Food and Agriculture Organization of the United Nations

IsDB البنك الإسلامي للتنمية Islamic Development Bank

IFAD Investing in rural people

MAPPING AFFORDABLE AND TRANSFERRABLE

CLIMATE-SMART TECHNOLOGIES FOR SMALLHOLDER FARMERS

MAPPING AFFORDABLE AND TRANSFERRABLE CLIMATE-SMART TECHNOLOGIES FOR SMALLHOLDER FARMERS

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FOREWORD

In an era marked by escalating global challenges that impact food security and nutrition, our commitment to empowering rural populations, including small-scale farmers and pastoralist communities, through accessible, affordable, and adaptable technologies is more critical than ever. By supporting these communities, we can enhance their capacity to sustainably manage natural resources, boost productivity, and contribute to global efforts toward achieving food security for all. This report represents a collaborative effort between the Food and Agriculture Organization of the United Nations (FAO), the Islamic Development Bank (IsDB), and the International Fund for Agricultural Development (IFAD) to tackle these challenges head-on.

Aligned with the digital era, this partnership marks a significant milestone in harnessing innovative technologies to empower rural households and smallholder farmers to thrive amidst multifaceted challenges. By leveraging science and technology, and guided by evidence-based approaches, we aim to identify and promote context-relevant technologies and innovations that can be integrated throughout agricultural value chains, thereby improving the livelihoods of smallholder farmers and ensuring food security for entire populations.

These technologies and solutions are anticipated not only to improve agricultural productivity but also to pave the way for sustainable, low-carbon practices. Through this partnership, we envision a future where agricultural innovation fosters resilience, reduces poverty, creates employment opportunities, and mitigates vulnerabilities. By bridging gaps in access to technology and knowledge, we strive to build a more equitable and food-secure world.

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EXECUTIVE SUMMARY

In response to the pressing need for innovative solutions to address food security challenges, a tripartite cooperation agreement between the **Islamic Development Bank (IsDB)**, **FAO's Regional Office for the Near East North Africa** and the **International Fund for Agricultural Development (IFAD)** initiated a comprehensive "Mapping exercise of affordable and transferrable food security-related technologies." This project targets ten countries where smallholder farmers face different challenges, including Bangladesh, Brazil, Egypt, Jordan, Morocco, Nigeria, Palestine, Tajikistan, Tunisia and Türkiye.

The mapping effort focuses on **six technology thematic areas** critical to improving food security: 1) postharvest, reducing food loss and waste; 2) water management and saving technologies; 3) sustainable pest control and crop management; 4) e-commerce and market access, 5) fintech; and 6) green energy for farmers. By identifying, analysing and cataloguing affordable, reliable and environmentally friendly technologies, the project aims to build a **knowledge base**, a **technology assessment framework** and a **decision support tool** to guide evidence-based investment in promising agricultural technologies within unique contexts. This collaborative effort seeks to accelerate the development and transfer of environmentally friendly technologies, ultimately promoting low-carbon development, environmental sustainability and increased productivity, while mitigating risks to food security and public health.

A screening criteria and a three-level technology assessment methodology were developed. The screening criteria narrowed down the thousands of technologies available across different technology databases to a total of **349 technologies** across the **six thematic areas** in the **ten target countries**. **Ten technology directories** were created, which include detailed information for the 349 technologies. A total of **228 technologies** were screened and evaluated through the multilevel assessment, which included **3 276 criteria** and resulted in the identification of a total of **120 highly viable technologies**.

The assessment methodology was transformed into the **Green and Climate Smart Technology Assessment Tool (GC-STAT)**, an Excel-based tool allowing adaptable evaluation scores and criteria weights. GC-STAT streamlines technology assessment, providing a consistent and effective method for technology evaluation. It consists of seven sheets including a country profile, a methodology overview, a technology directory and assessment sheets. Its user-friendly design enables easy navigation through embedded links, facilitating thorough assessments without requiring advanced Excel expertise.

The iterative nature of the assessment methodology, coupled with highlighting the need for further stakeholder engagements and consultations, underscores a commitment to adaptability and responsiveness to context-specific needs and priorities.

This report not only serves as a benchmark in agricultural technology assessment, but also catalyses a broader discourse on context-specific sustainable farming practices that benefit smallholder farmers. Its findings and methodologies pave the way for future initiatives and collaborations, emphasizing the importance of stakeholder engagement, adaptability and innovation in addressing the multifaceted challenges confronting smallholder farmers worldwide.

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INTRODUCTION

Millions of small-scale producers, largely residing in rural areas, represent the backbone of low- and middle-income economies. Despite their pivotal role in sustaining livelihoods and agricultural production, their contributions are frequently undervalued and unrecognized.[1] Small-scale farmers, who form a substantial portion of rural communities, often struggle with poverty despite their essential role in the agricultural sector.

Nations must take decisive action and intensify efforts to address the multifaceted challenges hindering the achievement of the Sustainable Development Goals (SDGs), and the eradication of poverty, hunger and food insecurity. This involves the development of innovative policies, organizational processes and practices, alongside the adoption of advanced technologies, research and scientific insights, in addition to effective cooperation among cross-sectoral stakeholders.

New, emerging and existing innovative technologies can play a critical role in anticipating and addressing food security challenges and crises through climate-smart solutions that strengthen early warning systems, increase productivity, ensure efficiency, reduce post-harvest losses, reduce food waste and optimize water and energy resources. Delayed access to relevant technologies, therefore, could lead to extended negative and irreversible consequences on food security, and ultimately, public health. Thus, there is a need to accelerate the development and transfer of environmentally friendly technologies that promote low carbon development and environmental sustainability through increased productivity, while avoiding the depletion of natural resources.

The tripartite cooperation agreement between the Islamic Development Bank (IsDB), FAO's Regional Office for the Near East North Africa and the International Fund for Agricultural Development (IFAD)

1 Arulingam, I., Brady, G., Chaya, M., Conti, M., Kgomotso, P. K., Korzenszky, A., Njie, D., Schroth, G., Suhardiman, D. 2022. *Small-scale producers in sustainable agrifood systems transformation*. Rome, FAO. https://doi.org/10.4060/cc0821en

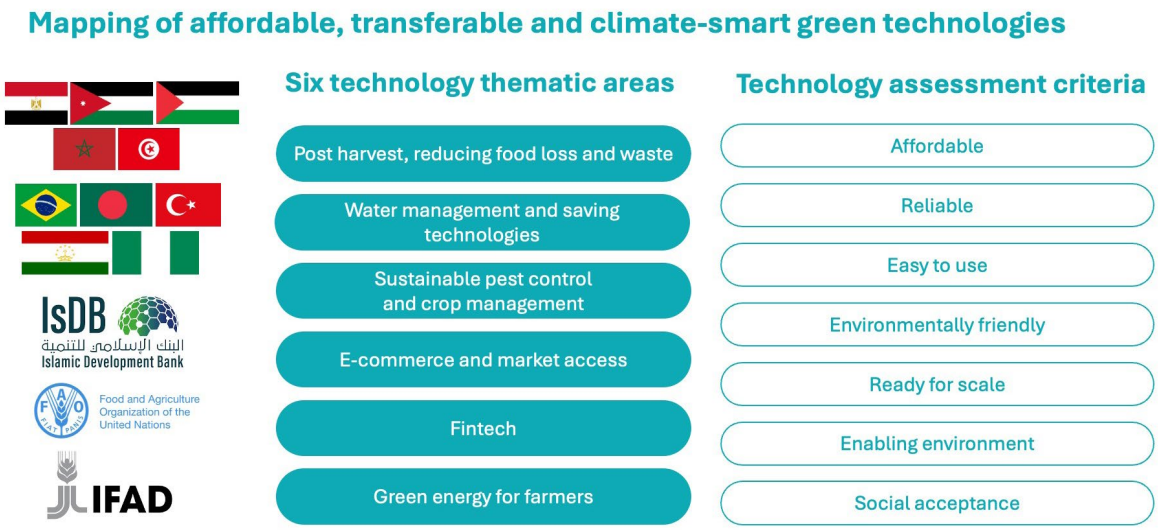
initiated a "Mapping exercise of affordable and transferrable food security-related technologies" in the three partners' member countries. The mapping focuses on ten countries with potential agricultural technologies suitable for smallholder farmers based in developing countries, and where the three partners have facilities that enable technical cooperation. The initially identified countries among partners are Bangladesh, Brazil, Egypt, Jordan, Morocco, Nigeria, Palestine, Tajikistan, Tunisia and Türkiye.

The mapping entails the recording and analysis of readily available technologies across **six initial thematic areas:**

1. postharvest, reducing food loss and waste;
2. water management and saving technologies;
3. sustainable pest control and crop management;
4. e-commerce and market access;
5. fintech; and
6. green energy for farmers' agribusiness operations.

These technologies should be affordable, reliable and easy-to-use, green and environmentally friendly, and should have the potential to be leveraged and mainstreamed throughout the crop value chain to improve food security among smallholder farmers in the selected countries (Figure 1).

Figure 1. Overall background for mapping study



Source: Authors' own elaboration.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MAPPING OBJECTIVES

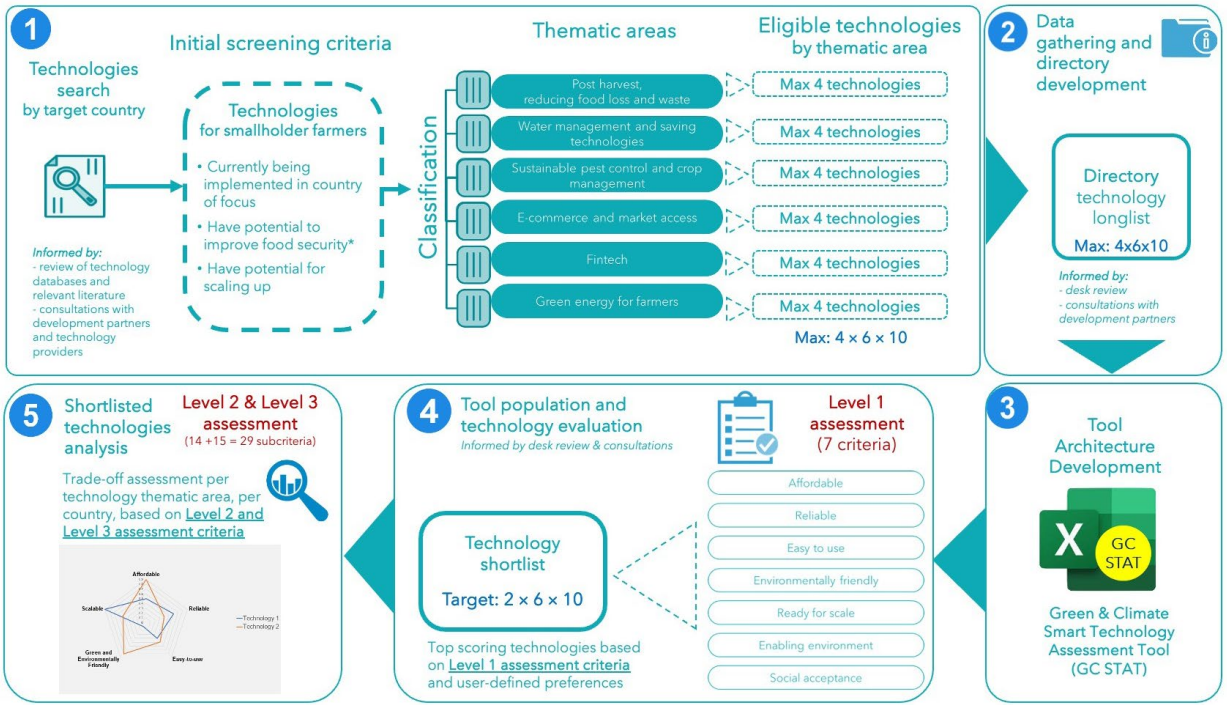
The **overall objective** of this exercise is to develop a comprehensive knowledge base of affordable, transferable, and climate-smart green technologies across the six thematic areas to enhance food security in Bangladesh, Brazil, Egypt, Jordan, Morocco, Nigeria, Palestine, Tajikistan, Tunisia and Türkiye. It includes the following sub-objectives:

1. **Co-create** a framework with criteria for assessing and comparing the performance of identified technologies, allowing for the identification of the most viable solutions for adoption and scaling up.
2. **Establish** a user-friendly technology directory template and compile a long list of potential fit-for-purpose technologies and their providers, ensuring accessibility and dissemination of valuable information to benefit rural producers and smallholder farmers.
3. **Develop** a technology assessment decision support tool that integrates the identified criteria. This tool will streamline the systematic evaluation and prioritization of technologies for deployment in target countries.

METHODOLOGY

The co-development of the methodology for this project involved a structured and collaborative approach through regular technical meetings, which focused on harmonizing diverse perspectives across experts within the IsDB, FAO and IFAD teams. Figure 2 outlines the overall methodology implemented throughout this project.

Figure 2. Overall methodology



Source: Authors' own elaboration.

1. Agreement on the thematic areas

Discussions at the technical meetings resulted in the identification of six thematic areas (TA) to guide the technology identification and classification:

- TA1: post-harvest techniques to reduce food loss and waste;
- TA2: water management and water-saving technologies;
- TA3: sustainable pest control and crop management;
- TA4: e-commerce and market access;
- TA5: fintech; and
- TA6: green energy solutions for farmers.

2. Eligibility criteria for screening technologies

A consensus was reached on the primary eligibility criterion being that technologies must be validated in the target country to be considered. This decision ensured that the technologies assessed were relevant and applicable to the specific contexts of the target countries, thereby enhancing their practicality and potential impact within local communities.

The team agreed that the technologies needed to specifically:

- benefit smallholder farmers;
- be currently implemented and validated in the country of focus;
- have potential to improve food security;[2] and
- have potential for scaling up.

This overall eligibility criterion guided the initial screening process for technologies that qualified for further evaluation. The goal was to identify **four technologies** under each of the **six thematic areas** for each of the **ten countries**.

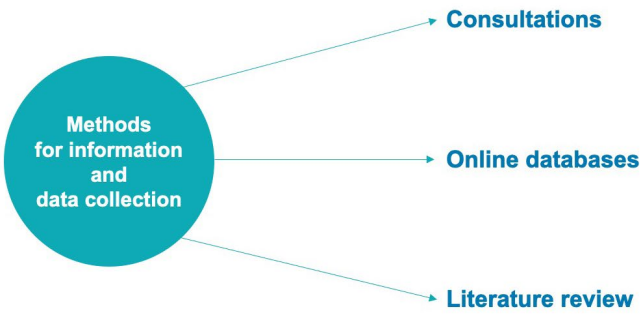
2 Food security is the state where all people at all times have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life.

2.1. Data collection

A multipronged approach was adopted to guide the initial search and screening of technologies per target country (Figure 3), which included:

- **Consultations with development partners**, which played a significant role in shaping the initial search and screening of technologies tailored to each target country's needs. These discussions provided valuable insights into local challenges, priorities and existing technologies and resources to explore.
- **A review of technology databases**, which aimed at capturing a diverse array of technological interventions implemented in each target country. The systematic review of databases provided a structured and comprehensive overview, enabling the discernment of innovative solutions and advancements that have demonstrated applicability within the specific context of each country and across the six thematic areas. Table 1 includes a list of databases explored to identify affordable, transferable and climate-smart green technologies across the six thematic areas.

Figure 3. Methods for information and data collection



Source: Authors' own elaboration.

Table 1. Shortlist of online databases and resources

Database or resource name	Managing entity	Link
WIPO Green Database of Technologies and Needs	World Intellectual Property Organization (WIPO)	https://wipogreen.wipo.int/wipogreen-database/database
Gender-Responsive Climate-Smart Agriculture Database	Accelerating Impacts of CGIAR Climate Research for Africa (AICCRA) by CGIAR	https://aiccra.cgiar.org/database-gender-responsive-climate-smart-agriculture
Climate-Smart Agriculture (CSA) Country Profiles	Climate Change, Agriculture and Food Security (CCAFS) by CGIAR	https://ccafs.cgiar.org/resources/publications/csa-country-profiles
Diagnostic Tools for Investment (DTI) in water for agriculture and energy	FAO	https://www.fao.org/land-water/databases-and-software/diagnostic-tools-for-investment/en/
Green Climate Fund Open Data Library	Green Climate Fund	https://data.greenclimate.fund/public
MENA Regional Innovation Hub	Water and Energy for Food	https://we4f.org/mena#:~:text=The%20MENA%20region%20
Innovation News (examples of agriculture startup companies in the MENA region)	King Abdullah University of Science and Technology (KAUST)	https://innovation.kaust.edu.sa/top-agtech-startups-changing-mena-region/
TECA (Technologies and Practices for Small Agricultural Producers)	FAO	https://teca.apps.fao.org/en/
OECD iLibrary	Organisation for Economic Cooperation and Development (OECD)	https://www.oecd-ilibrary.org/
World Bank Locations	World Bank	https://www.worldbank.org/en/where-we-work
Agricultural Innovation Systems	OECD	https://www.oecd.org/publications/agricultural-innovation-systems-9789264200593-en.htm
National Innovation Internet Portal of Tajikistan[3]	Agency of innovation and digital technologies under the President of the Republic of Tajikistan	https://innovation.tj/en/english/
Information on research and innovation for the Brazilian agriculture sector	Embrapa (Brazilian Agricultural Research Corporation)	https://www.embrapa.br/en
The Agropensa System	Embrapa	https://www.embrapa.br/en/agropensa
Transforma (Network of social technologies)	Fundação BB (Fundação Banco do Brasil)	https://transforma.fbb.org.br/

Source: Authors' own elaboration.

3 This website was under construction at the time of the publication of this report.

- **A review of relevant literature**, included academic literature (peer-reviewed journal articles using Google scholar) and published reports by partners and other national and international organizations working on affordable, transferable and climate-smart green technologies under the identified six thematic areas. The synthesis of information from the literature review contributed a nuanced understanding, integrating academic insights with on-the-ground perspectives, thereby enriching the screening process with a well-informed and holistic perspective.

2.2 Directory development and population

The technology directory included the fields outlined in Table 2, which were populated for each of the four technologies identified through the initial screening process. During the screening and desk review process, technologies were categorized into two groups: *first choice* (those prioritized for inclusion in the directory), and *potential game changers* (second choice).

Detailed information about each technology was collected and systematically organized within the directory to ensure a comprehensive overview and easy accessibility. Through this project, this directory was populated with a total of 4 technologies × 6 thematic areas × 10 countries = 240 technologies. In addition, a similar number of technologies were included as potential game changers because they did not necessarily meet the criteria to advance to other levels of assessment as the four shortlisted technologies did.

Table 2. Example of a technology directory profile

Egypt	TA 3 – Sustainable pest control and crop management
Name	SOWIT precision agriculture platform and apps
Type	Innovation
Description	A startup that has analysed over 80 000 hectares and increased yields by 12 percent. It is a non-invasive remote-sensing multidevice solution that provides farmers with precise agricultural data using AI, drone, satellite and smart phone imaging technology enabling them to optimize water on a daily basis. It supports young farmers who might lack the experience or knowledge to face the increasing variability of weather and market through imagery-based algorithms. The suite includes six apps: Sowater® enables farmers to optimize crop irrigation and avoid overwatering. Fertisat® uses satellite imagery to ensure farmers can homogenize their plots through precise fertilization operations. Sodry® helps predict the best time for harvesting and dry matter distribution. SoYield® allows farmers to anticipate estimated yield before harvesting. Monitor+® provides weekly crop reports, including disease and weather alerts during the growth stages. Skowt® directs operators straight to sensitive areas and provides them with a complete report. SOWIT also provides other physical tools like soil sensors and weather stations.
Benefits	Saves water and provides useful information to farmers, lowers cost, assesses risk and provides real time data to allow farmers to react rapidly to potential damage. The SOWIT algorithm analyses the farmer's land and the provided crop details; farmers can access the data and apply the given recommendations for each solution.

Egypt	TA 3 – Sustainable pest control and crop management
Benefit focus on (beyond thematic area):	Water saving
End users	Farmers
Maturity	Mature (7+ years)
Year of deployment	2018
Acquisition cost	Yes
Licensing cost	None
Skills required/ special training needs	Yes
Presence of incentives or subsidies/policy support	None
Concerns about social acceptance	None
Additional information	Contact person: Hamza Rkha Email: hamza.rkha@sowit.fr More about SOWIT: Water and Energy for Food (WE4F) Agence Ecofin, Entreprendre

Source: Authors' own elaboration.

3. Developing a technology assessment tool

The recognition of contextual nuances across countries and the diverse priorities of farmers regarding technology selection led to the development of an assessment tool. Acknowledging these variations, we implemented a **multilevel assessment process** divided into three distinct phases, facilitating the organization of parameters at each stage. A pivotal aspect introduced was the concept of configurable *weights*, offering the flexibility to tailor assessment results to diverse stakeholder priorities and perspectives. We also emphasized the need to **evaluate trade-offs** between different technologies based on the developed assessment criteria. This adaptation enabled the dynamic evaluation and weighting of different criteria, reflecting the preferences and experiences of various users. By adopting this approach, we aimed to move beyond static assessments and embrace a more responsive framework capable of capturing and integrating the multifaceted perspectives inherent in technology adoption and implementation within agricultural contexts. Details about the Green and Climate Smart Technology Assessment Tool (GC-STAT) can be found in the following chapter.

4. Level 1, Level 2 and Level 3 assessment methods and rationale

To facilitate the process of evaluating the screened and documented technologies in the directory (4 technologies × 6 thematic areas × 10 countries = 240 technologies), a three-level assessment process was developed. The scope of each assessment level, its method for evaluation, and rationale are summarized in Figure 4.

Figure 4. Level 1, Level 2 and Level 3 assessment methods and rationale

What?	How?	Why?
Level 1 assessment: preliminary evaluation of technology longlist (7 criteria)	• Desk review • Consultations with development partners and technology providers	Identify a short list of technologies for detailed evaluation
Level 2 assessment: detailed evaluation of technology shortlist (14 subcriteria)	• Desk review • Consultations with development partners and technology providers	Evaluate the trade-offs between shortlisted technology options
Level 3 assessment: deep evaluation and on ground validation of technology shortlist (15 subcriteria)	• Surveys • On-ground data collection • Interviews with users	Validation and deeper contextualized evaluation

Source: Authors' own elaboration.

- **Level 1 assessment** serves as a preliminary evaluation step based on scoring the **seven** identified criteria (Table 3). This step included desk reviews and consultations with development partners to best reflect the scores [1–5] for each criterion. Level 1 assessment was conducted for all 240 technologies, with the aim of creating a shortlist of high scoring technologies of 2 technologies × 4 thematic areas × 10 countries = **120 technologies**. The developed methodology allows for putting different weights to the **seven** criteria. For example, if one wants to prioritize technologies that have the least cost, a higher weight could be given to *affordability* compared to the weights for other criteria. The total weights for all criteria need to add up to 100 percent. The **two top-scoring technologies** based on the Level 1 assessment advance to the next stage.

