves delivering money to recipients, either physical currency or e-cash. Cash transfers are, by definition, unrestricted in terms of use: clients/farmers can use cash for whatever they want. The approach assumes that the main constraint is seed access (purchasing power) and that the right seed is available locally. "Better practice" guidance for using cash in conflict settings has been developed (International Committee of the Red Cross (ICRC), 2018) and cash specifically linked to seed emergency assistance is on the rise (Keane et al., 2019; Longley et al., 2023).

Cash transfers are increasingly used by humanitarians: cash allows farmers themselves to prioritize purchase choices (even 'individualizing' aid) and injects resources into the wider economy. Some state that the option of digital transfer (where this exists) can help reach individuals in ways that are "faster, safer, and far easier to achieve on a large scale," and—under selective conditions—can serve those in remote locales and high-armed conflict regions (International Committee of the Red Cross (ICRC), 2018, p. 10). There is growing, specialized advice on digital transfers, partly to ensure that recipient lists remain confidential and out of the hands of warring groups (Burton, 2020).

With the expansion in the use of cash, much has been written around their use. In one overview linked specifically to conflict contexts, ICRC reflects on the use of cash or vouchers vs. in-kind transfers suggesting that the delivery choice very much depends on the specifics of the conflict situation on the ground.

> *High-value cash transfers–like those to support livelihoods or build medium-term accommodation–can expose recipients and humanitarian staff to security risks. Where security is a significant risk, the use of electronic cash transfers or vouchers is encouraged.*
>
> *On the other hand, cash transfers are sometimes chosen precisely because they reduce particular security risks in certain situations. Cash or vouchers may be less visible than in-kind assistance. This means people can receive and transport cash and/or vouchers discreetly, making them a less visible target for common criminality… This is especially true if cash is transferred electronically. The relative absence of warehouses, supply lines and staff is more discreet and reduces physical risks, but it may also relocate risk into the digital realm, where hacking and misuse of personal data, theft, and obstruction are real concerns* (International Committee of the Red Cross (ICRC), 2018, p. 38, *edited*).

How has it been tailored to conflict?

- Banks have been specifically vetted not to have ties with the war economy. In the case of Sudan, Ebdaa bank relocated its head office out from the capital (Khartoum) to Gedaref. Ebdaa also pivoted to working with community leaders to distribute direct cash assistance—which is an important means where communities may have limited mobile phone access (Mercy Corps, 2023a,b).
- Inflation has been built into the calculation for conflict zones. In Biu, northeastern Nigeria, where the market was functioning and the quality of goods available was adequate, ICRC provided cash to households, basing the cash values on agricultural items needed and their quantity, including a 10 per cent contingency for any possible inflation. ICRC worked with Teasy Mobile to transfer the cash via a digital platform whereby beneficiaries could go to any Teasy cash agent and collect their cash on the day of distribution (International Committee of the Red Cross (ICRC), 2018).

market support to supply side: formal seed sector (agrodealers, private sector)

What is it?

Humanitarian market support to the formal seed sector might include support to seed companies or specific agrodealer networks on a range of themes: for seed production (including of specific crops), for packaging (e.g., in small sizes), or for delivery, including to more remote or unstable areas. As an overarching and key support type, formal sector companies benefit specifically from DSD when they receive tenders to supply emergency seed in bulk. This type of support is so common that a specialized "Relief Seed Business" has emerged in areas of repeated disaster, for example, across Southern Africa (Bramel and Remington, 2004).

How has it been tailored to conflict?

- Private sector companies may be singled out for support to intensify high quality seed production when government institutions become non-functioning. In Sudan, through the SASAS project, several companies were supported to multiply high quality seed which was then "sold" to farmers with a 65% price subsidy provided by aid actors (i.e., farmers pay 35%) (Abdalla Omer et al., 2025).

market support to supply side: informal seed sector (traders)

What is it?

