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The Power of Conservation Agriculture and Small-Scale Irrigation

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In today's climate-altered world, the challenge of food security is more pressing than ever. Farmers face the harsh realities of unpredictable weather patterns, diminishing rainfall, and increasingly erratic seasons. However, there's hope on the horizon: small-scale irrigation paired with conservation agriculture practices is transforming farming from a high-risk venture into a sustainable, climate-resilient livelihood.

Excessive or uncontrol irrigation (left) erosion (right) during furrow irrigation at one of CFGB's project sites.

Small-scale irrigation is more than just a tool for climate adaptation; it's a powerful means of financial empowerment. By providing a consistent water supply, it enables farmers to produce crops even when weather patterns turn unpredictable. With water being a limiting factor in many regions, having access to a reliable irrigation system allows farmers to diversify their crop portfolio, grow more produce, and cultivate multiple cropping cycles throughout the year. This

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A Christian Response to Hunger

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increased agricultural productivity leads to higher yields, enhanced nutrition, and improved food security for farming families and their communities.

But the benefits go beyond food security. By growing more diverse crops, farmers can boost their incomes by selling surplus produce in local markets. Small-scale irrigation also strengthens resilience by reducing the dependency on unreliable rainfall, making farmers less vulnerable to droughts and the economic instability they often bring.

While small-scale irrigation is a game-changer, not all irrigation methods are created equal. Traditional furrow irrigation, a common technique used in many parts of the world, presents significant challenges that can undermine its efficiency and sustainability.

One of the main drawbacks of furrow irrigation is its water inefficiency. This method often leads to considerable water loss through evaporation and deep percolation, particularly in sandy soils. Furthermore, the distribution of water is frequently uneven, with some crops receiving too much water and others too little, negatively impacting overall crop yields. Additionally, furrow irrigation can contribute to soil erosion, especially on sloped fields, as the flowing water washes away topsoil, depleting soil fertility over time.

Labor and maintenance are also substantial challenges with traditional furrow irrigation systems. The furrows require constant upkeep to ensure that they remain clear of obstructions and are properly shaped for efficient water flow. This task can be labor-intensive, particularly for smallholder farmers with limited resources. Furthermore, in arid regions, the evaporation of water from furrows can lead to the accumulation of salts in the soil, further degrading its quality and making it less suitable for growing crops.

These drawbacks highlight the need for innovative approaches to irrigation—methods that conserve water, improve soil health, and reduce the labor required to manage the system. This is where conservation agriculture (CA) comes into play.

Conservation agriculture integrates farming practices that not only improve soil health but also enhance water efficiency. By adopting techniques such as minimum tillage, mulching, and crop rotation, farmers can significantly reduce the amount of water needed for irrigation.

One of the key benefits of conservation agriculture is that it improves soil structure, which enhances the soil's ability to retain moisture. This reduces the need for frequent irrigation and helps farmers conserve water. Additionally, the use of mulch keeps the soil cooler and moist for longer periods, further reducing irrigation costs and labor. These practices not only save time and money but also make farming more sustainable by promoting healthier soils that are less susceptible to erosion.

What's more, conservation agriculture helps farmers adapt to the challenges posed by climate change. By improving water retention and reducing evaporation, CA practices help mitigate the effects of droughts, making small-scale farming more resilient in the face of unpredictable weather patterns.

The benefits of conservation agriculture combined with small-scale irrigation are not just theoretical—they have been demonstrated in real-world studies. Research conducted in Ethiopia and Ghana examined the impact of conservation agriculture (CA) with drip irrigation on water productivity in vegetable home gardens. The results were striking. Water usage was reduced by 18% to 45.6% under CA practices, while crop yields increased by 9% to nearly double when compared to conventional tillage (CT).

This improved water-use efficiency means that farmers can irrigate more land with the same amount of water, which opens up exciting possibilities for expanding irrigation areas or bringing new farmers into the fold. As a result, more people can benefit from stable and increased crop production, which supports broader food security goals.