Table 3. Level 1 assessment criteria and rating scheme

Level 1 assessment criteria	Rating (1 = Low, 5 = High)
Affordability	1: Very expensive, not cost-effective. 2: Moderately expensive, limited cost-effectiveness. 3: Reasonably priced, fair cost-effectiveness. 4: Affordable, good value for money. 5: Highly affordable, excellent cost-effectiveness.
Reliability	1: Frequently fails or is unreliable. 2: Occasional reliability issues. 3: Generally reliable with few issues. 4: Very reliable, consistently performs well. 5: Extremely reliable, nearly flawless performance.
Easy-to-use	1: Very complex, difficult to use. 2: Moderately complex, requires some effort to use. 3: User-friendly, easy for most users. 4: Very easy to use, intuitive. 5: Exceptionally easy, no expertise required.
Green and environmentally friendly	1: Harmful to the environment. 2: Some environmental impact, not entirely green. 3: Moderately eco-friendly, some positive environmental aspects. 4: Very eco-friendly, minimal environmental impact. 5: Exceptionally green, highly beneficial to the environment.
Potential to be scaled and mainstreamed throughout the crop value chain	1: Very limited scalability, difficult to mainstream. 2: Some scalability, challenges in mainstreaming. 3: Moderate scalability, can be mainstreamed with effort. 4: High scalability, easily mainstreamed in the value chain. 5: Exceptional scalability, seamlessly mainstreamed throughout the value chain.
Enabling environment	1: Highly unsupportive or restrictive environment. 2: Some challenges in the environment, not fully supportive. 3: Moderately supportive environment, some facilitative elements. 4: Very supportive environment, conducive to success. 5: Exceptionally supportive, ideal for implementation and growth.
Social acceptance and empowerment potential	1: Low social acceptance, limited empowerment. 2: Somewhat accepted, minor empowerment potential. 3: Moderately accepted, fair empowerment potential. 4: Widely accepted, significant empowerment potential. 5: Universally accepted, maximizes social empowerment.

The total Level 1 score for a technology is the weighted average of the ratings to the above criteria. L1 score = (Score [1–5] × weight [0–1]). The total possible score for a technology is 35 (i.e. the technology scores 5 on all seven criteria).

Source: Authors' own elaboration.

- **Level 2 assessment** consists of evaluating the 120 shortlisted technologies (2 technologies × 6 thematic areas × 10 countries) based on a list of 14 subcriteria that provide a more in-depth insight into the criteria category. For example, the subcriteria cost of acquisition and cost of operation, provide a more detailed understanding of the affordability of the technology. The step is done through desk reviews and consultations with development partners. The same weights used in Level 1 assessment are used for Level 2 assessment.
- **Level 3 assessment**[4] consists of evaluating 15 additional subcriteria for further validation of the suitability of the technology within a specific context. This level requires a more in-depth assessment based on different instruments, including surveys, on-ground data collection and interviews with technology users and providers, among others. Detailed Level 2 and Level 3 subcriteria, indicators and rating schemes can be found in Table 4.

4 Level 3 assessment was not performed on this project due to budget and time constraints.

Table 4. Detailed criteria, subcriteria, indicators and rating schemes for technology assessments

Criteria	Subcriteria	Indicator	Rating (1 = Low, 5 = High)
Affordability	Cost of acquisition	Initial cost to obtain the technology or solution. *(cost of acquisition = purchase cost + installation cost)*	1: Extremely high cost; not feasible for most. 2: High cost; affordable only for larger or well-funded entities. 3: Moderate cost; accessible to many but still significant. 4: Low cost; within reach for most users. 5: Very low cost; highly affordable for almost all.
	Cost of operation	Total operational cost per unit output. *(cost of operation per unit = output / total cost of operation)*	1: Extremely high operational costs; unsustainable for long-term use. 2: High operational costs; challenging for continuous use. 3: Moderate operational costs; manageable for regular use. 4: Low operational costs; economical for frequent use. 5: Very low operational costs; highly efficient for ongoing use.
	Bankability	Credit rating. *(Indicates creditworthiness of project, influencing ease of securing financing)*	1: Very poor; indicates an extremely high risk of default. Demonstrates severe financial instability, with minimal capacity to meet debt obligations. 2: Poor; signifies a high risk of default. Exhibits notable financial challenges and there are concerns about its ability to fulfill debt obligations. 3: Fair; represents a moderate level of risk. Has an acceptable financial position, but there may be some uncertainties or vulnerabilities. 4: Good; indicates a low risk of default. Has a solid financial standing, with a strong capacity to meet debt obligations. 5: Excellent; reflects an exceptionally low risk of default.
	Payback period	Time needed to recoup initial investment through increased efficiency, productivity or other benefits.	1: Very long-term payback period; benefits realized in several years. 2: Long-term payback period; benefits realized after a significant period. 3: Moderate-term payback period; benefits balanced with investment time. 4: Short-term payback period; benefits realized relatively quickly. 5: Immediate payback period; benefits realized almost immediately after investment.

Criteria	Subcriteria	Indicator	Rating (1 = Low, 5 = High)
Reliability	Performance consistency	Failure rate is the frequency of failures over the operational period. *(failure rate = total operational hours/ number of failures)*	1: Extremely highly failure rate; frequent performance issues 2: High failure rate; occasional performance issues. 3: Moderate failure rate; reliable with some minor issues. 4: Low failure rate; rarely experiences issues. 5: Very low failure rate; performs optimally under all conditions.
	Durability	Lifespan and ability to withstand environmental or operational stresses. *(number of usage cycles before major repair or replacement is needed)*	1: Very low; prone to frequent damage or failure. 2: Low; not resilient to regular wear and tear. 3: Moderate; withstands normal use with some maintenance. 4: High; resilient to harsh conditions and long-term use. 5: Very high; withstands extreme conditions without significant wear.
	Support and maintenance	Availability of support and ease of maintenance to ensure continued performance. *(average number of hours or days required for maintenance annually)*	1: Very high; high maintenance requirements, difficult to maintain. 2: High; limited support available, regular maintenance needed, somewhat challenging to maintain. 3: Moderate; moderate maintenance required, manageable maintenance. 4: Low; good support, low maintenance required, easy to maintain. 5: Very low; excellent support, minimal to no maintenance required, very easy to maintain.
Easy-to-use	Setup: Assembly and installation difficulty	Training time required for an operator to setup the system. *(number of hours or days of required training to setup system)*	1: Very high; very complex, requires professional installation. 2: High; moderately complex, some technical skills needed. 3: Moderate; average difficulty, basic skills sufficient. 4: Low; easy, minimal skills required. 5: Very low; very easy, no special skills required, clear instructions.
	Operation: Knowledge intensity	Training hours required for an operator to operate the system. *(number of hours or days of required training to operate system)*	1: Very high; requires extensive technical expertise. 2: High; requires good technical understanding. 3: Moderate; moderate level of knowledge needed. 4: Low; basic knowledge sufficient. 5: Very low; intuitive, no technical knowledge needed.
	Operation: Labour capacity requirements	Operational commitment indicator. *(number of hours or days needed to operate technology)*	1: Very high; labour intensive or many hours needed. 2: High; above-average labour hours required. 3: Moderate; moderate labour requirements. 4: Low; few labour hours required. 5: Very low; minimal to no labour needed.
	Compatibility and interoperability	Compatibility and interoperability with existing farming practices and infrastructure.	1: Not compatible with other systems or products. 2: Limited compatibility; works with few systems. 3: Moderately compatible; some adjustments needed. 4: Highly compatible with most systems. 5: Fully compatible and interoperable with all relevant systems.

Criteria	Subcriteria	Indicator	Rating (1 = Low, 5 = High)
Green and environmentally friendly	Resource efficiency	Efficient use of resources such as water, energy and land. *(water use efficiency = crop yield / water consumed)* *(energy use efficiency = output / energy input)* *(land use efficiency = crop yield / land area)*	1: Highly inefficient; excessive resource usage. 2: Below average efficiency; more resources than usual required. 3: Average efficiency; standard resource usage. 4: High efficiency; less than average resources needed. 5: Extremely efficient; minimal resource usage.
	Emissions reduction	Reducing greenhouse gas (GHG) emissions. *(% reduction in GHG emissions)*	1: Increases emissions significantly. 2: Has a small or neutral effect on emissions. 3: Moderately reduces emissions. 4: Significantly reduces emissions. 5: Nearly eliminates or drastically reduces emissions.
	Biodiversity preservation	Impact on the ecosystem and biodiversity.	1: Highly detrimental to biodiversity. 2: Somewhat harmful or neutral to biodiversity. 3: Moderately supports biodiversity. 4: Significantly enhances biodiversity. 5: Exceptionally beneficial for biodiversity preservation.
	Soil health improvement	Enhances soil fertility and structure while reducing soil erosion and pollution.	1: Degrades soil health significantly. 2: Has a small or neutral impact on soil health. 3: Moderately improves soil health. 4: Significantly improves soil health. 5: Exceptionally enhances soil health.
	Climate resilience	Potential for improving resilience to heat stress, drought or water scarcity.	1: Negligible potential: Indicates minimal capacity for enhancing resilience to heat stress, drought or water scarcity 2: Limited potential: Suggests a low level of capability to improve resilience, with scope for modest enhancements through targeted interventions. 3: Moderate potential: Represents a moderate capacity for resilience improvement, signifying a reasonable foundation for effective interventions and adaptations. 4: Substantial potential: Denotes a high level of capability, signaling significant opportunities for enhancing resilience to heat stress, drought or water scarcity. 5: Maximum potential: Reflects an exceptional capacity for improvement, suggesting that comprehensive interventions could lead to the highest attainable level of resilience in the face of heat stress, drought or water scarcity.

Criteria	Subcriteria	Indicator	Rating (1 = Low, 5 = High)
Potential to be scaled and mainstreamed throughout the crop value chain	Scalability	Can be scaled up to meet increased demand or expanded to other areas or applications.	1: Not scalable; only suitable for very limited applications. 2: Limited scalability; suitable for small-scale applications. 3: Moderately scalable; can be expanded with some effort. 4: Highly scalable; easily expanded to larger or multiple applications. 5: Exceptionally scalable; adaptable to a wide range of scales and contexts.
	Crop agnostic	Compatibility with different crop types and farm sizes.	1: Highly specific; only suitable for a single or very few crop types. 2: Somewhat limited; suitable for a small range of crops. 3: Moderately adaptable; works with a fair range of crops. 4: Highly adaptable; suitable for most crops. 5: Completely agnostic; suitable for all crop types.
	Successful pilots	Number of successful pilot implementations.	1: No successful pilots or significant failures. 2: Limited success in pilots; some issues observed. 3: Moderate success in pilots; generally positive results. 4: Highly successful pilots; consistent positive outcomes. 5: Exceptionally successful pilots; universally positive and replicable results.
	Readiness and technical maturity	Prototype stage Pilot phase Multiple pilots Regional implementation National scaling International expansion	1: Very early stage, significant development needed. 2: Early stage, some development and testing needed. 3: Moderately developed, ready for limited deployment. 4: Well-developed, ready for widespread deployment. 5: Fully matured and tested, ready for immediate and broad implementation.

Criteria	Subcriteria	Indicator	Rating (1 = Low, 5 = High)
Enabling environment	Policy	Presence of incentives or subsidies.	1: No supportive policies; adverse or restrictive policy environment. 2: Few supportive policies; generally indifferent or slightly restrictive environment. 3: Moderate level of supportive policies; neutral environment. 4: Strong supportive policies in place; favorable environment. 5: Comprehensive and highly supportive policy framework; highly conducive environment.
	Regulation	Presence of supporting regulations – licensing requirements.	1: Highly restrictive or onerous regulations; significant barriers to implementation. 2: Some restrictive regulations; moderate barriers to implementation. 3: Balanced regulations; some barriers, but also some facilitations. 4: Favorable regulations; facilitate easy implementation. 5: Highly favorable or streamlined regulations; actively promote implementation.
	Private sector participation	Level of participation by the private sector.	1: No interest or adverse reaction from the private sector. 2: Limited interest or engagement from the private sector. 3: Moderate level of interest and engagement from the private sector. 4: High interest and active participation from the private sector. 5: Very high interest; enthusiastic participation and investment from the private sector.
	Funding opportunities and financial support availability	International funding opportunities.	1: No funding opportunities or financial support available. 2: Limited funding opportunities; challenging to secure support. 3: Moderate level of funding opportunities; reasonably accessible financial support. 4: Abundant funding opportunities; easily accessible financial support. 5: Exceptionally abundant funding and financial support; highly accessible and diverse
	Security	Vulnerability of the technology to theft.	1: Highly vulnerable 2: Vulnerable 3: Moderate vulnerability 4: Secure 5: Highly secure

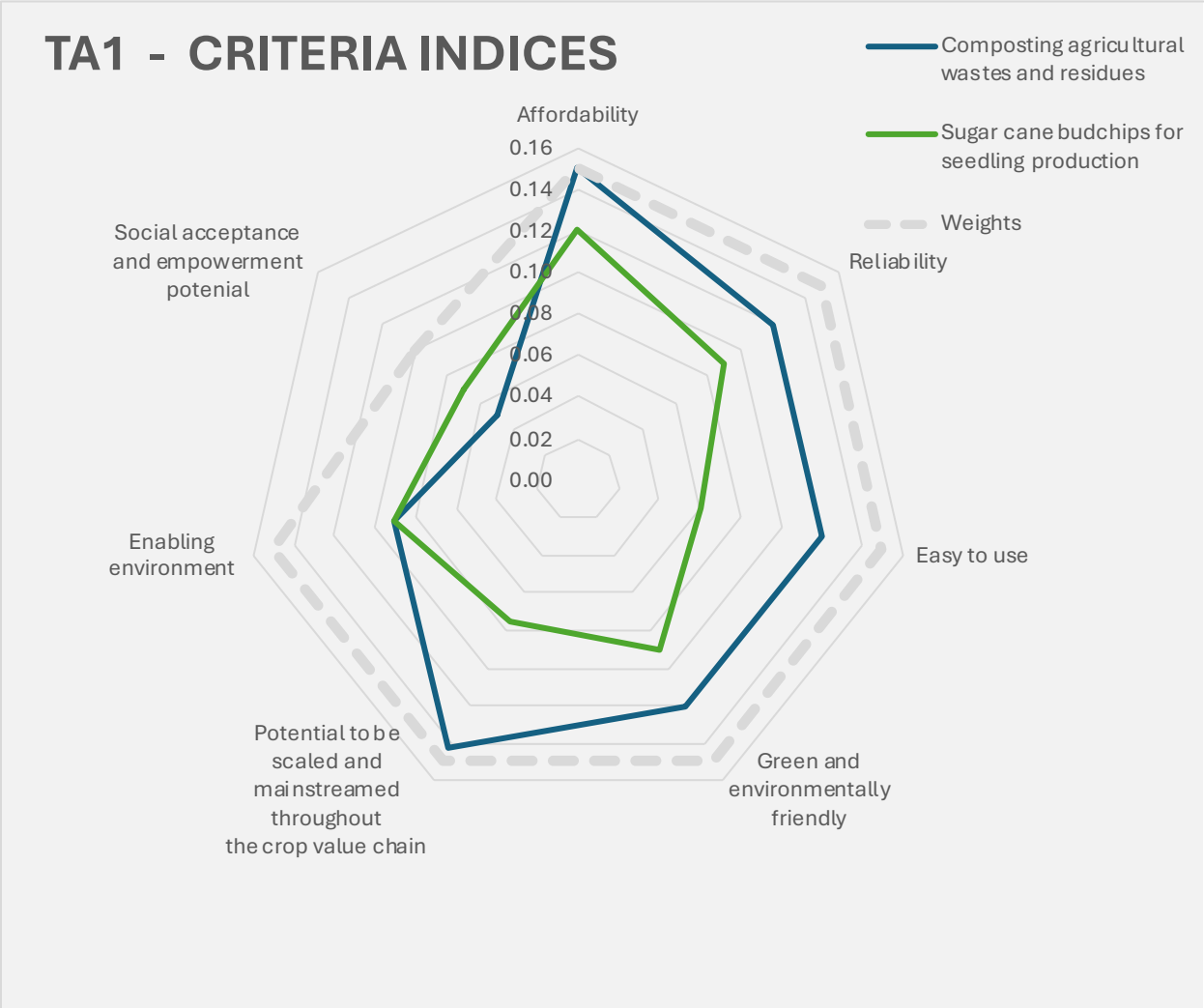
Criteria	Subcriteria	Indicator	Rating (1 = Low, 5 = High)
Social acceptance and empowerment potential	Community empowerment	The extent to which the new technology empowers local communities to make decisions about their own food security and livelihoods.	1: Negatively impacts the community or has no empowerment effect. 2: Minimal empowerment or involvement of the community. 3: Moderate level of community empowerment and involvement. 4: High degree of community empowerment and active involvement. 5: Exceptionally empowering, with substantial community leadership and benefits.
	Gender inclusivity	The extent to which the technology empowers women in agriculture.	1: Excludes or significantly disadvantages one gender. 2: Limited inclusivity; slight bias toward one gender. 3: Moderately inclusive; generally equal opportunities for all genders. 4: Highly inclusive; actively promotes gender equality. 5: Exceptionally inclusive; ensures equal benefits and opportunities for all genders.
	Social acceptance	Acceptance by stakeholders and ease of adoption across different segments of the crop value chain.	1: Strong opposition or lack of acceptance. 2: Limited acceptance; some resistance. 3: Moderate acceptance; generally favorable attitudes. 4: High level of acceptance; widespread support. 5: Exceptionally high acceptance; universally welcomed and endorsed.
	Job creation	The extent to which the technology would lead to job creation.	1: Negligible or negative impact on job creation. 2: Minimal job creation; few jobs generated. 3: Moderate job creation; a fair number of jobs generated. 4: High job creation; significant number of jobs generated. 5: Exceptional job creation; substantial and diverse employment opportunities generated.

Source: Authors' own elaboration.

5. Shortlisted technologies analysis

In our methodology, we emphasize the need for trade-off analysis to account for the context-specific nature of each country and the diverse interests of various stakeholders, including smallholder farmers, agritech investors and national stakeholders. Recognizing that a total assessment score might be misleading, as two technologies with the same score could possess vastly different strengths and weaknesses, our approach focuses on a more holistic evaluation of technologies. By understanding and quantifying the trade-offs associated with adopting different technologies, we aim to provide insights that better inform decision-making processes and support the selection of interventions that align with the unique needs and priorities of stakeholders across diverse agricultural landscapes.

Figure 5. Trade-off analysis for different technologies



Source: GC-STAT tool.

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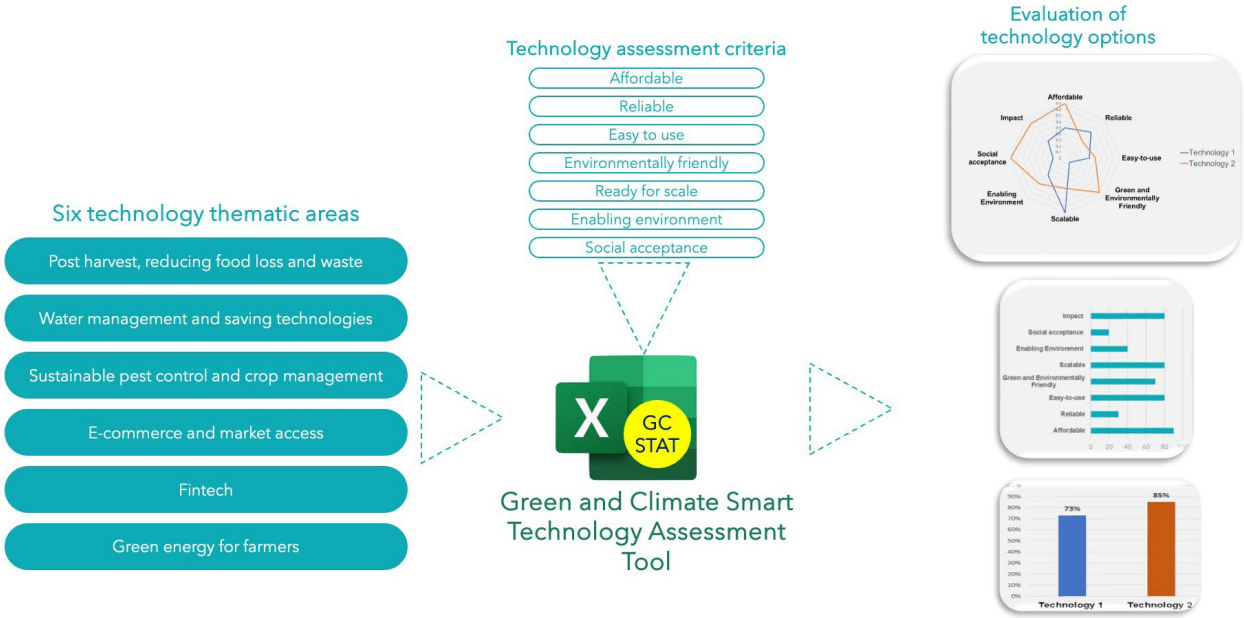
GREEN AND CLIMATE SMART TECHNOLOGY ASSESSMENT TOOL (GC-STAT)

The assessment methodology and framework were transformed into a decision support tool to streamline technology assessment, enabling adaptable evaluation scores and criteria weights (Figure 6). This tool facilitates in-depth evaluations across the ten target countries and provides a template for extending similar analyses to new countries, recognizing the diverse perspectives of users in assessing and weighing criteria according to their preferences and priorities.

The tool is the outcome of iterative refinement processes aimed at achieving consensus to its structure and functionality, followed by efforts to enhance operational efficiency and automation. Despite requiring extra effort beyond initial planning, this development was pivotal in establishing a centralized convergence point for both the methodology and diverse perspectives.

Moreover, rigorous validation was conducted across the ten target countries, involving multiple debugging sessions to ensure comprehensive functionality. The successful deployment of this tool marks a significant project milestone, offering a consistent and effective method for technology assessment across diverse countries and serving as a foundational resource for future initiatives and collaborations among project partners.

Figure 6. Overall structure of the Green and Climate Smart Technology Assessment Tool (GC-STAT)



Source: Authors' own elaboration.

What is GC-STAT?

GC-STAT is an Excel-based tool designed to streamline the assessment of agricultural technologies for smallholder farmers, enabling a systematic evaluation across various thematic areas with color-coded sheets for easy navigation and automated analysis.

Why GC-STAT?