Humanitarian market support to the informal seed sector might include support: to those producing local seed (of a verified quality); to those moving local seed from one region to another (from a non-stressed to a stressed region); or to those marketing local seed within a conflict-affected region. Support to the informal sector seems logical, as smallholder farmers source upwards of 80% of their seed from informal sources in normal times (Louwaars et al., 2013; Westengen et al., 2023) and an even greater proportion in stress periods, as informal systems tend to be more resilient (McGuire and Sperling, 2016). Concerns by donors and implementers are sometimes raised around the perceived quality of seed sourced from local markets.

Table 6 highlighted three distinct approaches humanitarian agencies took to support the informal seed system in conflict-affected contexts (see the first three bullets below for more details). A fourth case, where there was no humanitarian support, is included here and particularly instructive.

How has it been tailored to conflict?

- In Mali, local (indigenous) seed production villages, located in non-conflict zones, produce highly adapted pearl millet varieties for the region, including for conflict and drought-stressed zones. They are tendered to also supply humanitarian agencies. Originally autonomous, they were more recently given outside support to establish seed cooperatives, with special seed stores, labeling, seed treatments, etc. (H. Guindo and E. Weltzien, *pers. comm.*, 2023).
- Traders in Chad—destined to supply DSD and fair responses during conflict periods—are given a range of training support around seed quality management and maintenance. The guidance/training starts from plant and seed selection in the field, to cleaning and sorting seed post-harvest, to advice on storage practices (Solidarités International, 2013).
- Traders potentially providing local seed to humanitarian fairs are given transport subsidies. This has been done in numerous places (cases cited in Table 6 for Burundi and South Sudan). Note that traders know the local context and fluctuations and are often more "conflict-savvy" than outsiders (CRS & S. Walsh, *pers. comm.*, 2025).
- In northern Uganda, there was no formal sector for sweet potato vines and no/little outside humanitarian seed system support during an extremely turbulent Lord's Resistance Army (LRA) period. Informal seed producers developed a system to produce and market high quality vines, rotating marsh areas where initial planting stocks could be nurtured (Rachkara et al., 2017).

improved storage

What is it?

Storage methods or containers might be "improved" to ensure that stored seed is: of better quality (not prone to be damaged); safer (not easily looted); and more easily movable, if displacement is necessary. Storage can take different forms, in: pits; containers (clay, plastic, tins); metal silos; or special hermetic storage bags that asphyxiate insects and keep seed dry. Promoting enhanced seed storage of farmers' own stocks in conflict-affected contexts has distinct advantages—the seed is likely to be adapted, immediately accessible, and cost-free.

How has it been tailored to conflict?

- In the Ebola crisis in Sierra Leone, no technology modification was needed in terms of the hermetic bag design, as previous pilot work had already confirmed their effectiveness and acceptability. It was the training around the technology that had to be tailored to become more remote: (a) the local training agents had to be trained virtually (and even across international borders via Skype/WhatsApp), and (b) any face-to-face trainings in villages involved only very small groupings (e.g., 5 people or less) (Baributsa et al., 2021b).
- Hermetic bags are increasingly used in the DRC, including in north Kivu, an area of protracted conflict. The lightweight bags have some advantages over pits because they are movable, if displacement is necessary, and can be hidden up in rafters or dug into garden plots (Baributsa et al., 2021a).
- Traditional pits can be better reinforced for above- and below-ground stores in the face of stress. In southern and eastern Ethiopia, GOAL helped design above-ground stores similar to traditional ones but sturdier and equipped with rat guards. The below-ground stores were also modified with improved ventilation and drainage as these underground versions can be hidden from looters or thieving neighbors (Mengistu and Garrand, 2014).

seed-related information (extension and advisory)

What is it?

Beyond focus on the physical seed itself, information may warrant specific programming in conflict contexts. Reliable, up-to-date information can be a scarce commodity, making it especially important for humanitarian actors to consider explicit two-way programming: to get information to and from farmers.