TABLE 1. AVERAGE IRRIGATION WATER USE AND CROP YIELD

Crop	Irrigation Use (1000 m³/ha)		Crop Yield (t/ha)		N
	CA	CT	CA	CT	
Garlic	2.96	3.63	3.05	1.96	9
Onion	1.29	2.38	3.20	2.81	5
Tomato	3.39	4.21	17.84	6.29	4
Cabbage	2.60	3.17	23.58	21.54	4
Sweet Potato	1.48	1.48	15.9	10.14	5

NOTE: N = NUMBER OF REPLICATES.
ADOPTED FROM THE "EXPERIMENTAL EVALUATION OF CONSERVATION AGRICULTURE WITH DRIP IRRIGATION FOR WATER PRODUCTIVITY IN SUB-SAHARAN AFRICA" ARTICLE.

Another study conducted in Ethiopia further demonstrated the potential of CA practices. The research found that conservation agriculture not only reduced water usage but also improved soil moisture and increased crop yields. Specifically, onion and garlic yields were around 40% higher in CA fields compared to conventional tillage. Additionally, irrigation water-use efficiency was significantly better under CA, with increases of 44% for onions and 57% for garlic.

In conclusion, the evidence is clear: conservation agriculture and small-scale irrigation are powerful tools for transforming smallholder farming. By improving water efficiency, enhancing soil health, and reducing the labor and costs associated with irrigation, farmers can achieve higher productivity, better incomes, and greater resilience in the face of climate challenges.

As we look to the future, adopting these practices at scale will not only benefit farmers but also contribute to broader goals of food security and climate resilience. With the right support, conservation agriculture can empower small-scale farmers to thrive, ensuring that they are well-equipped to meet the challenges of tomorrow while reaping the rewards of sustainable and profitable farming today.

Soil Cover is the driver of adoption of conservation agriculture by small-holder farmers

Lidet Sitotaw, Agriculture & Livelihoods Technical Advisor for Ethiopia

The issue of soil cover is the driving force of the movement of shifting from conventional to conservation agriculture. The 1930s Dust Bowl was a pivotal event that underscored the urgent need for sustainable farming practices, leading to the development of conservation agriculture. The severe dust storms and soil erosion that devastated the American Midwest were largely a result of changing prairies (which were part of the temperate grassland ecosystem) in to agricultural land which left the soil vulnerable to wind erosion. This environmental disaster highlighted the consequences of poor land management and spurred a movement towards soil conservation. Pioneers like Edward H. Faulkner, through his influential book "Plowman's Folly," criticized traditional ploughing methods and advocated for reduced tillage. This period marked the beginning of a shift towards practices that minimize soil disturbance, maintain soil cover, and promote crop rotation, forming the foundational principles of conservation agriculture. Transforming the ecosystem with year-round soil cover into agricultural land that only protects the soil for part of the year cause the Dust Bowl.

It is also important component to promote conservation agriculture for small holder farmers as it is the component of conservation agriculture (CA) that helps to balance the short-term (immediate) need of farmers which is equal or higher yield than the conventional farming and the long-term objective of CA which is environmental safety and sustainability. Some of the short-term benefits that can be obtained from conservation agriculture are reduce soil erosion (reduced run-off), smother weeds, increase soil fertility (through nitrogen fixing cover crops) and increased soil water availability. The long-term benefits can be soil fertility (through structural improvement and overall health), soil organic carbon (SOC) sequestration, economic stability and biodiversity.

Figure 1. By regularly adding animals feed leftover, by leaving some crop residue and by keeping livestock away from CA fields (left), it is possible to manage 30 % soil cover (right).

For smallholder farmers, yield is the most crucial factor that attracts them to new technologies or methods. The yield from their fields directly affects their food security, income, and overall livelihood. Achieving good yields allows them to feed their families, sell surplus produce for additional income, and reinvest in their farms. Therefore, without clear short-term benefits, the acceptance of conservation agriculture (CA) by smallholder farmers may be low. This is understandable, given that these farmers have long practiced conventional farming methods focused solely on high-yield technologies, often at the expense of environmental sustainability. Implementing CA as a Nature-Based Solution (NBS) to address the challenges posed by conventional agriculture highlights the importance of balancing high yields with environmental sustainability. According to the sixth criterion of NBS, 'NBS equitably balance trade-offs between achieving their primary goals and the continued provision of multiple benefits.' This means that while practicing agriculture—essentially a modified ecosystem—in a way that aims for long-term environmental and economic stability, we must not overlook the high yield (service) it needs to provide to smallholder farmers.