The tool has been developed to guide users through the methodology, ensuring consistency and ease of use. This tool incorporates the multilevel assessment process and allows for adaptable weighting of evaluation criteria, reflecting the diverse needs and priorities of different stakeholders. The evolution of the tool was in recognition of the context-specific nature for deployment of different technologies as well the unique set of preferences for different smallholder farmers within these different contexts. Therefore, the tool provides the flexibility of adapting weights for different criteria to reflect user preferences and allows for adjustment of ratings for different criteria based on user-experience.

At the core of our approach is a recognition that there is no single *best technology* under each of these thematic areas. Rather, there are trade-offs associated with adopting different technological solutions. Based on an understanding of these trade-offs, the tool offers quantitative evidence to support the choice of appropriate technologies based on the farmer's needs, priorities and constraints.

Adopting a standardized methodology for assessments offers several advantages compared to independent, ad hoc evaluations. This approach ensures consistency, enabling meaningful comparisons across different assessments and streamlining future evaluations. It embraces an Agile methodology, facilitating continuous refinement and improvement with each new assessment based

on prior experiences, reducing the likelihood of operational errors through automation and formula validation. Essentially, the tool serves as a dynamic *methodology in action*, solidifying the assessment process. Designed with Excel, it allows for easy updates and customizations, further enhancing its utility.

Figure 7. GC-STAT Country Profile summary page

COUNTRY: **EGYPT** — N. of Technologies: 36

THEMATIC Area		TECHNOLOGY Name	LEVEL 1 Assessment Score	LEVEL 2 Assessment Score
TA 1 Post harvest-reducing Food Loss and Waste	1	Composting agricultural wastes and residues	0.60	0.79
	2	Sugar cane budchips for seedling production	0.50	0.60
	3	FreshSource	0.50	
	4	Use of sugarcane byproducts to create activated carbon	0.48	
TA 2 Water management and water saving technologies	1	Water harvesting	0.50	0.75
	2	Modern Irrigation methods - Drip irrigation and gated irrigation	0.45	0.68
	3	Advanced irrigation monitoring	0.39	
	4	Aquafarming/Hydroponics	0.39	
TA 3 Sustainable pest control and crop management	1	Chitosan - Organic biofertilizer from shrimp shells	0.48	0.73
	2	AbuErdan - Access to tech for poultry farmers	0.50	0.61
	3	SowIt - Precision agriculture app/platform	0.45	
	4	Okadine - Bio-Fertilization	0.44	
TA 4 E- commerce and martket access	1	AxisPay	0.45	0.70
	2	Khodar	0.45	0.63
	3	Mozare3	0.45	
	4	Horticultural Export Improvement Association (HEIA)	0.43	
TA 5 Fintech	1	Mozare3	0.45	0.66
	2	Bashaier Network	0.45	0.60
	3	El Shuna	0.45	
	4	Feed the Future – Egypt Rural Agribusiness Strengthening Project: Buyer-led market access and CNFA ş	0.41	
TA 6 Green energy for farmers	1	The Zero Fund	0.54	0.63
	2	Household biogas units	0.48	0.62
	3	Agrisolar - Solar Pumping Irrigation System (SPIS)	0.48	
	4	Suncity - Mobile Solar pump	0.48	

Source: GC-STAT tool.

What is included in GC-STAT and how can it be used?

GC-STAT consists of **seven sheets**. The following provides a brief overview for each of these sheets:

1. **Country Profile sheet**
   This sheet serves as an overview and a control panel, guiding users through the tool's functionality (Figure 7). It provides an overview of the four high scoring technologies identified under each thematic area within the focus country. It also provides a summary of their scores based on the developed methodology. In the enhanced plus version, the control panel includes macro-enabled buttons, simplifying navigation and making the assessment steps clearer. This version also facilitates easy export of key results into PDF format. A key feature of the Country Profile sheet is a section on the right that dynamically updates with key findings as technologies are entered into the directory and ranked through the assessment phases.

2. **Methodology sheet**
   This sheet provides a version of Figure 2, which outlines the overall methodology for the assessment.

3. **Technology directory**
   This sheet includes 14 key fields, providing essential information on each technology (Figure 8). These fields include a detailed description of the technology, an assessment of its tradition versus high-tech characteristics, identification of the final users and a focus on benefits beyond the thematic area. Additionally, the directory offers contact information and delineates stakeholders involved, ranging from national research and development entities to service providers, private companies, NGOs and input suppliers. Other critical aspects covered include the technology's maturity level, year of deployment, acquisition and licensing costs, required skills or special training needs, as well as the presence of incentives, subsidies or policy support. The directory also considers concerns related to social acceptance and incorporates any additional relevant information, presenting a comprehensive overview to facilitate informed decision-making in the realm of technology assessment and adoption. A complete example of a technology directory can be found in Table 2.

Figure 8. Snapshot of the technology directory sheet

EGYPT — DIRECTORY

Thematic Area	Technology name	Technology description	Tradition vs. high tech	Final users
TA 1 Post harvest-reducing Food Loss and Waste	**Composting agricultural wastes and residues**	**Composting agriculture wastes** is the process of converting organic material to animal fodder, fish feed, organic fertilizers, and poultry farm bedding. **Benefits**: This process reduces the need for chemical fertilizer or to	Traditional	Farmers
	Sugar cane budchips for seedling production	**Sugar cane budchips for seedling production** is a more efficient process of creating sugar cane seedings. Instead of using stalk cuttings for planting, only pieces of the aixillary buds are planted. **Benefit**: fewer plants are needed to create seedlings, thus reducing post harvest food loss to seedling production.	Innovative: other	Farmers
	Use of sugarcane byproducts to create activated carbon	Sugarcane byproducts have **organic carbon** which can be made into activated carbon through pyrolysis. Activated Carbon is then used to adsorb heavy metals and help with pollution. **Benefits**: This option utilizes sugarcane byproduct that would otherwise be wasted and provides and additional avenue of income for sugarcane farmers.	Innovative: other	Others
	FreshSource	**FreshSource** is a company that aims at improving efficiency and logistics of moving fresh produce.	Innovative: digital	Others
TA 2 Water management and	**Advanced irrigation monitoring**	**Advanced irrigation monitoring** uses sensor devices measure the degree of soil moisture and soil moisture deficits. The data is automatically sent to the farmer's mobile phone, which helps them make decisions on when and how much to irrigate the soil.	Innovative: digital	Farmers
	Modern Irrigation methods - Drip irrigation and gated irrigation	**Drip irrigation** refers to irrigating crops via dipping, which keeps water closer to plant roots and ensures optimal moisture levels. Can be above or below surface. **Gated irrigation** refers to irrigation systems that control the amount and direction of irrigated water through pipes.	Innovative: other	Farmers

Source: GC-STAT tool.

4. **Summary of Level 1, Level 2 and Level 3 assessment criteria sheet**
   This sheet includes a summary of all the criteria and rating schemes for Level 1, Level 2 and Level 3 assessments (Table 3 and Table 4).

5. **Level 1 assessment sheet**
   The four technologies per thematic area in the Technology directory sheet are automatically populated for Level 1 evaluation. At this stage, the user needs to: 1) rate each of the seven criteria on a scale of 1–5 based on the provided assessment scheme; and 2) provide the weight for each of the criteria. The tool then automatically calculates and identifies the top two technologies based on their overall ranking for subsequent detailed Level 2 evaluation. Users are only able to make changes to the green cells while all other cells are conveniently locked to minimize the risk of corrupting the tool (Figure 9).

Figure 9. Snapshot of Level 1 assessment sheet

Level 1 Assessment

What?
Level 1 Assessment
preliminary evaluation of technology longlist

- Desk re
- Consult

Affordability

Thematic Area	Technology name	Overall Level 1 Assessment Score	1: Very expensive, not cost-effective. 2: Moderately expensive, limited cost-effectiveness. 3: Reasonably priced, fair cost-		Rating	Optional comments	Criteria Score
TA 1 Post harvest-reducing Food Loss and Waste	Composting agricultural wastes and residues	0.60	Tematic AREA configurable weight	###	5		0.75
	Sugar cane budchips for seedling production	0.50			5		0.75
	Use of sugarcane byproducts to create activated carbon	0.48			4	Depends on how much farmers are able to get for their sugarcane byproducts	0.60
	FreshSource	0.50			3	Unclear the cost to use service for farmer	0.45
TA 2 Water management and water saving technologies	Advanced irrigation monitoring	0.39	Tematic AREA configurable weight	###	2	Advanced sensors could be costly	0.30
	Modern Irrigation methods - Drip irrigation and gated irr	0.45			2	Replacing the system is costly, but after initial cost the maintenance would be the same as a non-drip irrigation system	0.30
	Water harvesting	0.50			4		0.60
	Aquafarming/Hydroponics	0.39			2		0.30
	Okadine - Bio-Fertilization	0.44			2	The first few years are less profitable than monocropping, so it	0.30

Country Profile | 1-Methodology | 2-Technology Directory | 3-Assessment Criteria | 4-Level 1 Assessment | Sheet2 | Sheet1 | 5-Level 2 explained | 5.1-Level 2-TA

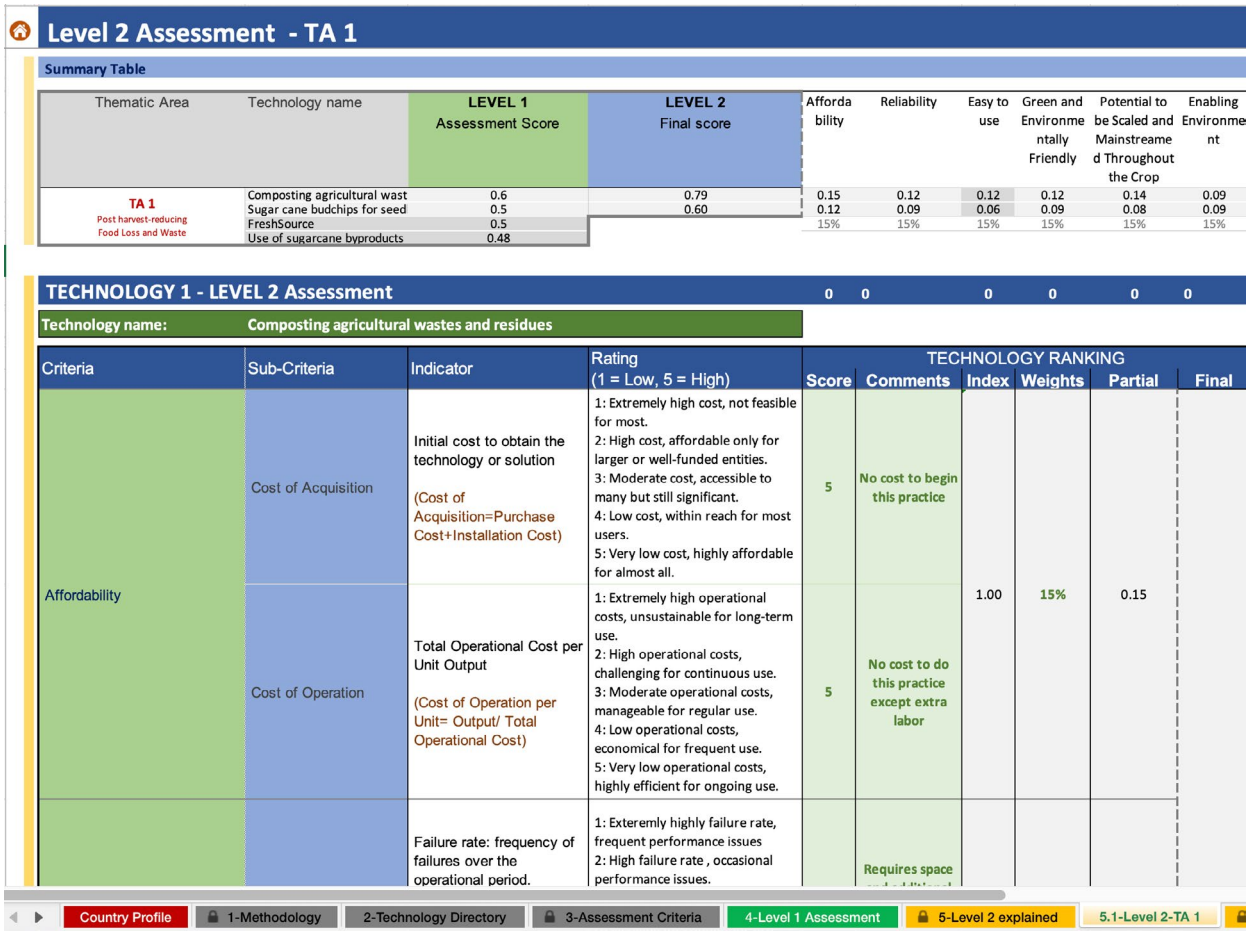
Source: GC-STAT tool.

6. **Level 2 assessment sheets**
   The tool includes six Level 2 assessment sheets; one sheet per thematic area. Each Level 2 assessment sheet includes the two top ranking technologies based on the Level 1 assessment and allows the user to provide further evaluation of 14 additional subcriteria. The weights included in Level 1 remain the same for consistency in evaluation. Users are similarly only able to make changes to the green cells, which include the rating for each of the subcriteria (Figure 10). The tool automatically calculates the total score for each of the technologies based on the weighted average of the 14 rated subcriteria.

7. Trade-off evaluation sheet

Beyond the total score per technology, this sheet provides a more in-depth insightful analysis of the technologies through highlighting their performance based on the different Level 2 assessment criteria. The tool automatically generates tables and spider charts offering a multidimensional comparison of technologies based on various assessment parameters. This level of analysis allows us to evaluate two technologies with a similar total score, whether one is more affordable, or less scalable and reliable than the other, for example. Based on the different preferences and objectives, this added layer of information offers useful insight for decision making.

Figure 10. Snapshot of Level 2 assessment sheet



Level 2 Assessment - TA 1

Summary Table

Thematic Area	Technology name	LEVEL 1 Assessment Score	LEVEL 2 Final score	Affordability	Reliability	Easy to use	Green and Environmentally Friendly	Potential to be Scaled and Mainstreamed Throughout the Crop	Enabling Environment
TA 1 Post harvest-reducing Food Loss and Waste	Composting agricultural wast	0.6	0.79	0.15	0.12	0.12	0.12	0.14	0.09
	Sugar cane budchips for seed	0.5	0.60	0.12	0.09	0.06	0.09	0.08	0.09
	FreshSource	0.5		15%	15%	15%	15%	15%	15%
	Use of sugarcane byproducts	0.48							

TECHNOLOGY 1 - LEVEL 2 Assessment

Technology name: Composting agricultural wastes and residues

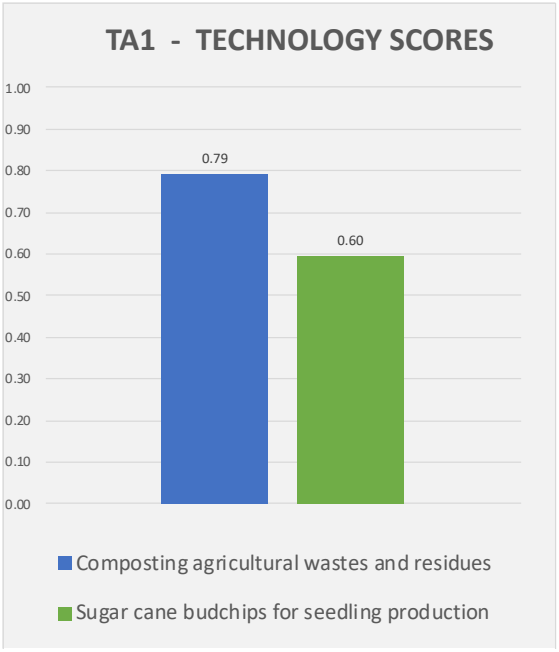
Criteria	Sub-Criteria	Indicator	Rating (1 = Low, 5 = High)	TECHNOLOGY RANKING Score	Comments	Index	Weights	Partial	Final
Affordability	Cost of Acquisition	Initial cost to obtain the technology or solution (Cost of Acquisition=Purchase Cost+Installation Cost)	1: Extremely high cost, not feasible for most. 2: High cost, affordable only for larger or well-funded entities. 3: Moderate cost, accessible to many but still significant. 4: Low cost, within reach for most users. 5: Very low cost, highly affordable for almost all.	5	No cost to begin this practice	1.00	15%	0.15	
	Cost of Operation	Total Operational Cost per Unit Output (Cost of Operation per Unit= Output/ Total Operational Cost)	1: Extremely high operational costs, unsustainable for long-term use. 2: High operational costs, challenging for continuous use. 3: Moderate operational costs, manageable for regular use. 4: Low operational costs, economical for frequent use. 5: Very low operational costs, highly efficient for ongoing use.	5	No cost to do this practice except extra labor				
		Failure rate: frequency of failures over the operational period.	1: Exteremly highly failure rate, frequent performance issues 2: High failure rate , occasional performance issues.		Requires space				

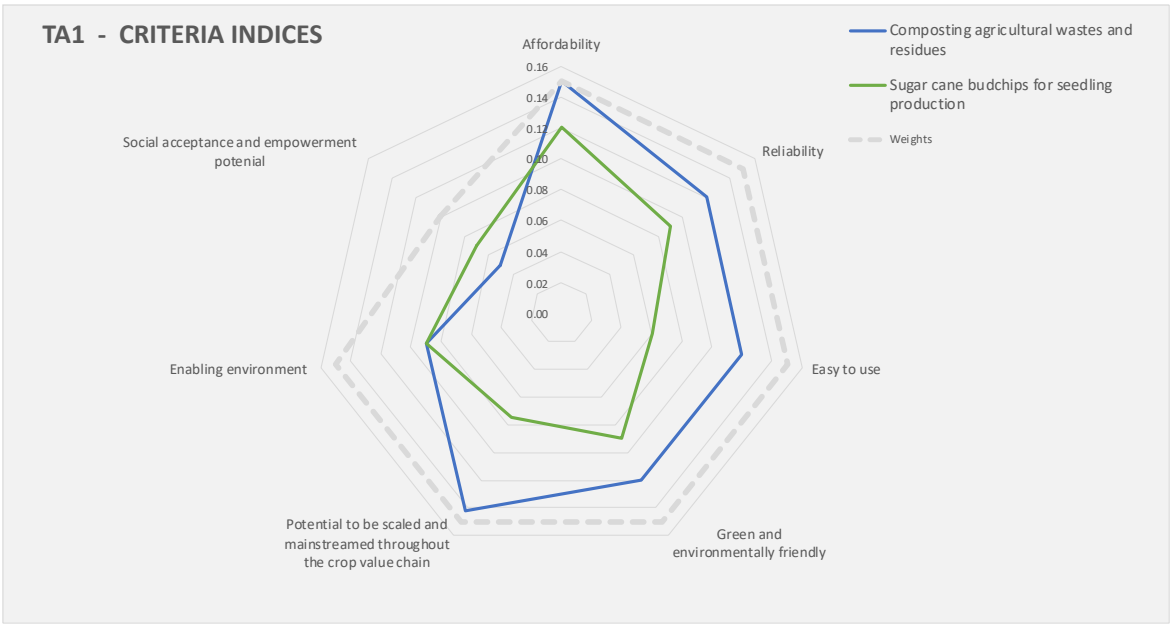
Country Profile | 1-Methodology | 2-Technology Directory | 3-Assessment Criteria | 4-Level 1 Assessment | 5-Level 2 explained | 5.1-Level 2-TA 1

Source: GC-STAT tool.

Figure 11. Snapshot of the trade-off evaluation sheet

			Level 2 Assessment							
Tematic Area		Technology Name	Final Score	Affordability	Reliability	Easy to use	Green and environmentally friendly	Potential to be scaled and mainstreamed throughout the crop value chain	Enabling environment	Social acceptance and empowerment potenial
TA1	Post harvest-reducing Food Loss and Waste	Composting agricultural wastes and residues	0.79	0.15	0.12	0.12	0.12	0.14	0.09	0.05
		Sugar cane budchips for seedling production	0.60	0.12	0.09	0.06	0.09	0.08	0.09	0.07
			Weights	15%	15%	15%	15%	15%	15%	10%





Source: GC-STAT tool.

Other comments about GC-STAT

This tool facilitates mainstreaming the agricultural technology evaluation process, serving as a valuable resource for stakeholders in each target country. Its user-friendly design ensures thorough assessments can be conducted without requiring advanced Excel expertise.

Navigational ease and methodology overview

Users have the flexibility to navigate the tool through embedded links or, in the plus version, by utilizing control panel buttons. It incorporates a comprehensive methodology overview within the sheets, ensuring users are well-acquainted with each phase: populating directories, Level 1 and Level 2 assessments, all conveniently broken down by thematic area. A short video tutorial is provided to introduce users to the tool and improve their understanding of its functionality.

User input and data protection

Designed with user-friendliness in mind, specific white fields in the directory sheet allow the easy input of information, while green fields with pre-set values are available in the ranking sheets. To uphold data integrity and prevent accidental modifications, all sheets are protected, safeguarding both the formulas and the overall structure of the tool.

Efficiency and accessibility

These strategic features enhance the tool's efficiency throughout the evaluation process, eliminating the need for advanced Excel skills. Users can focus solely on technology scouting, populating the directory and assigning rankings, making the tool accessible and straightforward to use.

Link to video tutorial

COUNTRY PROFILES – RESULTS

This section includes a summary report for each of the ten countries. Each Country Profile includes a **background** highlighting the specific country context and the key challenges and opportunities that face smallholder farmers. This is followed by a **Country Profile** which presents a summary of the results from the technology mapping and assessment exercise, using GC-STAT. The Country Profile includes the top four technologies with their Level 1 and Level 2 assessment scores. Based on the adopted methodology, the **technology profiles** and the **trade-off assessment** for the two highly scoring technologies is presented. The complete technology directories and GC-STAT tools for each of the ten countries can be found here.

The screening criteria allowed the narrowing down of thousands of technologies available across different technology databases to a total of 349 technologies across the **six thematic areas** in the **ten target countries**. The **ten technology directories** include detailed information for **349 technologies**. A total of **228 technologies** were screened and evaluated through a multilevel assessment (Level 1 and Level 2), which included **3 276 criteria**, resulting in the identification of a total of **120 highly viable technologies** (Table 5).