How has it been tailored to conflict?

An example of a seed security intervention implemented in Sierra Leone during the Ebola outbreak is presented, due to the lack of an example from a conflict context. When Ebola escalated (2014-2015), the government quickly declared a public health emergency which, among other effects, restricted or closed movements to local zones and markets, where many smallholder farmers source their seed.

For farmers, key seed issues revolved around their securing and storing seed from the upcoming harvest (i.e., seed storage, see #7

above). While many humanitarian agencies directed efforts to importing seed, a few shifted their prime focus toward safeguarding what was already in farmers' hands, including locally-saved seed.

- There was an information shift away from new seed delivery to saving what already existed in farmers' hands: a major technical shift (Baributsa et al., 2021b).
- Information sharing took place through a wide range of message channels (mostly non-seed linked). Church sermons—one of the few remaining physical gathering places—preached to save seed, and remote information systems further helped spread the message. Cell phone videos and posters passed technical information outward; a text messaging system was used to get farmer feedback via Skype, WhatsApp, and SMS. Radio jingles, ads, and talk shows also promoted seed saving awareness (Baributsa et al., 2021b).

seed networks in conflict contexts (during active conflict)

What is it?

Seed sharing networks are those that may share seeds even from outside conflict zones—including outside the country—to ensure that growers have specific desired planting materials. Seed shared often centers on local or heirloom varieties.

How has it been tailored to conflict?

The 15th Garden is a striking case that has been implemented in besieged Syria (Grüne Liga, 2017). The 15th Garden is a bottom-up network of urban gardens in cities that have been bombed, besieged, and blocked in Syria. The network includes family gardens, farmers in rural areas, and agriculture initiatives in refugee camps. The network has developed fast over the past years and posted information states:

> "*Via the 15th Garden, open pollinated seeds are swapped and reproduced in and around Syria, skills for sustainable agriculture and gardening are taught in workshops and courses, and knowledge is shared about the dangers related to the promises made by agribusiness actors…*"

The network was catalyzed by an activist named Abdallah Al Shaar to support urban farming projects across besieged cities throughout Syria. It was named after the day the revolution against Assad began, the 15th of March 2011. One major obstacle was the acquisition of seeds to get this all started. A network of German farms provided heritage seeds and money to Syrian farmers, sending the seeds via Lebanon, crossing the border. Because of blockades, activists risked their lives to get these seeds to the country (Grüne Liga, 2017). The 15th Garden seems to parallel networks elsewhere that support stressed farmers, such as in Rwanda, Sierra Leone, and Liberia (Zimmerer, 2017).

drones and airdrops

What are they

Both drones and airdrops involve the use of airborne vehicles to drop commodities. Drones are unmanned; airdrops involve manned airplanes.

Drones: Drones are small or medium-sized unmanned aerial vehicles (UAVs). They can drive remotely and autonomously and can maintain a controlled, sustained level of flight (Innovative Food Systems Solutions (IFSS), 2021). Theoretically, solar-powered drones have the potential to deliver seeds and other agricultural inputs to hard-to-reach areas, particularly after disasters and in an environmentally-friendly way (with their negative environmental impacts claimed to be zero).

To our knowledge, drones have not been used in war zones in Africa for seed, although an Australian company with a satellite office in South Africa, AirSeed Technologies, has used drones to restore areas affected by climate change (Hassan, 2022). Select seed companies have also used drones to deliver seed to help tree planting in places like the United Arab Emirates, Guam, or the United States. Specialized companies, such as DroneSeed (now Mass Reforestation) or AirSeed Technologies, provide reforestation services especially linked to wildfires and in mountainous terrain. Drones have also been used to deploy vessels that contain seeds, fertilizers, and other amendments, and experts claim that drone sowing might be six times faster than hand planting, as used in industrialized countries (Chiu, 2023). At this stage, drones are more of an idea than a reality for fostering seed security in conflict areas.