Conservation agriculture (CA) offers a significant yield advantage over conventional tillage (CT) in water-shortage areas. The key benefit lies in the moisture retention provided by the soil cover (mulch), which helps maintain soil moisture levels during dry periods. This retained moisture supports plant growth and enhances crop resilience, leading to better yields compared to CT, where soil moisture is more likely to be lost through evaporation and runoff. This makes CA a particularly effective strategy for improving agricultural productivity in regions facing water scarcity. Therefore, practicing conservation agriculture (CA) in water-stressed areas is an excellent strategy to meet farmers' needs for high yields while promoting environmental sustainability, making it a win-win approach for both productivity and the environment. So, since using appropriate soil cover plays a pivotal role in obtaining immediate yield advantages in conservation agriculture under water shortage areas, it stands out as the most important principle to help smallholder farmers adopt conservation agriculture quickly.

Figure 2. Pumpkin (left) and calabash (right) are used as part of soil cover “mulch” in CA.

When selecting soil cover, the primary objective should be protecting the soil and it's crucial to identify the specific threats to soil health that we aim to mitigate. With the prospect of conservation agriculture common agent that can harm soil include is erosion from wind and water. By understanding these threats, we can choose the most effective soil cover, such as cover crops, mulch, or crop residues. In addition, environmental factors play a crucial role in determining the most suitable type of soil cover for conservation agriculture. For instance, in areas prone to heavy rainfall and water erosion, cover crops with fast growing, with heavy biomass and strong root systems can help stabilize the soil. In contrast, in drier regions, mulches or drought-resistant cover crops can be more effective in retaining soil moisture and preventing wind erosion. Observing the dynamics of annual plants can be very insightful for determining the appropriate soil cover we should look for. For example, if an area will completely be dry until the next rainy season (not allow the growth of any annual plant), establishing a full cover crop can be challenging due to insufficient moisture. In such cases, alternative soil cover strategies can be more effective like mulching with organic materials like straw, wood chips and residue retention from previous crop. However, the presence of annuals that stay green until the next rainy season indicates that the soil retains enough moisture to support plant growth, even during dry periods. This suggests that cover crops could be viable in such areas and by selecting cover crops that are well-adapted to the local conditions, we can enhance soil health and sustainability.

For a farming system to be considered conservation agriculture, the minimum soil cover should be at least 30% at all times. This level of cover can be effectively managed by leaving some crop residue, continuously adding livestock feed leftovers and ensuring animals are kept away from the fields after the main crop is harvested (Fig. 1). Keeping livestock away from CA fields can indeed help maintain the integrity of the soil mulch and we can reduce the risk of it breaking into smaller pieces, which would otherwise increase its susceptibility to wind erosion and rapid decomposition due to the increased surface area to volume ratio. In addition, using mulch materials like cereal straw and grasses with a high carbon-to-nitrogen (C: N) ratio is an excellent way to ensure longer-lasting soil cover as they decompose more slowly.

Utilizing crops that are already well-suited to the local conditions as cover crops can be highly effective. This approach leverages the natural adaptability of these plants to the local climate, soil, and ecosystem. For example, Calabash (Lagenaria siceraria) and pumpkin (Cucurbita pepo) vines can indeed act like mulch (Fig. 2). Their sprawling growth habit covers the soil, helping to suppress weeds, retain moisture, and reduce erosion. Since their root systems can be outside the main field, they don't compete heavily with the main crops for nutrients and water.

Partner Profile: Lutheran World Federation, LWF-Burundi.

Jean Twiringiyumukiza, Agriculture and Livelihoods Technical Advisor for Central and West Africa.