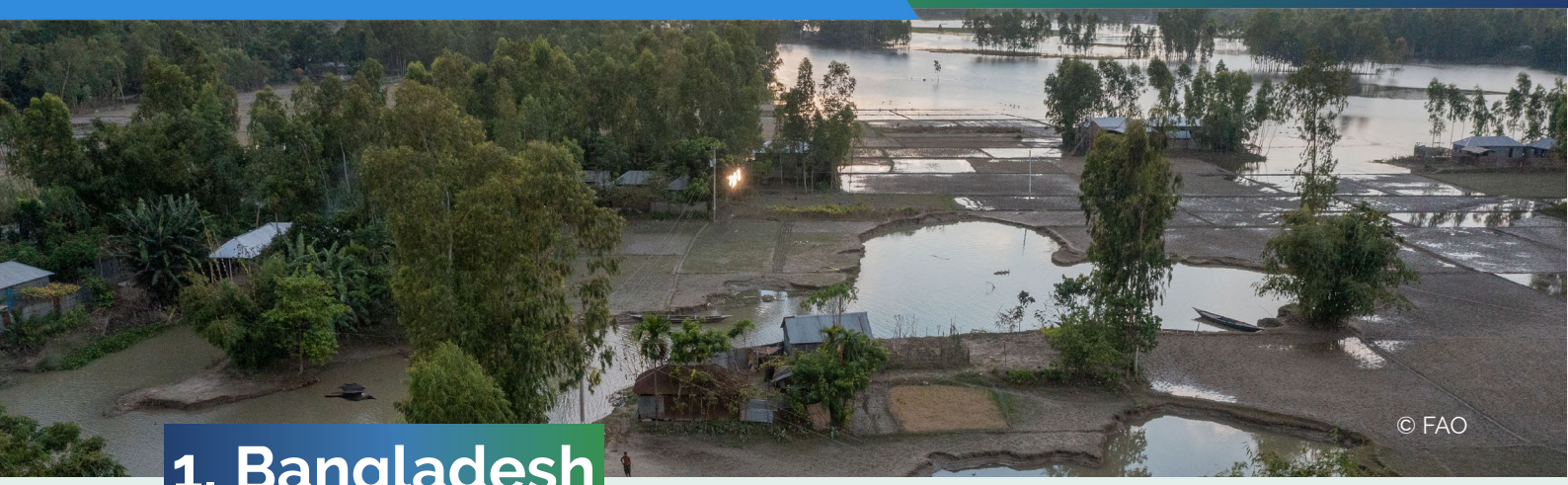
Assessment limitations

- **Scoring of Level 1 and Level 2 criteria:** The scoring for the Level 1 and Level 2 criteria was done based on desk reviews and consultations with partners in the selected countries. While this assessment serves as a good starting point for these mapped countries, further validation of the scoring through engagement with national stakeholders is recommended.
- **Criteria weights:** In this assessment, equal weights were given to all criteria. More accurately, the first six criteria were given a 15 percent weight, and the seventh criterion (social acceptance), was given a 10 percent weight, totalling 100 percent. We acknowledge that this distribution of weights might differ from one user to another, and from one country to another. GC-STAT allows for the easy adjustment of these weights to reflect different preferences for minimizing or maximizing specific criteria.
- **Evaluation results:** We acknowledge that Level 1 scores for the four technologies are often close. Our choice for conducting Level 2 assessment for the top 2 scoring technologies was done for practical reporting purposes, yet we acknowledge that this choice requires further engagement with stakeholders and a deeper understanding of their needs as well as the specifics of the local context. Information on all four technologies can be found in the Technology directory, and different technologies could be advanced to Level 2 assessment using GC-STAT.
- **Level 3 criteria evaluation:** The following assessment does not include Level 3 evaluation, which covers 15 additional subcriteria for further validation of the suitability of the technology within a specific context. This level requires a more in-depth assessment based on different instruments, including surveys, on-ground data collection and interviews with technology users and providers, among others. Level 3 assessment was not performed on this project due to budget and time constraints. It is encouraged that countries build on the existing assessment and proceed to evaluate Level 3 criteria for a more comprehensive evaluation.

Table 5. Summary of number of technologies and criteria assessed

Country	Technologies filtered (included in technology directory)	Technologies screened for Level 1 assessment	Technologies screened for Level 2 assessment	Level 1 criteria assessed (7 criteria)	Level 2 criteria assessed (14 sub criteria)	Total criteria assessed
Bangladesh	41	24	12	168	168	336
Brazil	53	24	12	168	168	336
Egypt	35	24	12	168	168	336
Jordan	36	23	12	161	168	329
Morocco	24	19	12	133	168	301
Nigeria	44	24	12	168	168	336
Palestine	18	18	12	126	168	294
Tajikistan	33	24	12	168	168	336
Tunisia	30	24	12	168	168	336
Türkiye	35	24	12	168	168	336
Summary	349	228	120	1 596	1 680	3 276

Source: Authors' own elaboration.



1. Bangladesh

1.1 Introduction to the agriculture sector and its challenges

Bangladesh faces multifaceted challenges in its agricultural sector. Frequent flooding during the monsoon season destroys crops and erodes soil, exacerbated by the country's vulnerability to cyclones and storm surges along its coastal regions. The high population density also exerts intense pressure on arable land, reducing its availability for agriculture. Salinity intrusion in coastal areas further compounds agricultural challenges by affecting the cultivation of certain crops, particularly rice. Inadequate water management infrastructure leads to inefficient water use and poses challenges during dry seasons. Climate change further exacerbates these challenges with rising temperatures and changing rainfall patterns, threatening crop yields and farming cycles.

Despite these challenges, Bangladesh presents numerous opportunities for agricultural development. Its fertile deltaic plains are highly suitable for rice cultivation, the country's staple food, offering opportunities for both subsistence and commercial farming. Furthermore, Bangladesh's varied agroecological zones allow for the cultivation of a wide range of crops, including jute, tea, fruits and vegetables. Aquaculture, particularly fish farming, holds significant potential as a major source of income and nutrition. The country's abundant rivers provide ample water resources for irrigation, fisheries and the transportation of agricultural goods. Moreover, there is potential for adopting innovative and adaptive farming techniques suited to the local environment, such as floating gardens and salt-tolerant crop varieties. Active involvement of government and NGOs in agricultural development, providing support in the form of subsidies, training and research, further enhances the prospects for sustainable agricultural practices and improved livelihoods.

Smallholder farmers in Bangladesh encounter specific challenges that impede their productivity and livelihoods. Limited market access restricts their ability to sell produce effectively and at fair prices, while poor infrastructure, including inadequate transportation and storage facilities, leads to significant post-harvest losses. Reliance on traditional farming methods limits productivity and fails to leverage advancements in agricultural science. Financial constraints, such as difficulties in accessing credit and loans, hinder investment in farm improvements and technology adoption. A gap in the adoption of modern agricultural techniques, combined with climate change impacts such as flooding and cyclones, greatly affects agricultural productivity. Additionally, small landholdings limit the potential for economies of scale, affecting competitiveness and income. Access to quality inputs, including seeds, fertilizers and pest control methods, remains a challenge, alongside a knowledge gap on market trends and regulatory barriers. Addressing these issues is crucial for enhancing the resilience and productivity of smallholder farming in Bangladesh.

1.2 Bangladesh country profile

COUNTRY: **BANGLADESH**

No. of technologies 41

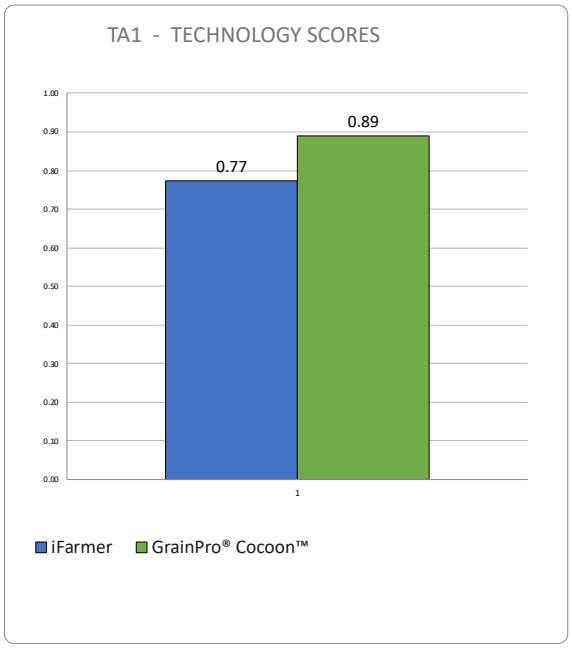
Thematic area		Technology name	LEVEL 1 assessment score	LEVEL 2 assessment score
TA 1 Post harvest-reducing food loss and waste	1	GrainPro® Cocoon™	0.63	0.89
	2	iFarmer	0.64	0.77
	3	Virtual call centers (VCCs)	0.61	
	4	Agroshift	0.50	
TA 2 Water management and water saving technologies	1	Hydroponics of floating islands using local materials	0.63	0.83
	2	Integrated Rice Advisory System (IRAS)	0.64	0.79
	3	Low cost soil moisture sensors	0.60	
	4	Bhungroo	0.55	
TA 3 Sustainable pest control and crop management	1	Agronomic support web-based platform	0.58	0.77
	2	AI detection of diseases and insects	0.60	0.74
	3	Biopesticides	0.58	
	4	Drone based pesticide spraying	0.45	
TA 4 E-commerce and martket access	1	Soluta-Ag	0.66	0.89
	2	Online agricultural marketplace	0.60	0.83
	3	Online marketplace for Fresh Organics (hidroponics)	0.58	
	4	Blockchain enabled ecommerce & food value chain services	0.54	
TA 5 Fintech	1	Digital weather index insurance	0.63	0.82
	2	A-Card	0.55	0.76
	3	Marketplace with microfinance and microcredit (blockchain enabled)	0.54	
	4	MicroBanking System for Windows (MBWin)	0.51	
TA 6 Green energy for farmers	1	SirriS Smart Solar Irrigation System	0.68	0.84
	2	Solar irrigation pump	0.62	0.81
	3	Solar drip irrigation system	0.58	
	4	Using fish farm recirculating discharge water to generate electricity	0.48	

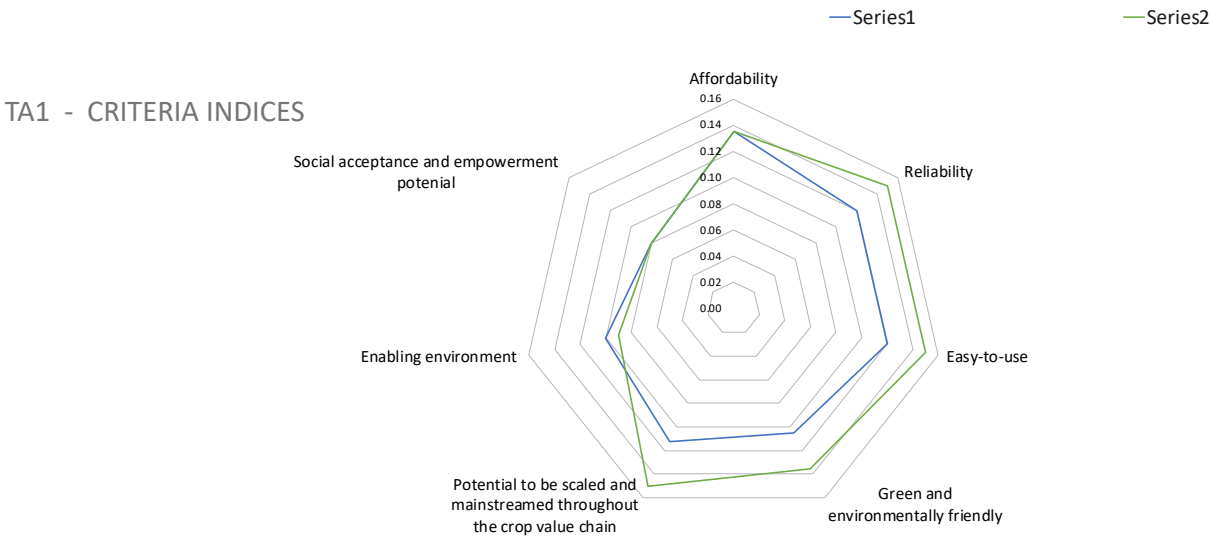
1.3 Technology profiles and assessment rankings

Bangladesh

TA1: Post-harvest techniques to reduce food loss and waste

Thematic area		Technology name	Level 2 assessment							
			Final score	Affordability	Reliability	Easy-to-use	Green and environmentally friendly	Potential to be scaled and mainstreamed throughout the crop value chain	Enabling environment	Social acceptance and empowerment potenial
TA1	Post harvest-reducing food loss and waste	iFarmer	0.77	0.14	0.12	0.12	0.11	0.11	0.10	0.08
		GrainPro® Cocoon™	0.89	0.14	0.15	0.15	0.14	0.15	0.09	0.08
			Weights	15%	15%	15%	15%	15%	15%	10%



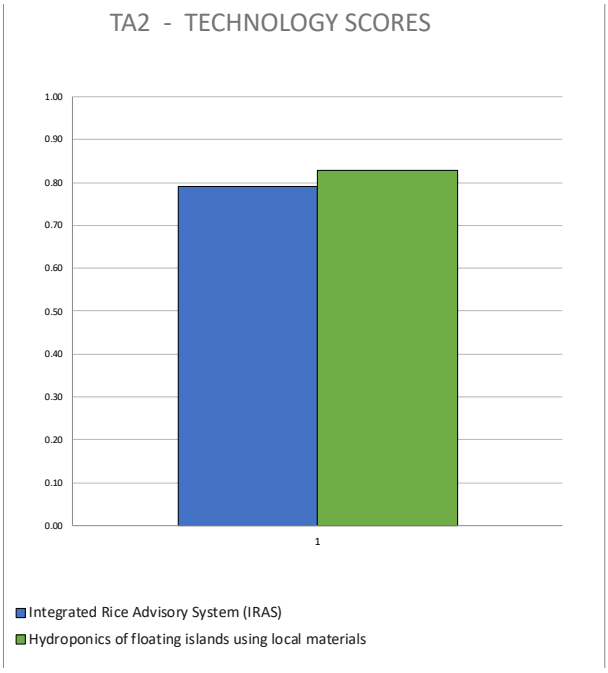


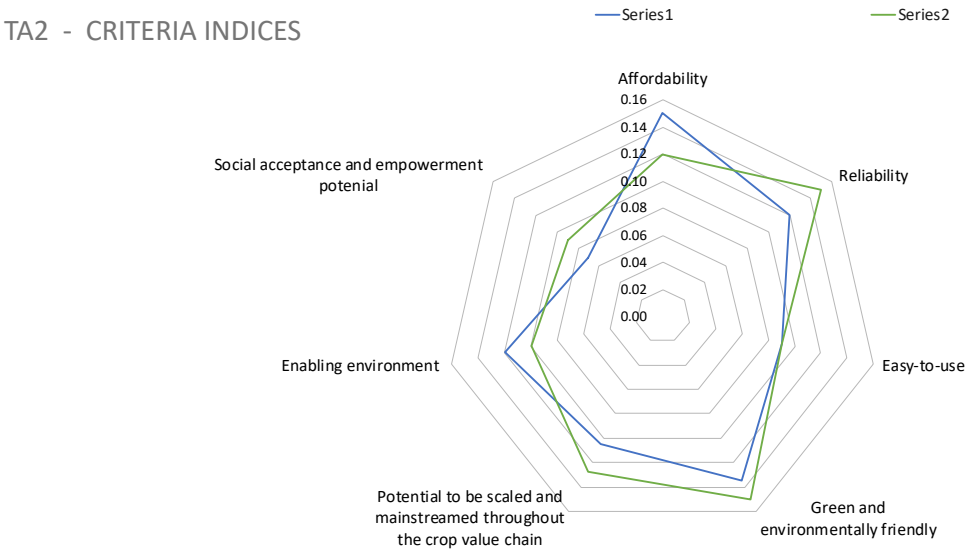
Source: GC-STAT tool.

Bangladesh

TA1: Post-harvest techniques to reduce food loss and waste

Thematic area		Technology name	Level 2 assessment							
			Final score	Affordability	Reliability	Easy-to-use	Green and environmentally friendly	Potential to be scaled and mainstreamed throughout the crop value chain	Enabling Environment	Social acceptance and empowerment potenial
TA2	Water management and water saving technologies	Integrated Rice Advisory System (IRAS)	0.79	0.15	0.12	0.09	0.14	0.11	0.12	0.07
		Hydroponics of floating islands using local materials	0.83	0.12	0.15	0.09	0.15	0.13	0.10	0.09
			Weights	15%	15%	15%	15%	15%	15%	10%





Technology one

Name	GrainPro® Cocoon™
Type	Innovation
Description	A flood-protected and hermetic storage solution for dry agricultural commodities, safeguarding against rodent attacks, air and moisture exchange, and providing flood protection below its zipper line.
Innovation	Low permeability to air and moisture, enabling chemical-free storage, long-term preservation and the possibility to monitor internal conditions. Additionally, a gas hermetic fumigation (GHF) version allows for CO_2 fumigation.
Benefits for smallholder farmers	Reduces post-harvest losses by up to 80 percent, extends grain storage life by 3–5 times, and reduces the need for chemical pesticides and fertilizers.
Acquisition cost	GrainPro® Cocoon™ Indoor prices start from USD 70: 50 lb/USD 70; 100 lb/USD 140; 250 lb/USD 280; 500 lb/USD 450.
Maturity	Mature (7+ years)
Additional information	5520 Connecticut Ave NW, Washington, DC 20015, USA Phone: (+1) 20 29216700

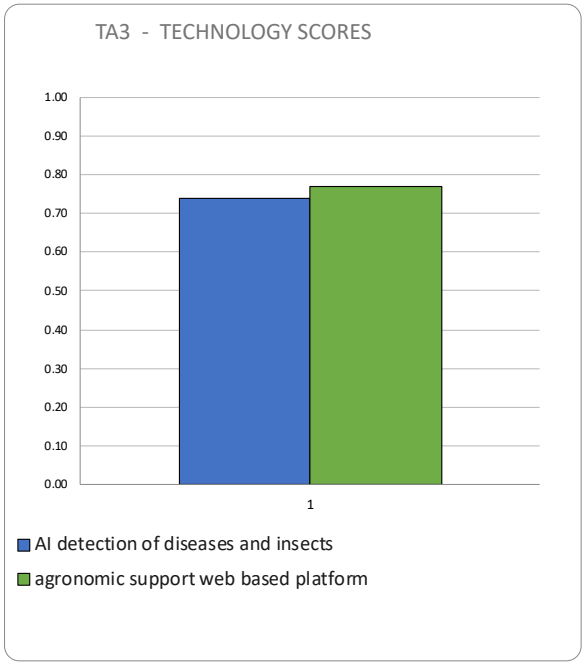
Technology two	
Name	iFarmer
Type	Digital
Description	A peer-to-peer lending platform offering a service to sell produce, enabling efficient connections between farmers and buyers featuring transparent pricing, 24-hour payment and a hassle-free experience.
Innovation	Tech-enabled supply chain network for direct aggregation of fresh produce, offering competitive prices and comprehensive services including finance, insurance and market access.
Benefits for smallholder farmers	Improved market access, better pricing and reduced value chain inefficiencies, significantly impacting livelihoods and food security.
Acquisition cost	None
Technology maturity	Intermediate (3–7 years)
Additional information	8E, Road 81, Gulshan 2, Dhaka 1212, Bangladesh Helpline: (+880) 96 38500800 Business team (calls and WhatsApp): (+880) 13 02536026; (+880) 17 84167973 Email: info@ifarmer.asia

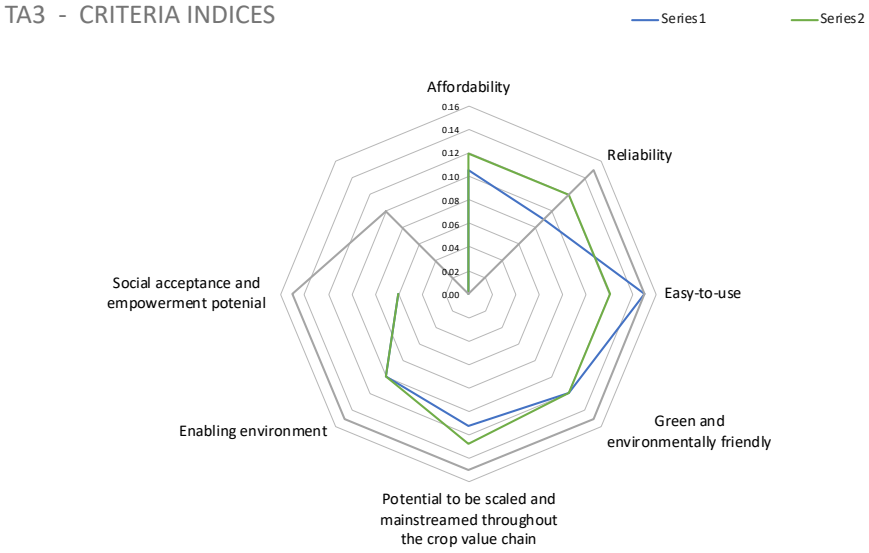
Bangladesh

TA2: Water management and water-saving technologies

Source: GC-STAT tool.