Airdrops: In contrast to drones, humanitarians have delivered seed via emergency airdrops from airplanes. In 2014, for example, agencies such as FAO, ICRC, and the United Nations World Food Program (WFP) conducted large-scale airdrops of food and crop seeds (including maize, sorghum, cowpea, and sesame) to conflict-affected communities in South Sudan (UN News, 2014). With roads rendered impassable by flooding and insecurity, and the planting season approaching, airdrops were deemed critical for supporting food production. However, due to their high cost and logistical complexity, such interventions are considered a last resort (Morgan, 2014).

The airdrops are done in close coordination with staff and volunteers on the ground. Clear communication with beneficiaries is essential to coordinate the drop time, location, and safety protocols, and to ensure farmers prepare the land and soil in advance for planting (Morgan, 2014).

conflict-resilient crops (cross-cutting intervention)

Conflict-resilient crops are a recent concept. They are a cross-cutting intervention because conflict-resilient crops or production systems might be promoted in many of the responses cited in Table 5, such as in seed production, seed banks, agricultural voucher use, etc. Box 1 explores the evolving concept and its content.

3.2.1.2 Overall trends in seed security interventions aiming to "do good—technically": initial summary (eight central findings)

The descriptions above give some initial insight into the kinds of seed security interventions implemented in conflict-affected contexts. No claims are made about their effectiveness or their farmer acceptability. The authors reviewed documentation for 24 cases: so, there was some breadth, but cases were thin in depth. The cases contain little information about the extent or nature of the conflict or the processes of implementation. While recognizing the limitations, this review represents a start in what has been a largely undiscussed, and scarcely documented field.

Overall, what do the cases suggest in terms of trends in seed security interventions aiming to do good technically? The eight central findings are listed below.

1 Seed security interventions are taking place in many and diverse conflict-affected contexts in Africa. This article cites 24 cases from 10 countries.
2 The seed security work implemented in these contexts includes a wide range of responses.

3 The basic set of interventions implemented in conflict-affected contexts largely parallels those implemented in routine seed security programs, in normal times. There were a few exceptions identified: spurring extensive international seed networks; and, possibly, airdrop delivery.
4 The interventions reviewed embraced select technical modifications linked to conflict-induced stresses: for example, alterations in storage design to address theft and shifts in crop choice to boost nutrition and respond to dietary needs.
5 Broadly, the technical tailoring (i.e., conflict-intentional programming) seems to have been modest, especially in relation to the extent of possible conflict-induced changes.
6 Given the importance and relative stability of informal seed systems, it was surprising to find very few efforts to support the informal sector specifically.
7 As a global set, the responses mainly focused on the supply-side, and on giving something free to beneficiaries. This thrust contrasts with expert advice that market-driven systems for service delivery (i.e., not supply-led programming) should be the essence of agricultural support in conflict-affected countries.
8 In terms of actively tailoring responses in conflict-affected contexts, the cash-based responses seem much more advanced than those linked to seed security. Cash-based analysis provides specific guidance around the risks and benefits of diverse approaches (e.g., cash vs. voucher; digital vs. paper).

In terms of actively tailoring responses in conflict-affected contexts, the cash-based responses seem much more advanced than those linked to seed security. Cash-based analysis provides specific guidance around the risks and benefits of diverse approaches (e.g., cash vs. voucher; digital vs. paper).

As an overall statement, there is relatively scant evidence that seed security interventions are being tailored to address conflict-induced stresses, that is, that they are conflict-intentional. This lag or gap contrasts to the significant number of interventions taking place.

This section has focused on the short-term seed security interventions that aim for better technical results—that is, aim to strengthen seed system performance. The next section briefly reviews seed security interventions that are tied to furthering social cohesion and/or peace.