Participant registration, confirmation and issuance of food vouchers in Kinyinya.

Lutheran World Federation (LWF) is a global communion of churches in the Lutheran tradition, living and working together for a just, peaceful, and reconciled world. LWF World Service is the humanitarian and development arm of the LWF. Established in 2006, LWF Burundi is one of the 21 LWF World Service's country programs with a national office in Bujumbura. It operates in 3 rural provinces; Cankuzo, Ruyigi and Muyinga in east of Burundi with the country office in Bujumbura.

LWF Burundi began partnering with Canadian Foodgrains Bank (CFGB) through Canadian Lutheran World Relief (CLWR) in 2021. Their first CFGB/CLWR supported project was AMAHORO (Acute Malnutrition and Hunger Optimal Relief Operation) as part of the HERD (Humanitarian Early Recovery and Development) Program. The HERD supported project in Burundi known as AMAHORO (which means Peace) got two phases and reached 1,200 households with about 6,060 people including IDPs, returnees, and vulnerable host community households in Ruyigi and Cankuzo provinces, and who were experiencing acute and chronic food insecurity. The project provided in-kind food, food vouchers or cash transfers to ensure access to nutritious food, agricultural training through farmer field schools and support to the community development infrastructures/community assets including rural markets, feeder roads, anti-erosive pits/contour lines, through cash-for-work. The village savings and loans associations (VSLAs) were established to support the creation of micro-projects and businesses. To ensure gender mainstreaming, the project also helped form gender equality advisory committees to participate in the project's decision-making and implementation. A six-month extension phase was also financed to enable the formalization and capacity building/training of cooperatives that had just been created towards the end of the second phase of the project.

During the 2022 project visit to the market fair in Kinyinya commune, the CFGB team noticed a good collaboration of the project with the local authorities. The head of commune (Bourgmestre) explained more clearly the key project interventions and their benefits to the communities. The organized fairs included community gathering and sensitization by the village elders. Participants were sensitized on the food nutrition and the importance of utilizing the vouchers to purchase food enough for the family. Various food items and non-food items were provided through pre-selected traders who had a contract with LWF to ensure prices were predetermined before the supply. LWF has a great experience in the voucher approach for food assistance.

Returnees who had received the first round of voucher transfer testified of the benefits of the food assistance and most highlights including getting enough food for the households as the purchased items lasted for an entire month, saving money by not purchasing food and used casual labour payments to rent out more land for farming/expanding farming areas, etc. Some households reported of selling part of the food items to renovate houses and purchase assets especially small livestock.

Niyoyakunze Evelyne—one of the HERD project participants

The HERD supported project ended this year, and LWF Burundi is proposing another project to increase food security and resilience to climate change for longer-term and sustainable impacts on food availability, access and stability in Eastern Burundi.

ALTA TRAVEL SCHEDULES

Jean Twilingiyumukiza:

25-28 November 2024
Burera, Musanze and Gakenke Rwanda
Exchange visit for CBCA to PDN Rwanda

Lilian Zheke:

17- 27 November 2024
Balaka and Chikwawa, Malawi
Partner support visit and Training. BIC_CODES and CARD

27- 31 January 2024
Gutu and Zaka, Zimbabwe
Partner support visit (ZCC and PAOZ

John Mbae:

November 25-27, 2024
Kitui- Kenya
ADRA- Kenya- FMNR Curriculum Development

November 28-30, 2024
Naivasha- Kenya,
Tearfund Team Building

January 27-31, 2025
Turkana- Kenya,
ADRA-Kenya support

Lidet Sitotaw:

November 10-16, 2024
Souther Ethiopia to visit EKHC and TDA's project

November 22-26, 2024
Oromia and Benishangul, to visit FHE's SCASI and Nature + projects

Nester Mashingaidze

25 – 29 November ,2024
Wageningen, Netherlands
Nature+ Case Studies Planning Meeting

27 – 31 January 2025
Dodoma, Tanzania
CA Plus Master Trainer Training

3 -14 February 2025
Geita and Musoma, Tanzania
Project visit AICT Geita and AICT MUD