Thematic area		Technology name	Level 2 assessment							
			Final score	Affordability	Reliability	Easy-to-use	Green and environmentally friendly	Potential to be scaled and mainstreamed throughout the crop value chain	Enabling Environment	Social acceptance and empowerment potenial
TA3	Sustainable pest control and crop management	AI detection of diseases and insects	0.74	0.11	0.09	0.15	0.12	0.11	0.10	0.06
		Agronomic support web-based platform	0.77	0.12	0.12	0.12	0.12	0.13	0.10	0.06
			Weights	15%	15%	15%	15%	15%	15%	10%





Bangladesh

TA2: Water management and water-saving technologies

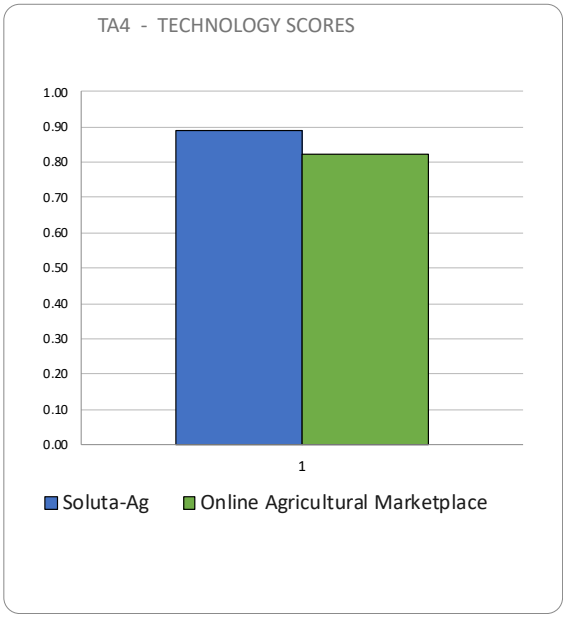
Technology one	
Name	Hydroponics of floating islands using local materials
Type	Traditional
Description	Utilizes floating islands from local materials for crop cultivation in waterlogged areas.
Innovation	Transformation of unproductive land using organic floating platforms for sustainable agriculture.
Benefits for smallholder farmers	Allows cultivation in waterlogged lands, high yield potential and post-cultivation compost benefits.
Acquisition cost	Low infrastructure and minimal capital requirements. Estimate: Construction of floating beds, seeds and maintenance: approximately BDT 5 600 (USD 118).
Maturity	Mature (7+ years)
Additional information	Seawater Solutions; Cultivating wetlands in Bangladesh by A.H.M. Rezaul Haq, T. K. Ghosal and P. Ghosh Email: g-trust@grameen.com

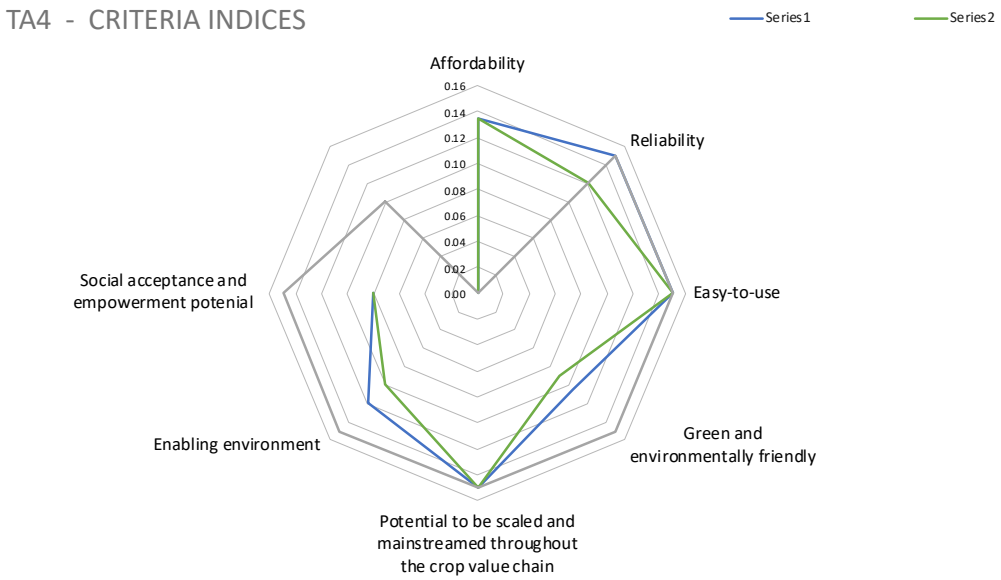
Technology two	
Name	Integrated Rice Advisory System
Type	Digital
Description	Uses satellite data for irrigation advisories in rice farming, optimizing water usage.
Innovation	Incorporates NASA satellite data for efficient irrigation and yield improvement in rice farming.
Benefits for smallholder farmers	Enhanced water management, reduced waste, cost savings, increased yield and climate change resilience.
Acquisition cost	No cost for farmers. Costs associated with platform development; free NASA and Landsat data – difficult to estimate.
Maturity	Nascent (1–3 years)
Additional information	Niaz Rahman, Bangladesh Rice Research Institute Email: niaz.stat@brri.gov.bd Faisal Hossain, University of Washington

Bangladesh

TA3: Sustainable pest control and crop management

Thematic area		Technology name	Level 2 assessment							
			Final score	Affordability	Reliability	Easy-to-use	Green and environmentally friendly	Potential to be scaled and mainstreamed throughout the crop value chain	Enabling Environment	Social acceptance and empowerment potenial
TA4	E- commerce and market acceess	Soluta-Ag	0.89	0.14	0.15	0.15	0.11	0.15	0.12	0.08
		Online agricultural marketplace	0.83	0.14	0.12	0.15	0.09	0.15	0.10	0.08
			Weights	15%	15%	15%	15%	15%	15%	10%





Source: GC-STAT tool.

Bangladesh

TA3: Sustainable pest control and crop management

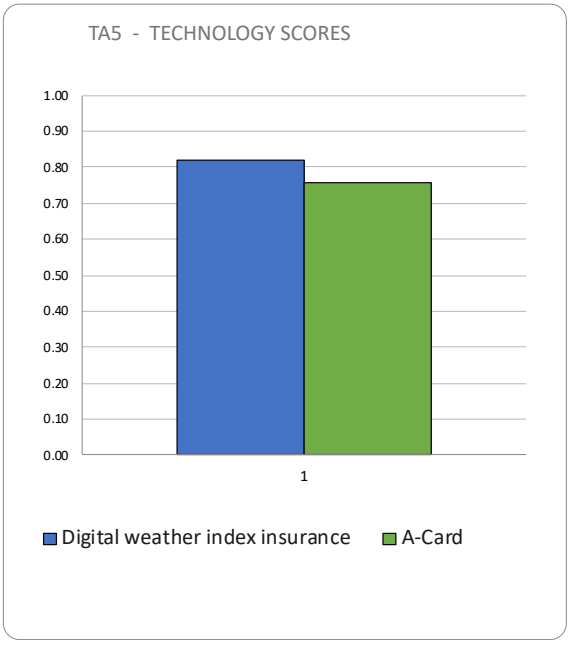
Technology one	
Name	Fosholi
Type	Digital
Description	A web-based platform providing resources and information on sustainable pest control and crop management to smallholder farmers in Bangladesh.
Innovation	Integrates digital technology to offer guidance on reducing chemical pesticide use, improving soil health and conserving water, contributing to sustainable agriculture.
Benefits for smallholder farmers	Enhances crop yields, promotes climate change adaptation, and improves livelihoods through accessible and improved agricultural practices.
Acquisition cost	None
Maturity	Intermediate (3–7 years)
Additional information	Address: ACI Centre 245, Tejgaon Industrial Area, Dhaka-1208, Bangladesh Phone: (+880) 28 878603

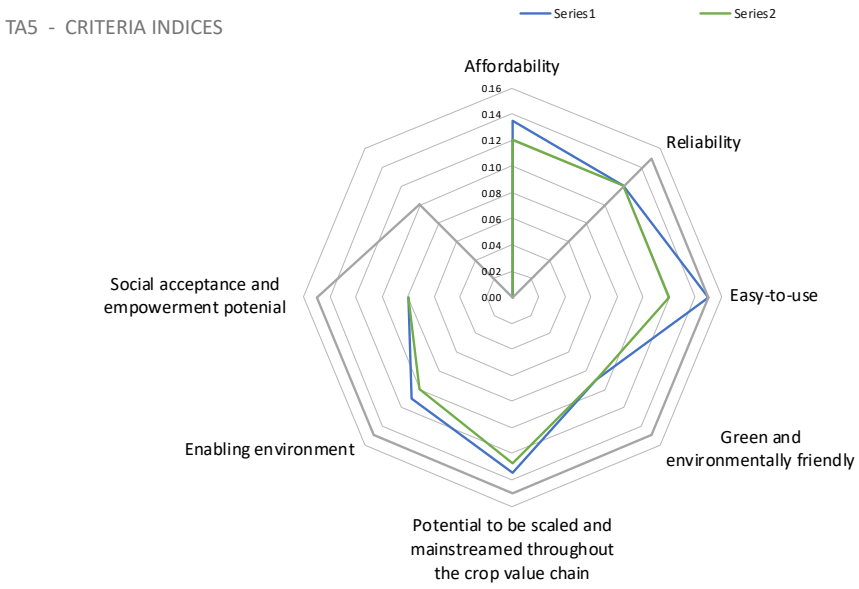
Technology two	
Name	Dr. Chashi
Type	Digital
Description	An AI-driven solution for real-time detection of crop diseases and insect infestations, providing farmers with actionable insights for crop health.
Innovation	Utilizes advanced image processing and deep learning to deliver instant and accurate diagnostics for crops, enhancing productivity.
Benefits for smallholder farmers	Offers critical, timely information to optimize crop health, thereby improving yields and reducing crop losses.
Acquisition cost	Freemium: basic free version; Premium version with app: USD 40; Training data: USD 20; Support services: USD 20.
Maturity	Nascent (1–3 years)
Additional information	Address: 25, Road 4, Block F, Banani, Dhaka 1213, Bangladesh Phone: (+880) 15 50079886 Email: support@drchashi.com

Bangladesh

TA4: E-commerce and market access

Thematic area		Technology name	Level 2 assessment							
			Final score	Affordability	Reliability	Easy-to-use	Green and environmentally friendly	Potential to be scaled and mainstreamed throughout the crop value chain	Enabling Environment	Social acceptance and empowerment potenial
TA5	Fintech	Digital weather index insurance	0.82	0.14	0.12	0.15	0.09	0.14	0.11	0.08
		A-Card	0.76	0.12	0.12	0.12	0.09	0.13	0.10	0.08
			Weights	15%	15%	15%	15%	15%	15%	10%





Source: GC-STAT tool.

Bangladesh

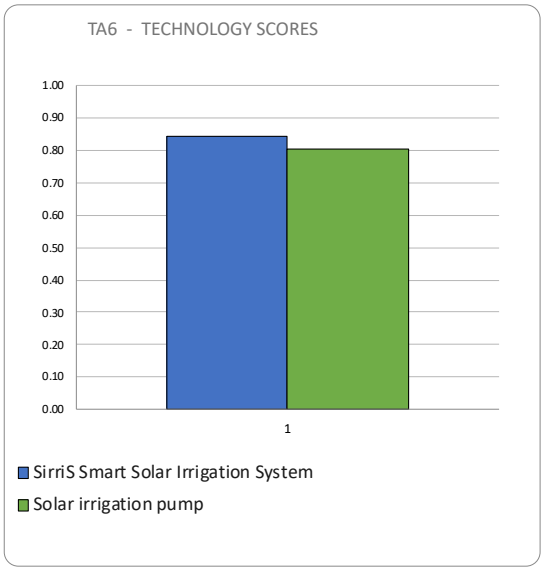
TA4: E-commerce and market access

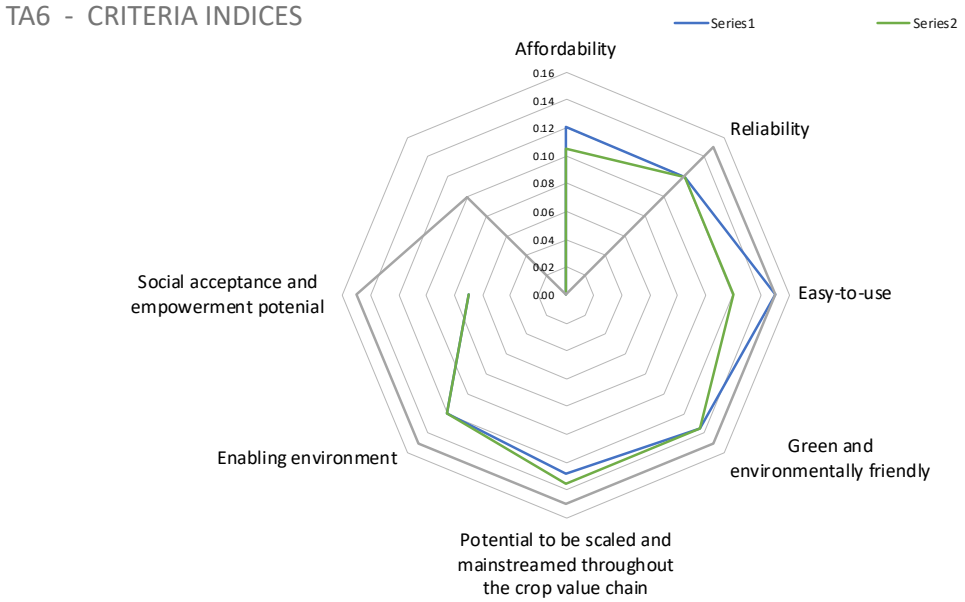
Technology one	
Technology name	Soluta-Ag
Type	Digital
Description	An integrated digital platform enhancing transparency and traceability in agriculture. It enables interactions among stakeholders for buying, selling, price comparison and performance monitoring.
Innovation	Integrated approach to managing transactions, inventory and business intelligence. It is designed for scalability, including offline capabilities.
Benefits for smallholder farmers	Connects farmers with buyers, providing real-time data for informed decision-making, and boosting income through better market access and reduced costs.
Acquisition cost	None
Maturity	Mature (7+ years)
Contact information	n/a

Technology two	
Name	Chaldal.com
Type	Digital
Description	A platform for Bangladeshi farmers to sell produce directly to consumers, featuring quick delivery, a diverse market of over 15 000 products and business opportunities for larger orders.
Innovation	Quick delivery system, wide product range and payment flexibility, supporting the farmers' cash flow and broadening market access.
Benefits for smallholder farmers	Direct market access, quick product delivery, exposure to a wide range of consumers and opportunities for larger orders, aiding in cost savings and improved cash flow.
Acquisition cost	None
Maturity	Mature (7+ years)
Additional information	WhatsApp: (+880)18 81234567

Bangladesh
TA5: Fintech

Thematic area		Technology name	Level 2 assessment							
			Final score	Affordability	Reliability	Easy-to-use	Green and environmentally friendly	Potential to be scaled and mainstreamed throughout the crop value chain	Enabling Environment	Social acceptance and empowerment potenial
TA6	Green energy for farmers	SirriS Smart Solar Irrigation System	0.84	0.12	0.12	0.15	0.14	0.13	0.12	0.07
		Solar irrigation pump	0.81	0.11	0.12	0.12	0.14	0.14	0.12	0.07
			Weights	15%	15%	15%	15%	15%	15%	10%





Source:

GC-STAT tool.

Bangladesh
TA5: Fintech

Technology one	
Name	Digital weather index insurance
Type	Digital
Description	A financial tool for smallholder farmers to manage risks from adverse weather. It uses weather indices for objective, quicker payouts without requiring traditional crop damage assessments.
Innovation	Index-based payouts triggered by specific weather conditions, ensuring objective and timely compensation to farmers and simplifying the claims process.
Benefits for smallholder farmers	Timely financial support during adverse weather, simplified claims, improved access to credit and encouragement for agricultural investment.
Acquisition cost	Premium to be paid by the farmer for insurance. No additional costs currently.
Maturity	Intermediate (3–7 years)
Additional information	Provided by Syngenta Foundation Phone: (+41) 61 323 5634 Email: syngenta.foundation@syngenta.com

Technology two	
Name	A-Card
Type	Digital
Description	A digital financial product for smallholder farmers to purchase farm inputs. It integrates formal banking with microfinance and uses NFC-enabled biometric PoS for secure transactions.
Innovation	Integrating formal banking with microfinance and using biometric verification for secure, efficient input purchases.
Benefits for smallholder farmers	Access to affordable credit, reduced transaction costs and an enhanced purchasing process for agricultural inputs, improving overall financial inclusivity.
Acquisition cost	None
Maturity	Intermediate (3–7 years)
Additional information	Bidyuth K. Mahalder, USAID Agricultural Extension Support Activity

Bangladesh

TA6: Green energy solutions for farmers

Source: GC-STAT tool.

Bangladesh

TA6: Green energy solutions for farmers

COUNTRY: **BRAZIL**

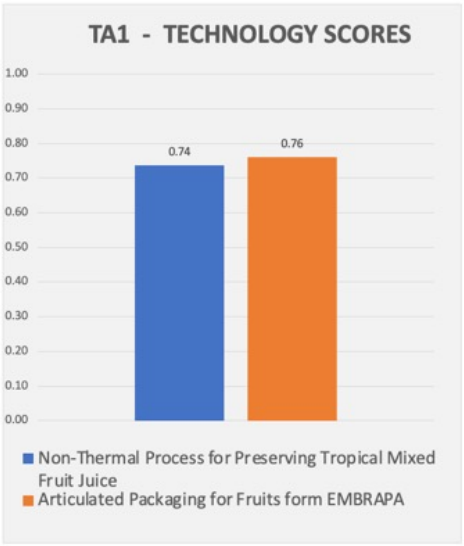
No. of technologies 53

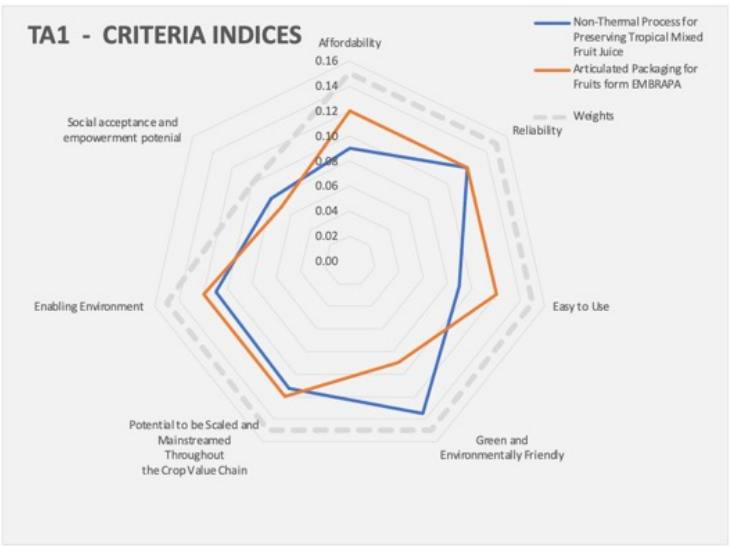
Thematic area		Technology name	LEVEL 1 assessment score	LEVEL 2 assessment score
TA 1 Post harvest-reducing food loss and waste	1	Articulated packaging for fruits by Embrapa	0.57	0.76
	2	Non-thermal process for preserving tropical mixed fruit juice	0.58	0.74
	3	SondaLeite - Milk quality assessment in realtime	0.52	
	4	Thermal shock treatment for açaí fruits	0.45	
TA 2 Water management and water saving technologies	1	Reuso de Águas Cinzas na Agricultura Familiar	0.58	0.77
	2	Barraginhas De Captação De Águas Superficiais De Chuvas: Rainwater harvesting	0.53	0.73
	3	Barragem Subterrânea (Underground Dam): Rainwater harvesting	0.52	
	4	Hydroponics run on water from desalinators(ideally used with the Solar Desalinator - see belo	0.50	
TA 3 Sustainable pest control and crop management	1	Agronomic recommendations APP (BoosterPRO by Agrosmart)	0.61	0.86
	2	Agronomic recommendations APP (IZagroApp by IZagro)	0.60	0.81
	3	Mixed native and non-invasive exotic seed planting (Muvuca technique)	0.55	
	4	DIY agro-infusor (Aerobic bio-compost maker)	0.50	
TA 4 E-commerce and martket access	1	AWI Superfoods	0.60	0.84
	2	Laços do Agro Digital Platform	0.62	0.82
	3	Inatú Amazônia	0.60	
	4	Arado marketplace	0.51	
TA 5 Fintech	1	Agrolend: easy credit on APP with approval on Whatsapp	0.60	0.81
	2	Terra Magna fintech	0.60	0.81
	3	Ecotrace Solutions	0.58	
	4	Nagro: short-term and production agri expenses in 48h	0.53	
TA 6 Green energy for farmers	1	Solar Desalinator(ideally used with Hydroponics run on water from desalinators)	0.62	0.82
	2	DIY (Do It Yourself) PVC hydraulic ram: pumping water without electricity	0.60	0.82
	3	DIY (Do It Yourself) Small bio-gas producers (from animal manure)	0.55	
	4	Solar powered portable tool disinfecting contaminated water	0.50	

Technology one

Name	SirriS
Type	Digital

Tematic Area		Technology Name	Level 2 Assessment							
			Final Score	Affordability	Reliability	Easy to Use	Green and Environmentally Friendly	Potential to be Scaled and Mainstreamed Throughout the Crop Value Chain	Enabling Environment	Social acceptance and empowerment potenial
TA1	Post harvest-reducing Food Loss and Waste	Non-Thermal Process for Preserving Tropical Mixed Fruit Juice	0.74	0.09	0.12	0.09	0.14	0.11	0.11	0.08
		Articulated Packaging for Fruits form EMBRAPA	0.76	0.12	0.12	0.12	0.09	0.12	0.12	0.07
			Weights	15%	15%	15%	15%	15%	15%	10%





Description	An app-based solar-powered irrigation system, automating irrigation based on soil and crop data. It reduces reliance on electricity and fossil fuels and can be remotely controlled.
Innovation	Automated, sensor-controlled irrigation system powered by solar energy, with remote monitoring and control capabilities.
Benefits for smallholder farmers	Significant water conservation, reduced irrigation costs, increased crop yield and decreased reliance on non-renewable energy sources.
Acquisition cost	Entry level with a single valve: BDT 50 000 (USD 600). A more complete solution including hardware (solar panels, batteries, controller, irrigation pump) and software (app, installation, training): BDT 102 500 (USD 935.82)
Maturity	Nascent (1–3 years)
Additional information	Shahriar Ahmed Chowdhury, Center for Renewable Energy Services Limited (CRESL)

Technology two

Name	Solar irrigation pumps
Type	Innovation

Description	Uses solar energy to power motors, enabling off-grid irrigation. Pumps can directly water crops or fill storage tanks for later use.
Innovation	Off-grid capability, reducing reliance on grid electricity and improving water access in remote areas.
Benefits for smallholder farmers	Effective solution for energy-saving irrigation, increased crop yields and climate change mitigation.
Acquisition cost	Estimates: 5 HP[5]: BDT 100 000 (USD 935.82); 7.5 HP: BDT 150000 (USD 1 423.61); 10 HP: BDT 200 000 (USD 1 911.39); 15 HP: BDT 300 000 (USD 2 853.23).
Maturity	Mature (7+ years)
Additional information	M.D. Khalekuzzaman, Sustainable Development Research Society (SDRS)

2. Brazil

2.1 Introduction to the agriculture sector and its challenges

Brazil's agricultural sector faces several challenges impacting its sustainability and productivity. Climate change-induced weather variations disrupt rainfall patterns and temperatures, affecting crop growth and yields. Extensive deforestation, notably in the Amazon, raises environmental concerns and threatens long-term sustainability. Moreover, the heavy reliance on monoculture, particularly soybeans and sugar cane, diminishes biodiversity and heightens vulnerability to pests and diseases. Inadequate infrastructure, including poor transportation and storage facilities, hinders efficient marketing and exportation of produce. Social and land issues, such as unequal land distribution and labour disputes, also present significant challenges to the sector's development.

Despite these challenges, Brazil's agricultural landscape offers numerous opportunities for growth and innovation. The country's bioenergy potential, especially in ethanol production from sugarcane, presents significant growth prospects. Brazil's rich biodiversity allows for the cultivation of a wide range of crops, promoting agricultural diversification. Its role as a leading exporter of commodities like soybeans, coffee and meat provides vast opportunities in global markets. Increasing focus on sustainable farming practices and government policies aimed at agricultural innovation and smallholder support further contribute to the sector's potential growth.