3.3 Humanitarian seed security interventions contributing to peace: do good—socially

3.3.1 Seed security interventions contributing to peace: do good—socially

Seed security interventions have been noted specifically in the context of work to promote peace (Food and Agriculture Organization of the United Nations (FAO), 2018). Such seed-linked interventions have been suggested as one possible entry point to achieve a bigger vision of more social cohesion, more collective action, etc. Possible connections between seed security and peace-linked work are of particular relevance given the ongoing promotion of Humanitarian-Development-Peace (HDP) Nexus programming approaches (United States Agency for International Development (USAID), 2021).

BOX 1 Conflict-resilient crops: what are they? What are their features?

Farming communities in the face of conflict may shift toward specific crops that they sense will be less affected by existing conflict-induced stresses or less vulnerable to future ones. For instance, the special role of cassava in conflict areas has been noted for many locales.

• *DRC: Originating from South America and introduced in the 16th century to Africa by sailors, cassava very quickly became an essential crop in time of crisis. The low maintenance required, its capacity to be stored in the ground, and the fact that bitter varieties are less likely to be looted than other crops make it particularly well adapted to conflict areas. It produces more than twice the number of calories per hectare (ha) than maize* (International Committee of the Red Cross (ICRC), 2007, p. 23).

• *CAR, 2014: "Many farmers had Seleka-proofed [rebel militia groups] their crops. They planted cassava, a hardy root, rather than corn, which can be easily stolen by marauding rebels. Cassava, on the other hand, is harder to pilfer; it needs to be dug up before being carted away, and even then, the roots require days of processing before it is edible,"* (Bauer, 2024, p. 86).

• *South Sudan, 1995: Southern Sudanese have expanded cassava production because it has proven useful in crises, as in Mozambique and Liberia. It resists insects and can be left in the ground for years as a food reserve safe from looters* (Prendergast, 1996, p. 74).

Conflict-resilient crops (or sometimes labeled conflict-resistant crops) is a recent term sometimes employed for crops that seem to respond to select stresses induced by instability or violence (Mercy Corps, 2014). The following attributes have been associated with conflict-resilient crops, with important variations by context.

Crops that:

• Cannot be used directly, i.e., that need processing to realize value (e.g., coffee, soybean).

• Are toxic if not processed properly (e.g., bitter cassava).

• Do not need tending; can be left in the field for months or even years (e.g., cassava).

• Can suffer damage but recover (e.g., cowpea).

• Are more difficult to harvest (e.g., peanuts and root crops, especially if the tops are cut off).

• Are very quick to mature and have small land requirements, like some vegetable crops.

Overall, conflict-resilient crops are ones that are difficult to steal, process, or convert to cash.

3.3.1.1 Seed and peace-linked work: a natural entry point?

Is seed a good entry point for peace-linked work? Does seed lend itself to promoting greater social cohesion? It is unclear if this theme has been previously explored but we reflect on six features of seed and seed systems that might lend themselves to a possible seed-peace work coupling (Box 2).

Note that none of these features of seed (Box 2) guarantees that its use will make a positive contribution to furthering peace. Simply, the coupling of seed and peace-linked work seems possible and potentially positive, for multiple reasons.

3.3.1.2 Seed and peace-linked seed security work: some examples

There are modest, but diverse approaches, where seed security and peace work has been explicitly linked to date (Table 7). The first approach centers on peacebuilding itself, with seed added as a component (along with others like free food or tools). The second approach centers on seed itself, and particularly on its propensity to

spur collective action over time through collective garden establishment and tending. The third, a quite novel approach, involves linking seed sharing networks internationally to ensure that a range of growers (rural and urban) can get adapted and local seed. This network model is described in Table 5 as a technical innovation and, below, in Table 7, as a peace-linked one as it aims to promote food sovereignty directly in conflict zones.