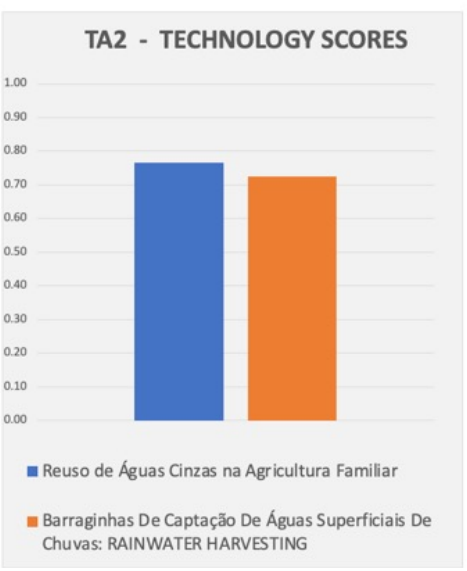
Smallholder farmers in Brazil face specific challenges that affect their productivity and livelihoods. Limited access to financing constrains their ability to invest in improvements or expansion, while land tenure insecurity and small landholdings hinder productivity and profitability. Moreover, a gap in adopting advanced agricultural practices and technologies impacts efficiency and yield. Connecting to broader markets is challenging, and the heavy reliance on rainfed agriculture makes the farmers

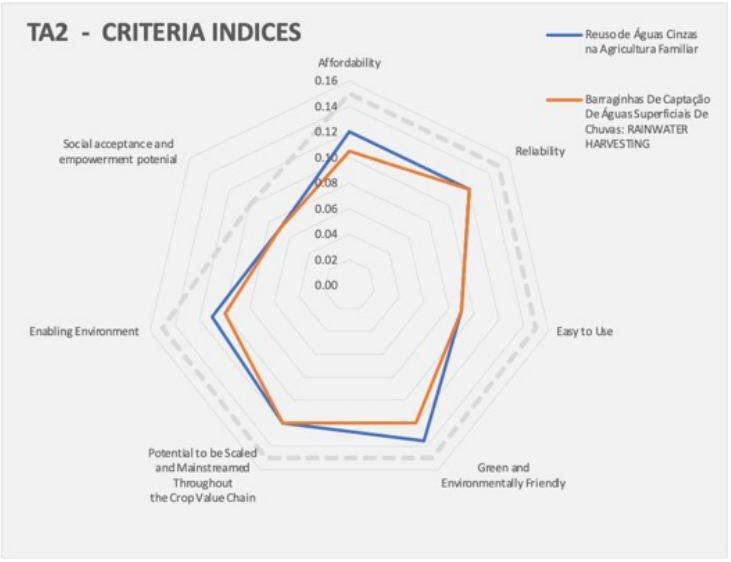
5 HP stands for Horsepower.

particularly vulnerable to climate change impacts.

However, there are opportunities for smallholder farmers to thrive. Government support in the form of

			Level 2 Assessment							
Tematic Area		Technology Name	Final Score	Affordability	Reliability	Easy to Use	Green and Environmentally Friendly	Potential to be Scaled and Mainstreamed Throughout the Crop Value Chain	Enabling Environment	Social acceptance and empowerment potenial
TA2	Water management and water saving technologies	Reuso de Águas Cinzas na Agricultura Familiar	0.77	0.12	0.12	0.09	0.14	0.12	0.11	0.07
		Barraginhas De Captação De Águas Superficiais De Chuvas: RAINWATER HARVESTING	0.73	0.11	0.12	0.09	0.12	0.12	0.10	0.07
			Weights	15%	15%	15%	15%	15%	15%	10%





subsidies, loans and tailored training programs can empower them. The growing demand for organic and sustainable products presents an avenue for higher profitability. Cooperative models can enhance resource utilization and market access, while focusing on niche markets or specialized crops can offer competitive advantages. Additionally, leveraging Brazil's diverse ecosystems and cultural richness for agrotourism can provide alternative revenue streams and foster sustainable development.

2.2 Brazil Country Profile

2.3 Technology profiles and assessment rankings

Brazil

TA1: Post-harvest techniques to reduce food loss and waste

Source: GC-STAT tool.

Brazil

TA1: Post-harvest techniques to reduce food loss and waste

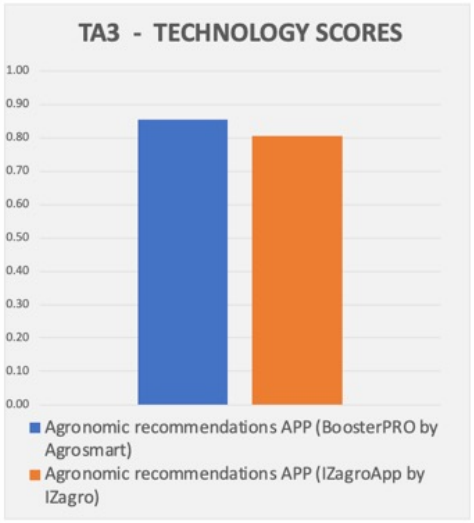
Technology one	
Name	Articulated packaging for fruits
Type	Innovation
Description	Primary, secondary and tertiary packaging designed for specific fruits. Primary packaging fits the fruit's shape, reducing damage. Secondary and tertiary packaging ensure stability and security during transportation.
Innovation	3D scanning for fruit modeling, creating anatomically-shaped packages. The packaging is easy to clean, requires minimal storage space and has a hinge system for efficient handling.
Benefits for smallholder farmers	Targeting cooperatives, this technology reduces post-harvest losses, maintains product quality up to the point of sale, and cuts costs with its returnable nature.
Acquisition cost	Estimate: BRL 2 000–5 000 (USD 400–1 000). This includes the cost of packaging materials, design and manufacturing of the packaging, and the training of farmers on how to use the packaging.
Maturity	Intermediate (3–7 years)
Additional information	Provided by Embrapa Fernando Teixeira Samary, Supervisor Address: Parque Estação Biológica, Brasília, DF, Brazil Phone: (+55) 61 3448 4433; Fax: (+55) 61 3448 4890; (+55) 61 3448 4891 Email: ctaa.chtt@embrapa.br

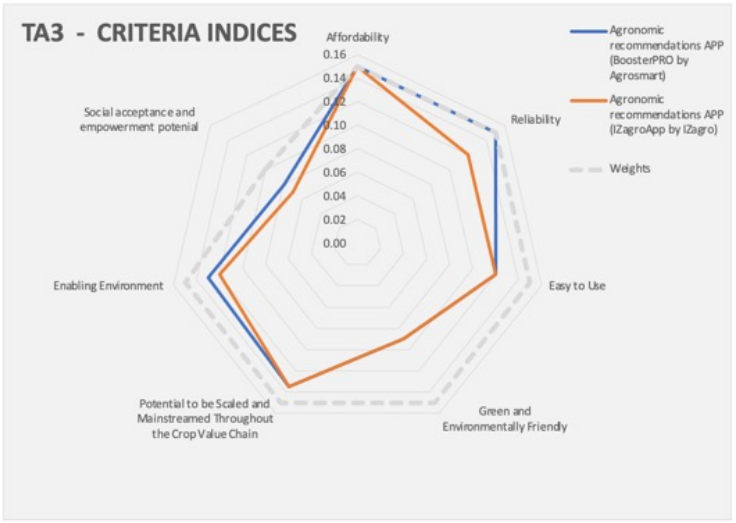
Technology two	
Name	Non-thermal process for preserving tropical mixed fruit juice
Type	Innovation
Description	A preservation method for mixed juice of melon, acerola and cashew using high hydrostatic pressure, maintaining sensory, nutritional and functional qualities.
Innovation	Utilizes cold pasteurization via high hydrostatic pressure.
Benefits for smallholder farmers	Enabling local processing of fruits, reducing post-harvest waste and creating value-added products.
Acquisition cost	Technology acquisition cost estimate range: BRL 10 000–20 000 (USD 2 000–4 000).
Maturity	Intermediate (3–7 years)
Additional information	Provided by Embrapa Embrapa Agroindústria de Alimentos Email: ctaa.chtt@embrapa.br

Brazil

TA2: Water management and water-saving technologies

Tematic Area		Technology Name	Level 2 Assessment							
			Final Score	Affordability	Reliability	Easy to Use	Green and Environmentally Friendly	Potential to be Scaled and Mainstreamed Throughout the Crop Value Chain	Enabling Environment	Social acceptance and empowerment potenial
TA3	Sustainable pest control and crop management	Agronomic recommendations APP (BoosterPRO by Agrosmart)	0.86	0.15	0.15	0.12	0.09	0.14	0.13	0.08
		Agronomic recommendations APP (IZagroApp by IZagro)	0.81	0.15	0.12	0.12	0.09	0.14	0.12	0.07
			Weights	15%	15%	15%	15%	15%	15%	10%





Source: GC-STAT tool.

Brazil

TA2: Water management and water-saving technologies

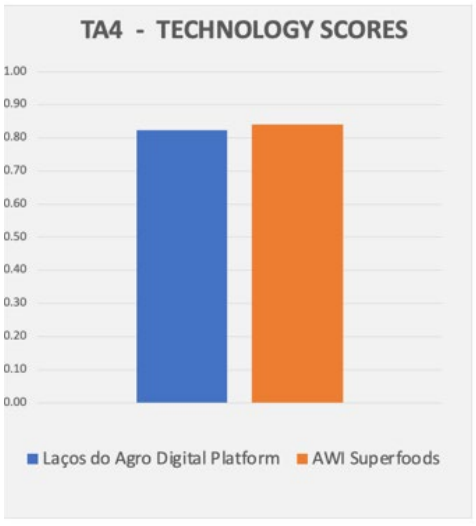
Technology one	
Name	Greywater reuse for agriculture
Type	Innovation
Description	Reusing greywater from sinks, showers and laundry for irrigation after biological filtration, which is particularly useful in semi-arid regions.
Innovation	It employs a system for filtering and repurposing greywater for agricultural use.
Benefits for smallholder farmers	Targeting cooperatives, it enables year-round cultivation, efficient use of water, improved crop diversity, economic benefits and environmental conservation.
Maturity	Intermediate (3–7 years)
Acquisition cost	Estimate (including greywater filtration system, installation and training): Household-scale system: BRL 5 000–10 000 (USD 1 000–2 000); Large-scale system (cooperative): BRL 10 000–50 000 (USD 2 000–10 000)
Additional information	Family biowater system in Transforma FBB Address: SCES, Trecho 02, Lote 22, Brasília, Brazil Phone: (+55) 61 31087000, Email: fbb@fbb.org.br

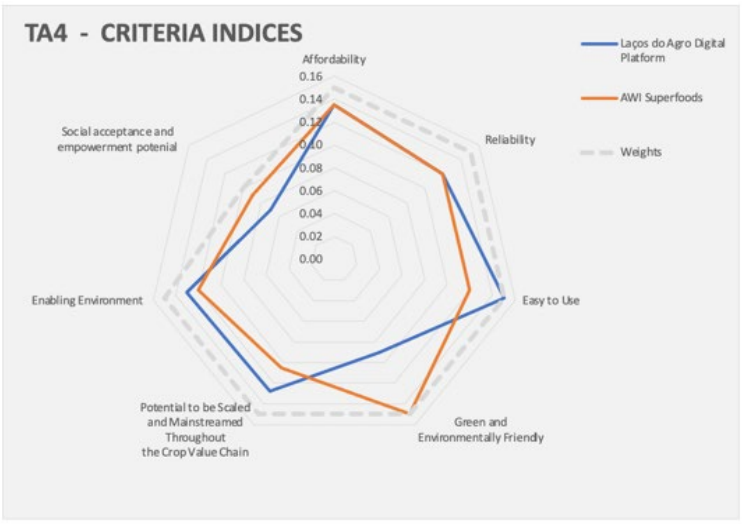
Technology two	
Name	Projeto Barraginhas
Type	Innovation
Description	Constructing small basins (barraginhas) to capture rainwater runoff, control soil erosion and recharge groundwater.
Innovation	An innovative approach in rainwater harvesting and sustainable water management in agriculture.
Benefits for smallholder farmers	Ensures water availability for irrigation, supports livestock and fish farming, enhances soil fertility, promotes self-reliance, contributes to environmental sustainability, potentially increases income and encourages community involvement.
Acquisition cost	BRL 200–500/barraginha (USD 40–100)
Maturity	Mature (7+ years)
Additional information	Surface rainwater collection barraginhas in Transforma FBB. Empresa Brasileira de Pesquisa Agropecuária (Embrapa) Milho e Sorgo Address: Highway MG424 - Km 65, Sete Lagoas (MG), Belo Horizonte, Brazil Phone: (+55) 31 30271207 Email: cnpms@cnpms.embrapa.br

Brazil

TA3: Sustainable pest control and crop management

Tematic Area		Technology Name	Level 2 Assessment							
			Final Score	Affordability	Reliability	Easy to Use	Green and Environmentally Friendly	Potential to be Scaled and Mainstreamed Throughout the Crop Value Chain	Enabling Environment	Social acceptance and empowerment potenial
TA4	E- commerce and market acceess	Laços do Agro Digital Platform	0.82	0.14	0.12	0.15	0.09	0.13	0.13	0.07
		AWI Superfoods	0.84	0.14	0.12	0.12	0.15	0.11	0.12	0.09
			Weights	15%	15%	15%	15%	15%	15%	10%





Source: GC-STAT tool.

Brazil

TA3: Sustainable pest control and crop management

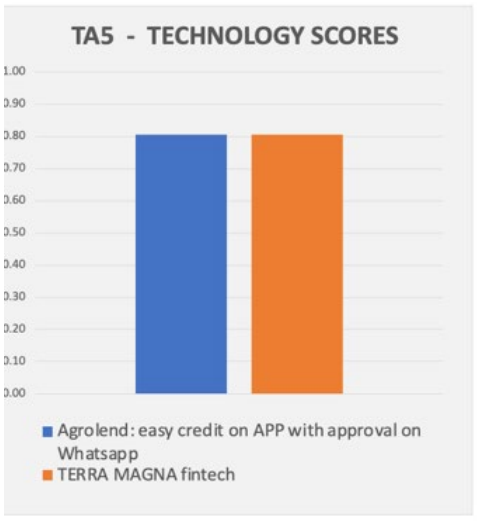
Technology one	
Name	BoosterPRO by Agrosmart
Type	Digital
Description	A climate intelligence platform that monitors agricultural variables like weather, irrigation and crop conditions for sustainable pest control and crop management.
Innovation	Includes forecast comparison, rainfall mapping, NDVI imaging for plant health monitoring and collaborative tools for farm teams.
Benefits for smallholder farmers	Assists farmers in handling weather-related risks, enhancing crop health management and improving decision-making, leading to better yields and sustainable pest control.
Acquisition cost	None
Maturity	Intermediate (3–7 years)
Additional information	Address: 128 Pereira Tangerino St., Jardim Guanabara, Campinas, SP, Brazil Email: contato@agrosmart.com.br

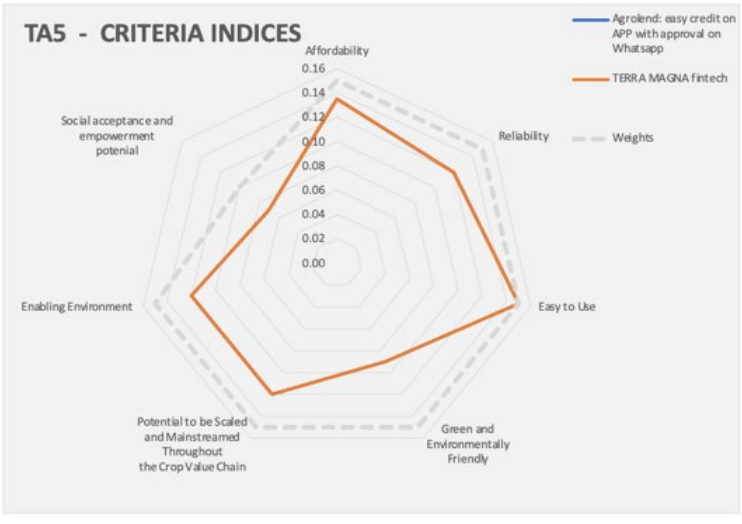
Technology two	
Name	**iZagroapp** by iZagro
Type	Digital
Description	A digital agronomy platform connecting farmers and agronomists, offering free agronomic information on major crops and their pests and diseases.
Innovation	The app advises on sustainable and regenerative farming practices and provides information on agricultural inputs.
Benefits for smallholder farmers	Enhances knowledge sharing, improves crop health management, and supports regenerative farming methods, beneficial for small and medium-size farmers.
Acquisition cost	None
Maturity	Intermediate (3–7 years)
Additional information	Phone: (+55) 16 997428655 Email: contato@izagro.com.br

Brazil

TA4: E-commerce and market access

Tematic Area		Technology Name	Level 2 Assessment							
			Final Score	Affordability	Reliability	Easy to Use	Green and Environmentally Friendly	Potential to be Scaled and Mainstreamed Throughout the Crop Value Chain	Enabling Environment	Social acceptance and empowerment potenial
TA5	Fintech	Agrolend: easy credit on APP with approval on Whatsapp	0.81	0.14	0.12	0.15	0.09	0.12	0.12	0.07
		TERRA MAGNA fintech	0.81	0.14	0.12	0.15	0.09	0.12	0.12	0.07
			Weights	15%	15%	15%	15%	15%	15%	10%





Source: GC-STAT tool.

Brazil

TA4: E-commerce and market access

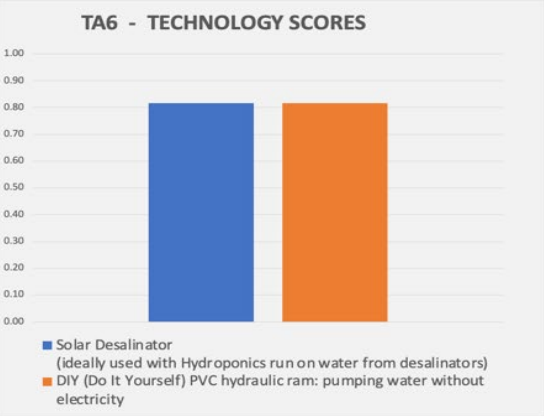
Technology one	
Name	AWI Superfoods
Type	Digital
Description	A company that focuses on developing innovative superfoods by sourcing natural ingredients from Brazil, promoting wellness and supporting local economies.
Innovation	Combines e-commerce for superfood distribution with a commitment to environmental stewardship and social impact.
Benefits for smallholder farmers	Offers income generation, promotes sustainable practices, supports community development and empowers smallholder farmers in the Amazon.
Acquisition cost	None
Maturity	Intermediate (3–7 years)
Additional information	Address: 1718, Apinajés St., Sumaré, São Paulo, Brazil Email: contact@awisuperfoods.com

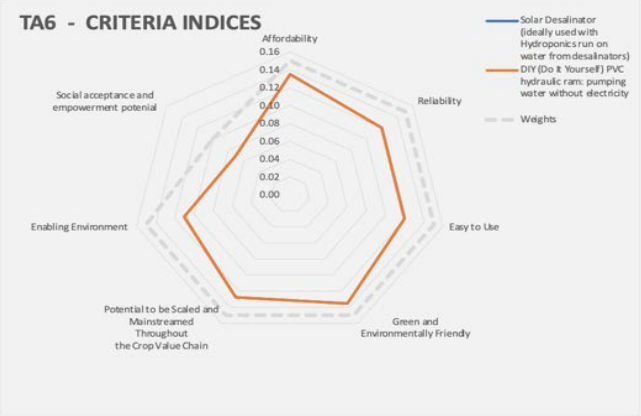
Technology two	
Name	Laços do Agro
Type	Digital
Description	A digital platform that connects smallholder farmers with buyers for product listing, bidding and sales management.
Innovation	Digital facilitation of direct farmer-buyer connections and market information transparency.
Benefits for smallholder farmers	Provides increased market access, improved bargaining power, reduced transaction costs, enhanced transparency, access to financing and training support.
Acquisition cost	Estimated subscription fee: Individual farmer: BRL 1 000–2 000/year (USD 200–400); Cooperative: BRL 50 000–100 000/year (USD 10 000–20 000)
Maturity	Nascent (1–3 years)
Additional information	Address: 2282, Paraná St., Medianeira, Paraná, Brazil Phone: (+55) 45 98841 5245 Email: contato@lacosdoagro.com

Brazil

TA5: Fintech

Tematic Area		Technology Name	Level 2 Assessment							
			Final Score	Affordability	Reliability	Easy to Use	Green and Environmentally Friendly	Potential to be Scaled and Mainstreamed Throughout the Crop Value Chain	Enabling Environment	Social acceptance and empowerment potenial
TA6	Green energy for farmers	Solar Desalinator (ideally used with Hydroponics run on water from desalinators)	0.82	0.14	0.12	0.12	0.14	0.13	0.11	0.07
		DIY (Do It Yourself) PVC hydraulic ram: pumping water without electricity	0.82	0.14	0.12	0.12	0.14	0.13	0.11	0.07
			Weights	15%	15%	15%	15%	15%	15%	10%





Source: GC-STAT tool.

Brazil
TA5: Fintech

Technology one	
Name	Agrolend
Type	Digital
Description	A fintech platform providing quick, easy credit to farmers for purchasing agricultural inputs like seeds and fertilizers.
Innovation	Utilizes a mobile app for loan applications with approvals via WhatsApp and a network of partners for credit at the point of sale.
Benefits for smallholder farmers	Provides accessible financial support, simplifies the process of acquiring agricultural inputs and enhances farmers' investment capabilities.
Acquisition cost	None
Maturity	Nascent (1–3 years)
Additional information	Address: 960, Joaquim Floriano St., 11th floor, São Paulo, Brazil Phone: (+55) 11 26672753

Technology two	
Name	TerraMagna
Type	Digital
Description	TerraMagna specializes in risk mitigation for agribusinesses using geospatial big data, cloud computing and satellite imagery for detailed land and business analysis.
Innovation	Employs satellite monitoring to analyse and monitor agricultural warranties from seeding to harvesting, enhancing credit clarity.
Benefits for smallholder farmers	Provides fair and accessible credit, facilitates risk assessment and management and supports informed decision-making in agriculture.
Acquisition cost	None
Maturity	Intermediate (3–7 years)
Additional information	Address: 1078, Anchieta Avenue, Jd Nova América, São José dos Campos, SP, Brazil Phone: (+55) 12 39233355 Email: contato@terramagna.com.br

TA6: Green energy solutions for farmers

Source: GC-STAT tool.

Brazil

TA6: Green energy solutions for farmers

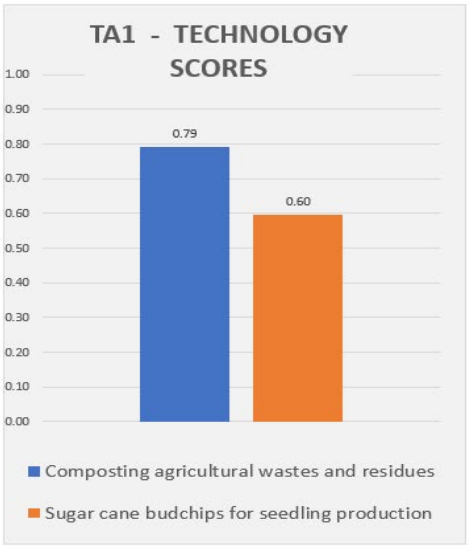
COUNTRY: EGYPT			No. of technologies	36
Thematic area		**Technology name**	**LEVEL 1**	**LEVEL 2**
TA 1 Post harvest-reducing food loss and waste	1	Composting agricultural wastes and residues	0.60	0.79
	2	Sugar cane budchips for seedling production	0.50	0.60
	3	FreshSource	0.50	
	4	Use of sugarcane byproducts to create activated carbon	0.48	
TA 2 Water management and water saving technologies	1	Water harvesting	0.50	0.75
	2	Modern Irrigation methods - Drip irrigation and gated irrigation	0.45	0.68
	3	Advanced irrigation monitoring	0.39	
	4	Aquafarming/Hydroponics	0.39	
TA 3 Sustainable pest control and crop management	1	Chitosan - Organic biofertilizer from shrimp shells	0.48	0.73
	2	AbuErdan - Access to tech for poultry farmers	0.50	0.61
	3	SowIt - Precision agriculture app/platform	0.45	
	4	Okadine - Bio-Fertilization	0.44	
TA 4 E- commerce and martket access	1	AxisPay	0.45	0.70
	2	Khodar	0.45	0.63
	3	Mozare3	0.45	
	4	Horticultural Export Improvement Association (HEIA)	0.43	
TA 5 Fintech	1	Mozare3	0.45	0.66
	2	Bashaier Network	0.45	0.60
	3	El Shuna	0.45	
	4	Feed the Future – Egypt Rural Agribusiness Strengthening Project: Buyer-led market access and CNFA platfo	0.41	
TA 6 Green energy for farmers	1	The Zero Fund	0.54	0.63
	2	Household biogas units	0.48	0.62
	3	Agrisolar - Solar Pumping Irrigation System (SPIS)	0.48	
	4	Suncity - Mobile Solar pump	0.48	

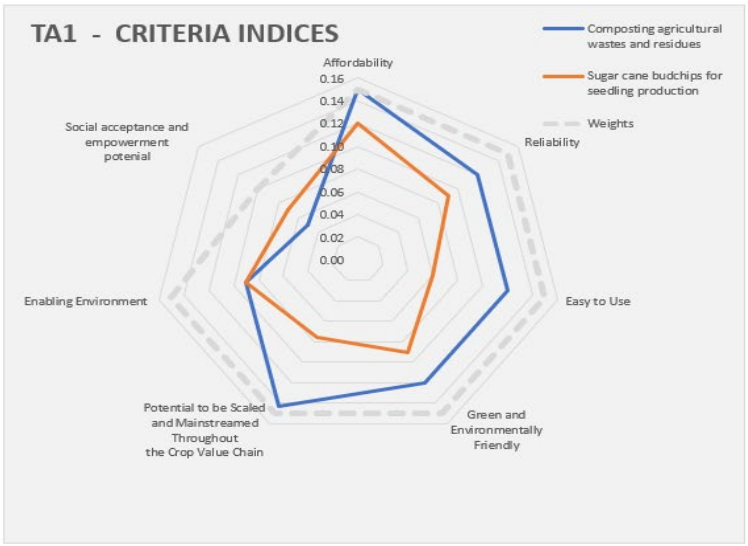
Technology two	
Name	Do it yourself (DIY) PVC Hydraulic Ram
Type	Innovation
Description	A homemade hydraulic ram made of PVC used for pumping water without electricity or fossil fuels. It is suitable for irrigation and livestock.
Innovation	Operates based on pressure differences in water levels, constructed from PVC pipes and metal valves, promoting environmental sustainability.
Benefits for smallholder farmers	Offers cost-effective water pumping, reducing dependency on electricity and fuel, featuring easy installation and maintenance.
Acquisition cost	Materials: BRL 50–100 (USD 14–28) Labour and installation: BRL 20–40 (USD 6–11)
Maturity	Nascent (1–3 years)
Additional information	Empresa de Pesquisa Agropecuária e Extensão Rural de SC (Epagri) Address: 31 Antonio Joaquim Palhano St., Centro, Frei Rogério, SC, Brazil Phone: (+49) 32 570045 Email: elcio@epagri.sc.gov.br

3. Egypt

3.1 Introduction to the agriculture sector and its challenges

Tematic Area		Technology Name	Level 2 Assessment							
			Final Score	Affordability	Reliability	Easy to Use	Green and Environmentally Friendly	Potential to be Scaled and Mainstreamed Throughout the Crop Value Chain	Enabling Environment	Social acceptance and empowerment potenial
TA1	Post harvest-reducing Food Loss and Waste	Composting agricultural wastes and residues	0.79	0.15	0.12	0.12	0.12	0.14	0.09	0.05
		Sugar cane budchips for seedling production	0.60	0.12	0.09	0.06	0.09	0.08	0.09	0.07
			Weights	15%	15%	15%	15%	15%	15%	10%





than 0.42 hectares, and more than 50 percent of the population deriving their livelihoods from the nitrogen use has declined from 71 percent in the 1960s to 44 percent in the 2010s, underscoring the need for green technologies and resource-efficient practices to improve soil health and reduce the reliance on chemical fertilizers (AbdelMonem *et al.*, 2022). These sustainable practices not only benefit the environment but also offer cost-effective solutions for smallholder farmers.

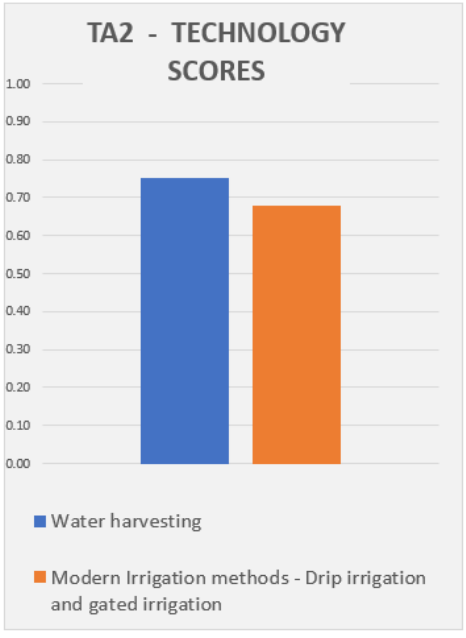
While state support for the agriculture sector has decreased over time, primarily limited to subsidies for strategic crops and low-interest credits, agritechnologies offer avenues for offsetting these reductions by reducing costs, enhancing yields and improving the quality of life (Ghonem, 2019). Egypt has demonstrated success in water management through strategies like reusing agricultural drainage water multiple times and increasing the utilization of desalinated seawater (FAO, 2023). These technological advancements serve as a blueprint for implementing water-saving technologies and strategies tailored to the needs of smallholder farmers, contributing to the sustainability and resilience of Egypt's agricultural sector.

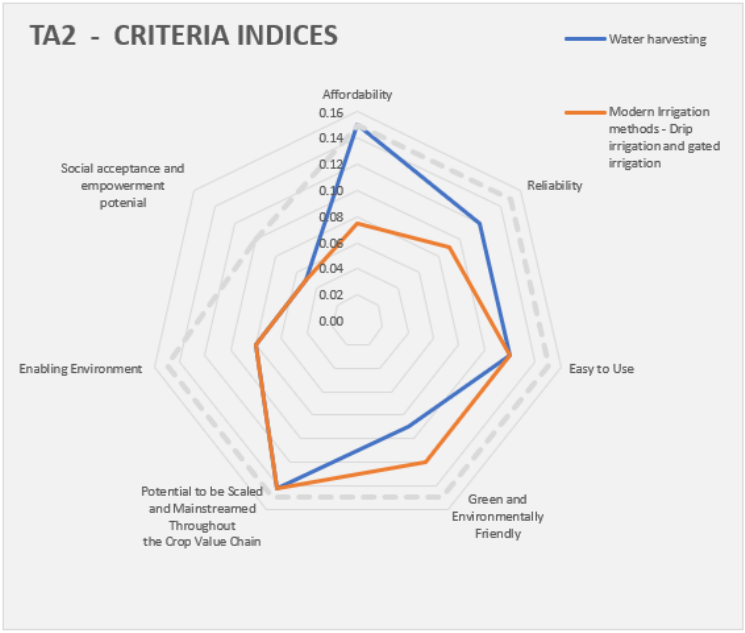
3.2 Egypt Country Profile

3.3 Technology profiles and assessment rankings

Egypt

Tematic Area	Technology Name	Level 2 Assessment							
		Final Score	Affordability	Reliability	Easy to Use	Green and Environmentally Friendly	Potential to be Scaled and Mainstreamed Throughout the Crop Value Chain	Enabling Environment	Social acceptance and empowerment potenial
TA2 Water management and water saving technologies	Water harvesting	0.75	0.15	0.12	0.12	0.09	0.14	0.08	0.05
	Modern Irrigation methods - Drip irrigation and gated irrigation	0.68	0.08	0.09	0.12	0.12	0.14	0.08	0.05
		Weights	15%	15%	15%	15%	15%	15%	10%





Egypt

TA1: Post-harvest techniques to reduce food loss and waste

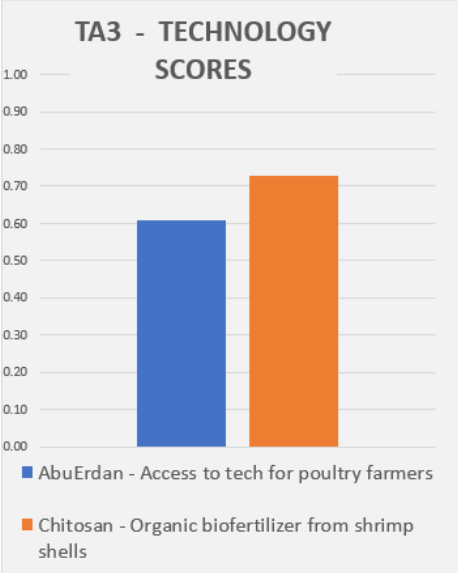
Technology one	
Name	Composting agricultural waste and residue
Type	Traditional
Description	The process of converting organic material to animal fodder, fish feed, organic fertilizers and poultry farm bedding.
Innovation	Utilizes waste materials to create supplies that improve cost, quality and availability of other necessary supplies.
Benefits for smallholder farmers	Reduces the need for chemical fertilizer or produces feed and fodder for animals. Farmers can benefit from saving money on these supplies. Additionally, producing and selling compost can diversify farmers' income.
Acquisition cost	None
Maturity	Mature (7+ years)
Additional information	Address: 3 Cairo-Belbeis Desert Road, Egypt Phone: (+202) 26588124 / 125 Ext. 237 Mobile: (+20) 12 23999147 E-mail: organic.egypt@hu.edu.eg

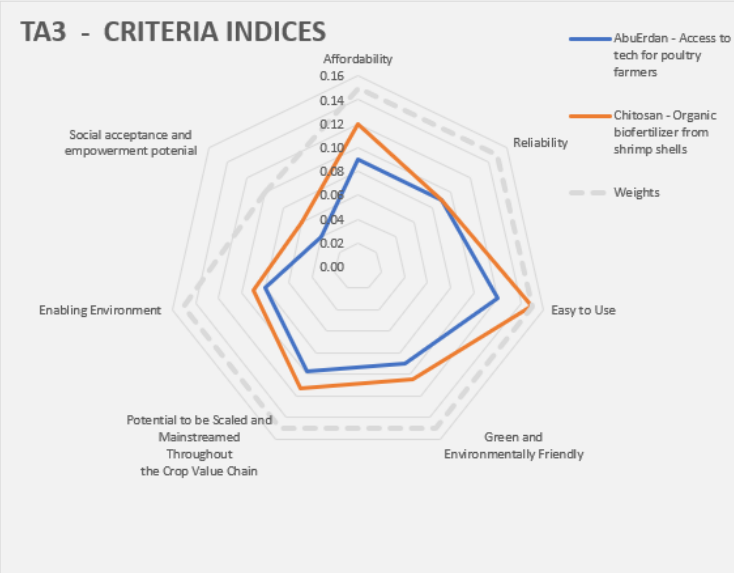
Technology two	
Name	Sugarcane bud chips for seedling production
Type	Innovation
Description	Creating sugarcane seedlings with sugarcane bud chips is a more efficient process. Instead of using stalk cuttings for planting, only pieces of the auxiliary buds are planted.
Innovation	Uses up to 96 percent less sugarcane to create seedlings than the traditional method, increasing the average productivity of each feddan from 33 to 55 tons.
Benefits for smallholder farmers	Reduces post-harvest food loss to seedling production and decreases the cost of seedlings if farmers purchase seedlings from third parties. Since sugarcane has a very high water requirement, increasing sugarcane productivity decreases water needs.
Acquisition cost	None. Some costs associated with providing training to farmers and nursery workers.
Maturity	Mature (7+ years)
Additional information	A new technique for planting sugar cane in Egypt, Assessment of using bud chips as an alternative to cane cutting for late planting of sugarcane by Mohamed O.A. Galal, Sugar Crops Research Institute (SCRI), Email: maweias2007@gmail.com

Egypt

TA2: Water management and water-saving technologies

Tematic Area		Technology Name	Level 2 Assessment							
			Final Score	Affordability	Reliability	Easy to Use	Green and Environmentally Friendly	Potential to be Scaled and Mainstreamed Throughout the Crop Value Chain	Enabling Environment	Social acceptance and empowerment potenial
TA3	Sustainable pest control and crop management	AbuErdan - Access to tech for poultry farmers	0.61	0.09	0.09	0.12	0.09	0.10	0.08	0.04
		Chitosan - Organic biofertilizer from shrimp shells	0.73	0.12	0.09	0.15	0.11	0.11	0.09	0.06
			Weights	15%	15%	15%	15%	15%	15%	10%





Egypt

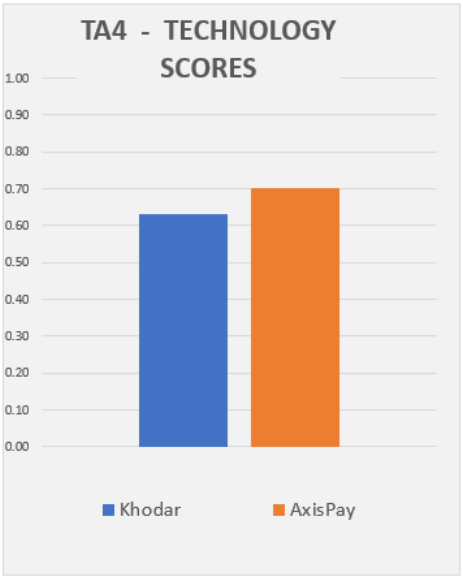
TA2: Water management and water-saving technologies

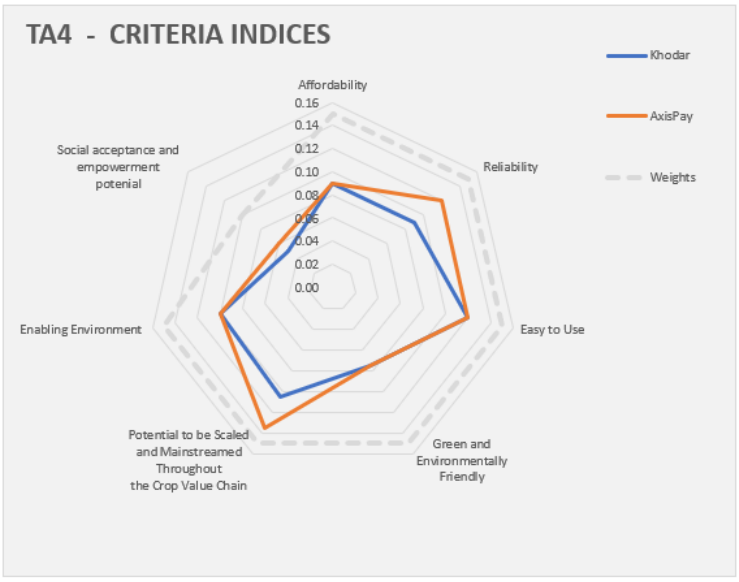
Technology one	
Name	Water harvesting
Type	Traditional
Description	Stores seasonal rainfall to use for crops throughout the year.
Innovation	Captures rainfall to prevent flooding and utilize water during dry seasons.
Benefits for smallholder farmers	Helps spread water supplies more evenly throughout the year. It also reduces surface runoff and water loss, which decreases erosion and protects downstream villages from floods. Harvested rainwater requires less energy than water pumping.
Acquisition cost	Low setup cost
Maturity	Mature (7+ Years)
Additional information	FAO project in Egypt Email: FAO-EGY@fao.org

Technology two	
Name	Drip irrigation method
Type	Innovation
Description	Irrigating crops via dripping, either above or below the soil surface. Gated irrigation refers to irrigation systems that control the amount and direction of irrigated water through pipes.
Innovation	Keeps water closer to plant roots and ensures optimal moisture levels. Gated irrigation manages moisture levels and optimizes water distribution across fields through the use of strategically placed gates or valves.
Benefits for smallholder farmers	Saves water and ensures that crops are sufficiently watered.
Acquisition cost	High cost of installation, moderate cost of maintenance.
Maturity	Mature (7+ Years)
Additional information	FAO project in Egypt Email: FAO-EGY@fao.org

Egypt
TA3: Sustainable pest control and crop management

Tematic Area	Technology Name	Level 2 Assessment							
		Final Score	Affordability	Reliability	Easy to Use	Green and Environmentally Friendly	Potential to be Scaled and Mainstreamed Throughout the Crop Value Chain	Enabling Environment	Social acceptance and empowerment potenial
TA4 E- commerce and market accesss	Khodar	0.63	0.09	0.09	0.12	0.08	0.11	0.10	0.05
	AxisPay	0.70	0.09	0.12	0.12	0.08	0.14	0.10	0.06
		Weights	15%	15%	15%	15%	15%	15%	10%





Egypt

TA3: Sustainable pest control and crop management

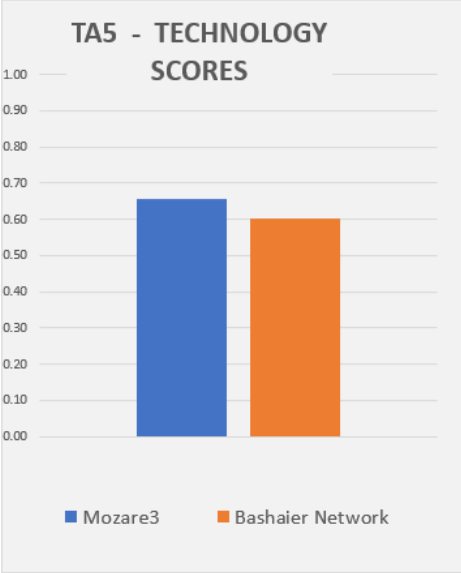
Technology one	
Name	Chitosan
Type	Innovation
Description	Produces effective fertilizer from shrimp by-products, making it easier for farmers to adopt organic farming.
Innovation	An organic biopolymer that can be used as agricultural fertilizer. Chitosan extracted from shrimp shells is the highest grade of chitosan. It is organic and utilizes material that is otherwise wasted.
Benefits for smallholder farmers	Chitosan's product increases production by at least 30 percent and up to 120 percent. It specializes in treating root rot and increasing yields.
Acquisition cost	Low cost for supplies. See products.
Maturity	Intermediate (3–7 years)
Additional information	Ehab Usama, CEO; Shahira Yehya, Co-founder.