Table 7, and the commentary that follows, give greater detail on each of these different interventions. Interestingly, the three approaches suggest diverse scales of seed interactions. In the first, seed is given on an individual basis and managed so; in the second (varied locales), seed is given to stimulate local group gardens; and the third involves seed sharing networks across many members and across very large geographical distances (across countries and continents). This diversity might spur reflection on future types of seed and peace-linked trends.

3.3.1.3 Commentary on seed and peace-linked seed security interventions implemented in conflict-affected contexts: social focus

More detail is added below on each of the seed and peace-linked seed security interventions.

#1 village peace and rights days, and seed

What is it?

Village-level Peace and Rights Days were held in Sierra Leone to allow villagers to debate the vulnerabilities that facilitated the civil war and to discuss local notions of human rights. In symbolizing new beginnings, seed was chosen as a useful medium through which to debate a more inclusive and less vulnerable society. Seed distribution was specifically *not* targeted as former distributions had led to inequities and spurred tensions. For instance, follow-up of former seed distributions revealed several exclusions: (a) smaller, more remote, and more ephemeral settlements were missed in the initial seed registration; (b) displaced 'strangers' were sometimes excluded; (c) poorer groups lacking friends on the seed selection committees were often overlooked; and (d) youth were excluded in some sites where only people over 40 were favored (Archibald and Richards, 2002, p. 358).

How has it been tailored to conflict?

- Seed distribution specifically was not targeted; it was a blanket distribution: each beneficiary received a smaller amount.
- Seed—considered a physical good but also a symbol of new beginning—was distributed in the context of Village Peace and Rights Days. These day-long events discussed and debated the war, its injustices and possible ways forward. Discussions were clustered by group: e.g., by youth, women, and elders.

#2 gardens in war-torn zones

What is it?

Collective gardening has been promoted in war-torn zones, generally after the active fighting has ceased. The rationale is that healing can emerge from collective work and that gardens—things that grow—can help heal wounds, address post-traumatic stress disorder (PTSD), promote social cohesion, and more. Gordon-Smith (2023) mentions several such projects and asserts that gardens in conflict-affected zones can: produce food; help restore degraded environments; empower specific groups (i.e., women); promote peace and reconciliation; and more.

Projects

- "Gardening for Peace": UN project in Gaza using gardening for emotional expression and stability
- "Path of Peace" garden: Israeli project bringing Jews and Arabs together
- "Olive Branch" project: Iraq and Syria

Within Africa, the RECOSA project (2019–2024) promoted home gardens as well as plant nurseries. The project aimed to strengthen the resilience and social cohesion of conflict-affected displaced populations, especially in the cross-border regions of Burkina Faso (Sahel region) and Niger (Tillabéri region). Households were trained and equipped to create home gardens and shared gardens and introduced to best market-gardening practices.

How has it been tailored to conflict?

- In community meetings, special emphasis was placed on recruiting individuals directly affected by conflict, including former militia members and families hosting or comprised of refugees (Sierra Leone, Archibald and Richards, 2002).
- A focus was intentionally put on shared gardens where the displaced congregate and work together (Burkina Faso, RECOSA project, Humanity and Inclusion, 2023).

In all the cases listed, the gardens themselves do not seem to have had specific technical modifications linked to the conflict or post-conflict recovery. The social gathering was the innovation.

BOX 2 Six seed features that might lend themselves to a seed-peace work coupling

1. *Seed sharing takes place and creates bonds in normal local systems*: Seed sharing, either between individual or within networks, is common in many rural communities, even pre-dating conflicts (Coomes et al., 2015). Such sharing is often built on trust and can facilitate intergroup coordination. Hence, there may be a foundation of social cohesion, already linked to seed, that peace efforts can leverage.

2. *Seed is sometimes closely tied to land, cultural identity, and pride—and perhaps healing*: Seed is embedded with a strong cultural identity in some communities. Safeguarding local varieties might help revitalize community pride, and joint stewardship of varieties might be one part of a broader social cohesion or healing process.

3. *Seed is a relatively easy technology: "plug and play"*: Seed is a relatively easy technology to use as farmer can usually manage it their own, with existing knowledge. Some use the term "plug and play." This suggests that the allied peace work can focus on the more complex cohesion processes, without substantial technical hurdles.

4. *Seed grows–it has a future*: Seed, inherently, is something that grows, has a future, and may last over seasons. The analogy to what is desired by peace may make seed a natural fit to social cohesion work.

5. *Seed is often short cycle–it yields quick results*: Seed is among the quicker technologies to mature and give results. In peace work, it may offer a short-term milestone against which possible social cohesion gains can be charted.

6. *Seed management is often associated with women and youth—those most vulnerable in conflict*: Seed systems, especially local ones, are most often managed by women, with youth doing a good deal of the labor. Conflict experts suggest that women and youth are those most affected by conflict. A focus on "seed" may also engage those most vulnerable.

TABLE 7 Seed and peace-linked seed security interventions: some examples.

#	Type of intervention	Location	Date	Organization/ reference	Salient aspects
1	DSD linked to village peace and rights days	Sierra Leone	2001	CARE. Archibald and Richards, 2002	Non-targeting of seed aid: all-receive aid; inclusive
					Seed distributed through "village peace and rights days"
2	Gardens in war-torn zones	Lebanon	No date	Gordon-Smith, 2023	Modifications seem to be social, rather than technical, e.g., even involving former combatants
		Israel			
		Gaza			
		Iraq		Reflections from: "farms no arms coalition of NGOs" (Lebanon) and other projects (Israel, Iraq, Syria)	Community gardening and market gardening
		Syria			
		Burkina Faso	2019–2024	Humanity and inclusion and its partners (RECOSA project), 2023	Has a disability component- aiding with wheelchairs, mobility aids
3	Seed sharing networks in direct conflict zones (with ongoing fighting)	Syria	2011–present	Grüne Liga, 2017	Open pollinated seeds are swapped and reproduced via seed sharing networks
				15th Garden (as described above in Table 5)	German farms provide heritage seeds and money to Syrian farmers, sending the seeds through Lebanon and crossing the border.

#3 seed networks in conflict landscapes (during active conflict)

What is it?

As noted in Section 3.2 above, networks share seeds from outside conflict zones—and even outside a country—to ensure that growers have their desired planting materials. A striking case has been implemented in Syria via the 15th Garden is a bottom-up network.

How has it been tailored to conflict?

- A network of German farms provided heritage seeds and money to Syrian farmers, sending the seeds through Lebanon and crossing the border.
- Open pollinated seeds are swapped and reproduced in and around Syria via seed sharing networks within and outside country.
- The 15th Garden movement is tied to broader food sovereignty movements (Grüne Liga, 2017).

Overall, evidence for work directly linking seed security response and peace efforts in conflict-affected contexts has been modest although seed might have some inherent or associated properties that make it one good entry point for peace-linked efforts. In an allied field—Environmental Peacebuilding ("Environmental Peacebuilding", Wikipedia, 2025)—seed is sometimes a curated resource, but usually within much broader natural resource management and peacebuilding activity scenarios.

4 Discussion and next steps forward

This article has reviewed seed security interventions in conflict-affected contexts, mostly drawn from cases in Africa. It has presented three clear sets of findings. (1) It has identified features of seed systems that might be affected in these unstable, conflict-affected periods. (2) It has reviewed the range of seed security responses implemented and concluded that, while of many and diverse types, very few have been tailored to address the changes, i.e., few have technical elements of "conflict-intentional programming." (3) Focusing on social cohesion and peacebuilding programs, the article has identified only three seed-linked approaches, and explored whether the attributes of seed make it an especially good entry point for more socially-oriented work.

Throughout this review, the authors have been transparent about limitations. It has been challenging to locate written documentation at all, and especially project reports or published articles that share in-depth insight into seed-linked interventions in these volatile, conflict-affected contexts. While the evidence presented has some important breadth, it falls short on the depth needed to, say, distinguish one type of conflict from another in terms of differentiated or predictable seed system effects.

Limitations aside, this article presents the first-ever overview of seed security interventions in conflict-affected contexts. Understanding this theme better has some urgency as seed security interventions are escalating in frequency and over a widening geographic scale. Seed-linked humanitarian responses can help farmers get back on their feet and spur production and sale, if done wisely. Alternatively, they can have no effect and even do damage, especially when uninformed about the changing contexts and needs. A broader aim of this article is therefore to help steer emergency response toward "doing better" and being more effective, even in volatile scenarios. The notion of *conflict-intentional* programming is key in this regard—combined with the more well-known humanitarian guidance around *conflict-sensitive* and *conflict-savvy* programming.

Based on the existing evidence, the authors suggest several basic initial steps for moving forward, focusing on both policy and practice, as concerted action is needed at multiple levels. Note that the first three steps center on gaining more understanding and especially evidence around conflict-intentional programming, gathering more robust field experience not just in written form but also through face-to-face practitioner exchanges. The last step proposes to then use this enhanced understanding and evidence to guide future program design and implementation on the ground via a concrete technical checklist.

Proposed next steps:

1 *Familiarize emergency response decision-makers, program managers and field responders—globally—with the concept*

of conflict-intentional. While Do No Harm is widely understood, conflict-intentional is a newer concept. It seems important to socialize this term more widely in the global domain via, *inter alia,* policy documents, programming guidelines, technical publications, webinars, and online posts. The aim is not to reify the term but rather to spur conflict-intentional reflections in policy strategy and programming guidance.

2 *Catalyze/review specific cases of seed security programming that have been conflict-intentional*. The available data on which this article drew was modest, despite use of substantial search engines. More evidence possibly resides in managers' and practitioners' minds and experience, but has yet to be documented. A targeted workshop or expert consultation might help capture practitioner insights from conflict-affected regions. Documenting this field-based experience is essential for refining and advancing conflict-intentional decision-making frameworks and field programming.

3 *Examine the potential of seed to further social cohesion/peace: are the two a good match?* Seed-linked programming may support social cohesion, making it a good fit for HDP nexus goals. However, the contributions of seed to social cohesion and/or peacebuilding remain largely underexplored. Joint reflection—via commissioned country-specific (?) reviews, webinars, case calls, or integrated workshops—could clarify when and how seed system work can contribute to broader social cohesion outcomes (possibly linked to #2).

4 *Develop conflict-intentional seed security programming checklists*. As knowledge on this topic advances, a second order step would be to elaborate more detailed guidance. To operationalize the concept, conflict-intentional programming checklists might be created to guide seed security intervention decision-making and field programming. Checklists should be grounded in practical questions—for instance, should the crop choice be the same as pre-conflict? Do the focus crops require inputs that are available? As seed security interventions are often designed and implemented by a range of technical and non-technical personnel, checklists should be accessible and intelligible to non-specialists.

Conflict-intentional programming should help to improve seed security response in conflict contexts. That is the fundamental notion driving this overview article. At this point, we have identified many significant changes that happen to seed system functioning in unstable, conflict periods. The issue is how to practically respond to these changes. This article aims to set in motion a process of more systematically recognizing how conflict affects seed systems and of tailoring programming to mitigate, adapt to, and respond to any shifts. Concerted action is needed at both policy and programmatic field levels.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Author contributions

LS: Conceptualization, Data curation, Investigation, Methodology, Supervision, Writing – original draft, Writing – review & editing. KL: Data curation, Funding acquisition, Investigation, Project administration, Resources, Writing – review & editing. GO: Funding acquisition, Project administration, Writing – review & editing. JM: Conceptualization, Writing – review & editing.

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Conflict of interest

The author(s) declared that this work was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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