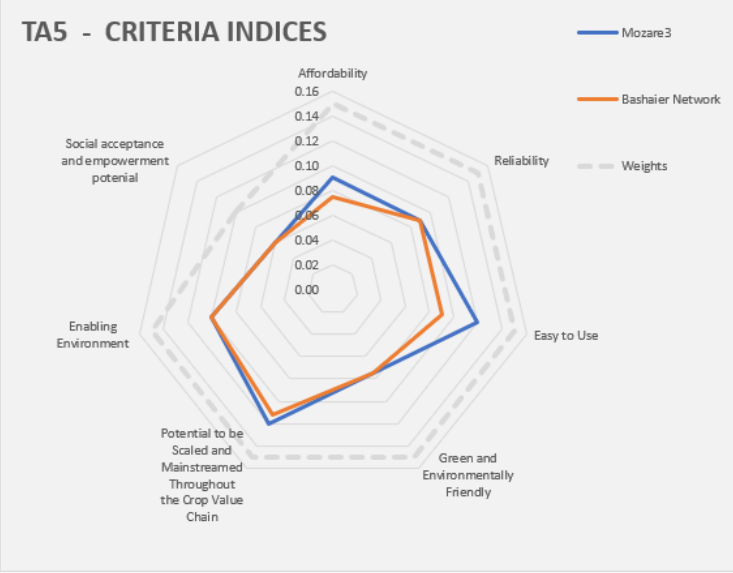
Technology two	
Name	AbuErdan
Type	Digital
Description	Uses technology and data to offer analytics to poultry farmers.
Innovation	Leverages new technologies like artificial intelligence, machine learning, and predictive analytics to offer poultry producers ways to take corrective actions in time. Their services include an IoT and cloud enabled app that can be easily set up.
Benefits for smallholder farmers	Data analysis leads to more efficient practices at all stages of poultry farming. This technology can be implemented at smaller scales to target smallholder farmers.
Acquisition cost	High cost for services
Maturity	Mature (7+ Years)
Additional information	Address: 2 Bahgat Aly St., Zamalek, Cairo, Egypt Email: info@abuerdan.com Watch introductory video

Egypt

TA4: E-commerce and market access

Tematic Area	Technology Name	Level 2 Assessment							
		Final Score	Affordability	Reliability	Easy to Use	Green and Environmentally Friendly	Potential to be Scaled and Mainstreamed Throughout the Crop Value Chain	Enabling Environment	Social acceptance and empowerment potenial
TA5 Fintech	Mozare3	0.66	0.09	0.09	0.12	0.08	0.12	0.10	0.06
	Bashaier Network	0.60	0.08	0.09	0.09	0.08	0.11	0.10	0.06
		Weights	15%	15%	15%	15%	15%	15%	10%





Egypt

TA4: E-commerce and market access

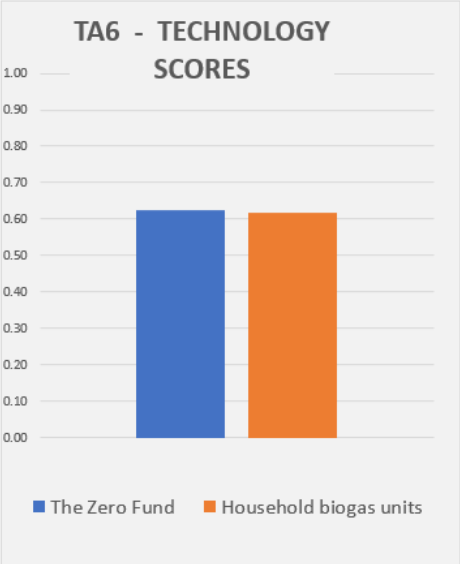
Technology one	
Name	AxisPay
Type	Digital
Description	An app that allows small businesses to make digital payments.
Innovation	Features include mobile payments, online banking, payroll processing and the ability to reimburse employees. AxisPay also has a personal option that allows individuals to send money to others with the app.
Benefits for smallholder farmers	A safe and fast payment option; more efficient options for small businesses wanting to pay employees.
Acquisition cost	None. The app is free and there are no fees or charges for Axis Bank users.
Maturity	Nascent (1–3 years)
Additional information	Hotline: 15731 Email: partnerships@axisapp.com

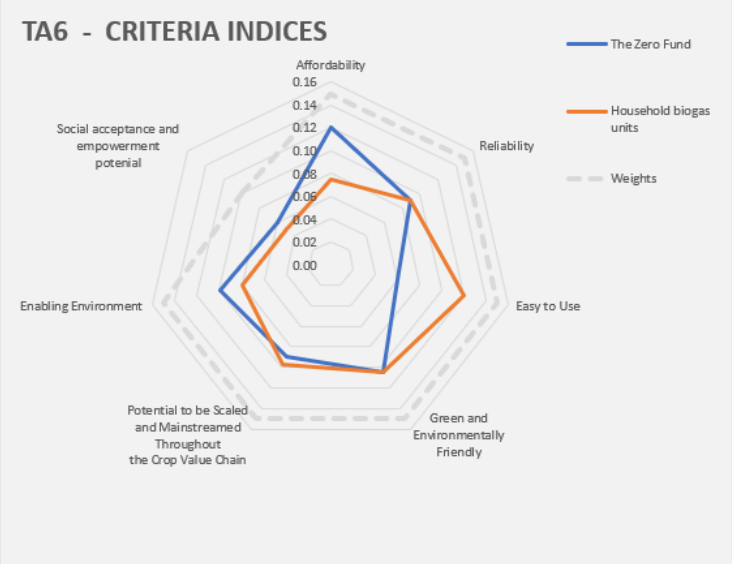
Technology two	
Name	Khodar
Type	Digital
Description	A platform that creates channels for Egyptian farmers to work directly with food chains and delivery services. It also connects farmers with other businesses who are seeking to buy fresh fruits and vegetables, and provides demand forecasts and recycles waste into organic fertilizer. Khodar includes a personal assistant service through WhatsApp to answer farmers' questions.
Innovation	Provides access to expert opinions, information and networking connections.
Benefits for smallholder farmers	More streamlined buying and selling process, better prices and less produce loss due to faster selling timelines.
Acquisition cost	None
Maturity	Nascent (1–3 years)
Additional information	Phone: (+20) 12 76663574 Email: hello@khodar.com

Egypt

TA5: Fintech

Tematic Area	Technology Name	Level 2 Assessment							
		Final Score	Affordability	Reliability	Easy to Use	Green and Environmentally Friendly	Potential to be Scaled and Mainstreamed Throughout the Crop Value Chain	Enabling Environment	Social acceptance and empowerment potenial
TA6 Green energy for farmers	The Zero Fund	0.63	0.12	0.09	0.06	0.11	0.09	0.10	0.06
	Household biogas units	0.62	0.08	0.09	0.12	0.11	0.10	0.08	0.05
		Weights	15%	15%	15%	15%	15%	15%	10%





Egypt
TA5: Fintech

Technology one	
Name	Mozare3
Type	Digital
Description	An agricultural technology company that connects smallholder farmers with processors and exporters. It draws up contracts with small farmers to order specific produce, and provides safe and quality supply purchasing avenues.
Innovation	Streamlines and digitizes financial services. It offers prepaid cards instead of dealing in cash and offers financing products to farmers to enable them to purchase equipment and supplies. It also has an app for farmers to view their contracts and financial information.
Benefits for smallholder farmers	Provides smallholder farmers with streamlined and digitized services and more formalized buying and selling arrangements.
Acquisition cost	None
Maturity	Nascent (1–3 years)
Additional information	Address: Park Avenue, Sheikh Zayed City, Egypt Phone: (+20) 12 10100048 E-mail: info@mozare3.net

Technology two	
Name	Bashaier Network
Type	Digital
Description	An online platform and app that connects small farmers, buyers and input suppliers directly.
Innovation	Helps farmers to find buyers, and contracts with NGOs and cooperatives. It also shows prices and cost analyses and can provide daily SMS updates for crops selected by the subscriber. Digital resources are accessible and updated frequently.
Benefits for smallholder farmers	Allows for more efficient communication, and buying and selling between the smallholder farmer and others.
Acquisition cost	None
Maturity	Mature (7+ years)

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Additional information	Phone: (+20) 12 01547720; (+20) 12 77133052 Email: mail@bashaier.net

Egypt

TA6: Green energy solutions for farmers

COUNTRY: **JORDAN** — N. of Technologies: 36

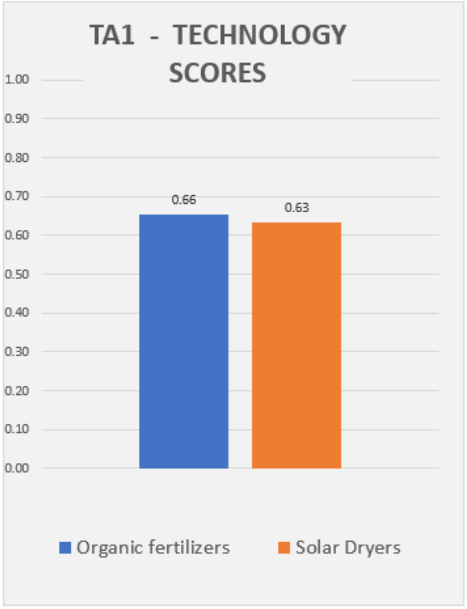
THEMATIC Area		TECHNOLOGY Name	LEVEL 1 Assessment Score	LEVEL 2 Assessment Score
TA 1 Post harvest-reducing Food Loss and Waste	1	Organic fertilizers	0.60	0.66
	2	Solar Dryers	0.50	0.63
	3	Portable Biogas Digesters	0.48	
	4	The Container Composter	0.48	
TA 2 Water management and water saving technologies	1	Rainwater harvesting	0.52	0.70
	2	Fertigo - Smart Irrigation and Fertigation	0.50	0.63
	3	Tensiometers	0.48	
	4	Aquaponics and hydrophonics	0.45	
TA 3 Sustainable pest control and crop management	1	Palmear	0.52	0.70
	2	Smart DESERT mobile app	0.54	0.69
	3	Cosmocel - Satellite imagery/analysis	0.50	
	4	The Vallerani System/Delfino Plough	0.43	
TA 4 E- commerce and martket access	1	e-FRESCO	0.50	0.63
	2	Ghoorcom	0.48	0.60
	3	E-payment systems - E-Fawatircom, CliQ, Zain Cash	0.48	
	4	Jordan Exporters and Producers Association for Fruit and Vegetables (JEPA)	0.45	
TA 5 Fintech	1	Jordan Renewable Energy & Energy Efficiency Fund (JREEF)	0.56	0.70
	2	Decapolis	0.48	0.66
	3	YalaNaqel	0.48	
	4	FINCA Jordan, ACC	0.48	
TA 6 Green energy for farmers	1	Solar drip irrigation systems	0.52	0.70
	2	Improved Jameed processing for small scale sheep dairy farms	0.56	0.64
	3	Off-grid solar cell systems	0.45	
	4	0	0.43	

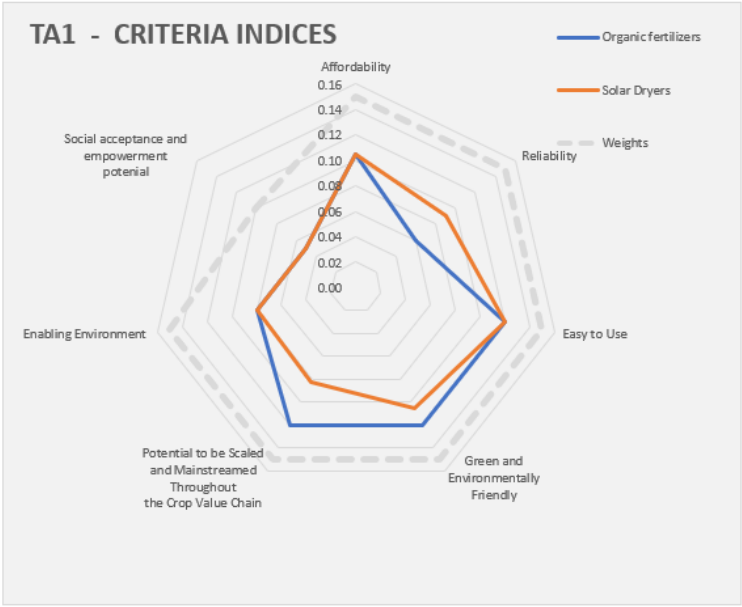
Egypt
TA6: Green energy solutions for farmers

Technology one

Name	The Zero Fund

		Level 2 Assessment							
Tematic Area	Technology Name	Final Score	Affordability	Reliability	Easy to Use	Green and Environmentally Friendly	Potential to be Scaled and Mainstreamed Throughout the Crop Value Chain	Enabling Environment	Social acceptance and empowerment potenial
TA1 Post harvest-reducing Food Loss and Waste	Organic fertilizers	0.66	0.11	0.06	0.12	0.12	0.12	0.08	0.05
	Solar Dryers	0.63	0.11	0.09	0.12	0.11	0.08	0.08	0.05
		Weights	15%	15%	15%	15%	15%	15%	10%





Benefits for smallholder farmers	Farmers can diversify their income by partnering with The Zero Fund energy and fertilizer, while lowering methane emissions.
Acquisition cost	Most biogas units cost USD 800–USD 1 500.
Maturity	Mature (7+ years)
Additional information	Bioenergy Association for Sustainable Development (BASD), Phone: (+20) 22 7408363 Email: info@bio-egypt.org

4. Jordan

4.1 Introduction to the agriculture sector and its challenges

Despite its dry climate, Jordan's agriculture sector has historically been a large part of its economy. Although its contribution has decreased over time, Jordan's agriculture sector is still significant, with nearly a quarter of families depending on it for income (Perosino, 2023). Sheep and poultry are the most prominent livestock, and Jordan is self-sufficient in vegetables, citrus and olives (Bahn *et al.*, 2021).

Livestock accounts for more than half of Jordan's agricultural output and is a source of income for over 44 000 Jordanians, which has led to problems of overgrazing, desertification and soil erosion (MEMR, 2021; MoEnv, 2020). Currently, approximately 2.6 percent of Jordan's land surface is cultivatable as farmland or livestock grazing land, which is down from 3.5 percent in 1988 (MoEnv, 2020). Methods and processes to increase the sustainability of grazing or the quality of livestock feed could have significant impacts on Jordan's smallholder livestock farmers.

The agriculture sector contributes 4 percent of Jordan's GDP and consumes over half of Jordan's limited water resources (MoEnv, 2020). Jordan had 62 m^3 of freshwater resources per capita in 2020, which is far below the 500 m^3 threshold for water scarcity (World Bank, 2020). Smallholder-oriented technologies in Jordan can impact the livelihoods of farmers by introducing water-efficient farming methods or hardier crops. High levels of pesticide residues due to overuse and misuse has led to decreased soil health, pesticide resistance, groundwater contamination and risks to consumer and environmental health. Pesticide levels also impact Jordan's ability to export its products to other countries due to noncompliance. Technologies and green practices could reduce the need for chemical fertilizer or find alternatives with fewer harmful side effects, which would allow farmers to spend less on fertilizer and sell their crops to more outlets.

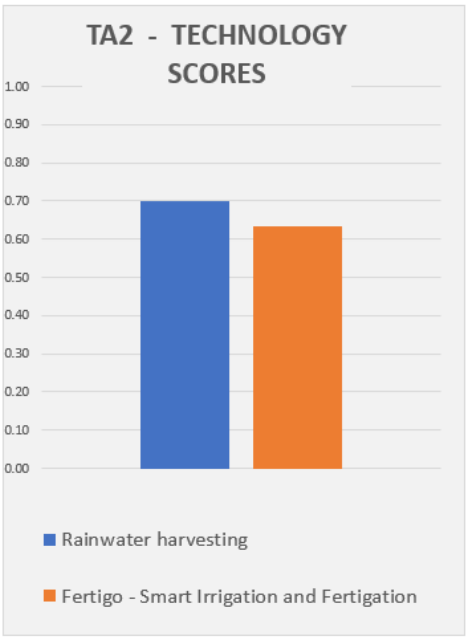
Jordan has explored many options to make its resource usage more efficient. Treated wastewater makes up 30.9 percent of water used by the agriculture sector, and there has been a concerted effort to establish policies to support the adoption of solar technologies and efficient irrigation systems (MEMR, 2020). These priorities could be easily focused on smallholder farmers to improve the sustainability and productivity of small-scalefarming.

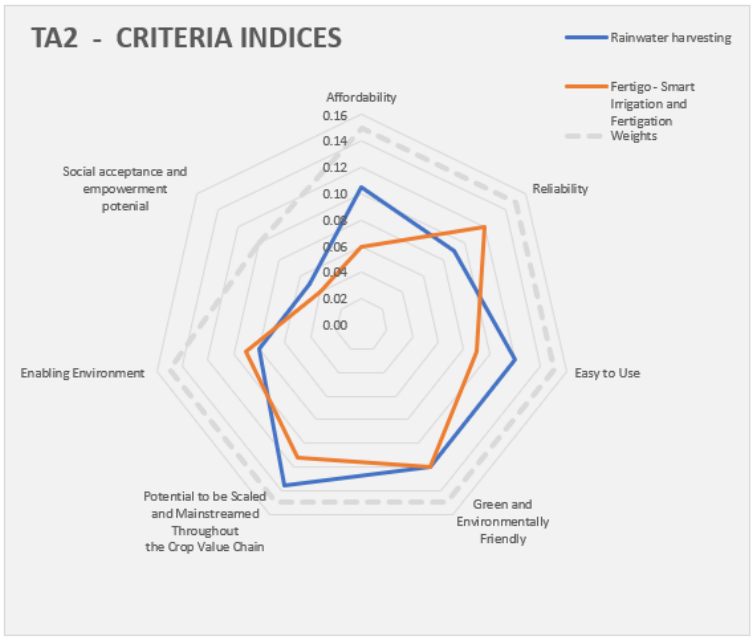
4.2 Jordan Country Profile

4.3 Technology profiles and assessment rankings

Jordan

Tematic Area		Technology Name	Level 2 Assessment							
			Final Score	Affordability	Reliability	Easy to Use	Green and Environmentally Friendly	Potential to be Scaled and Mainstreamed Throughout the Crop Value Chain	Enabling Environment	Social acceptance and empowerment potenial
TA2	Water management and water saving technologies	Rainwater harvesting	0.70	0.11	0.09	0.12	0.12	0.14	0.08	0.05
		Fertigo - Smart Irrigation and Fertigation	0.63	0.06	0.12	0.09	0.12	0.11	0.09	0.04
			Weights	15%	15%	15%	15%	15%	15%	10%





Jordan

TA1: Post-harvest techniques to reduce food loss and waste

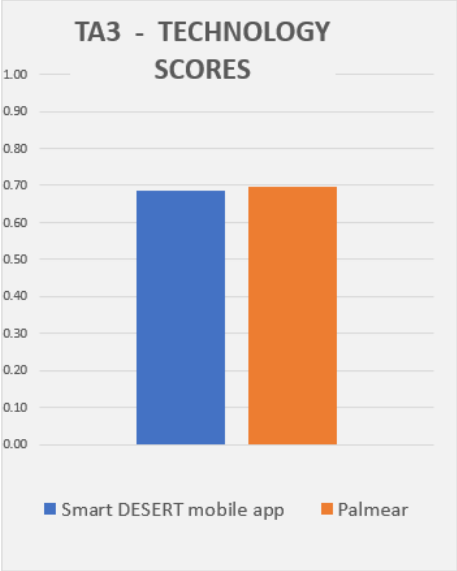
Technology one	
Name	Organic fertilizers
Type	Traditional
Description	A byproduct of composting that is cheaper than chemical fertilizers.
Innovation	Utilizes waste material to create organic fertilizer.
Benefits for smallholder farmers	Cheaper than chemical fertilizers and have fewer harmful environmental side effects. Producing compost and organic fertilizer can also diversify farmer income.
Acquisition cost	None (if producing via composting or replacing chemical fertilizers).
Maturity	Mature (7+ years)
Additional information	Phone: (+962) 65 350670; Fax: (+962) 65 350675 Email: middleeast.office@greenhasgroup.com

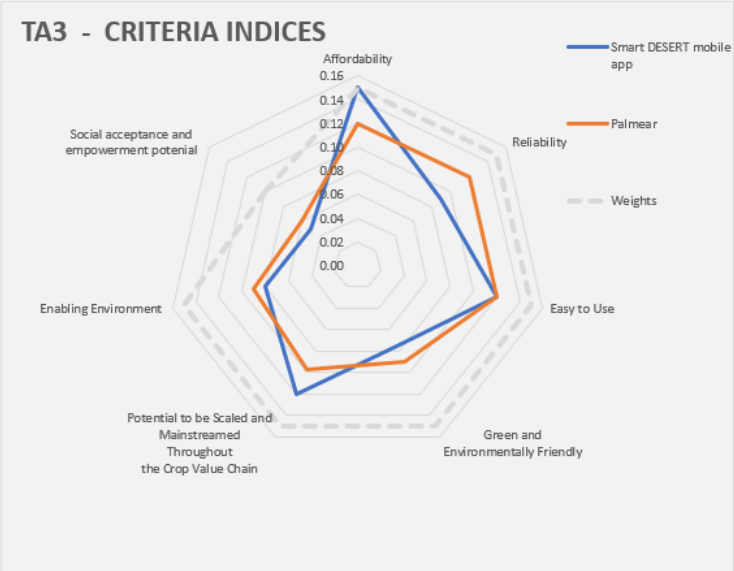
Technology two	
Name	Fabricated solar dryer for tomato slices
Type	Traditional
Description	Solar dryers can dry produce to be sold later if storage or sales options are not available.
Innovation	Preserves produce without the need for electricity.
Benefits for smallholder farmers	Keeps produce from spoiling and adds additional income due to less produce lost.
Acquisition cost	Low operational costs.
Maturity	Mature (7+ years)
Additional information	Study of fabricated solar dryer of tomato slices under Jordan climate condition by Abdullah Nasrallah Olimat Email: olimat2012@gmail.com

Jordan

TA2: Water management and water-saving technologies

Tematic Area		Technology Name	Level 2 Assessment							
			Final Score	Affordability	Reliability	Easy to Use	Green and Environmentally Friendly	Potential to be Scaled and Mainstreamed Throughout the Crop Value Chain	Enabling Environment	Social acceptance and empowerment potenial
TA3	Sustainable pest control and crop management	Smart DESERT mobile app	0.69	0.15	0.09	0.12	0.08	0.12	0.08	0.05
		Palmear	0.70	0.12	0.12	0.12	0.09	0.10	0.09	0.06
			Weights	15%	15%	15%	15%	15%	15%	10%





Jordan

TA2: Water management and water-saving technologies

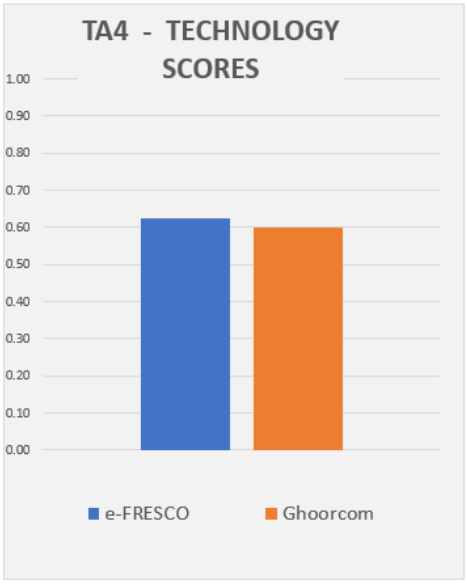
Technology one	
Name	Rainwater harvesting
Type	Traditional
Description	Water harvesting stores seasonal rainfall to use for crops throughout the year.
Innovation	Captures rainfall to prevent flooding and utilize water during dry seasons.
Benefits for smallholder farmers	Helps to spread water supplies more evenly throughout the year. Water harvesting also reduces surface runoff and water loss, which decreases erosion and protects downstream villages from floods. Harvested rainwater requires less energy than water pumping.
Acquisition cost	None
Maturity	Mature (7+ Years)
Additional information	Email: RNE-WEPS-NENA@fao.org Water harvesting for Al-Mashare' Jordan by FAO

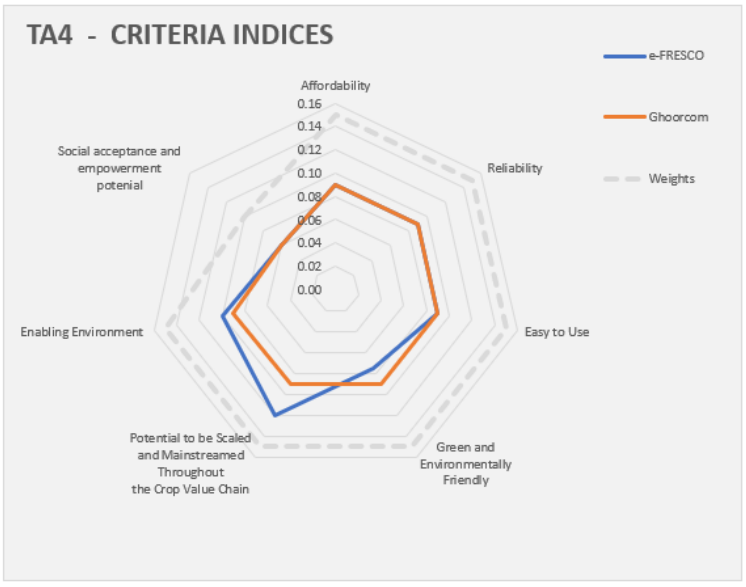
Technology two	
Name	Fertigo by Smart Green
Type	Digital
Description	An AI/IoT technology to optimize water and fertilizer usage remotely.
Innovation	It is automatable and integratable into existing irrigation systems. The Fertigo system has a built-in water-saving feature that adjusts the runtime according to local weather and site conditions to optimize water. It fertilizes and irrigates at the same time, which helps save water. It offers Arabic language services.
Benefits for smallholder farmers	Saves water and efficiently distributes fertilizer. It can be automated and monitors current conditions, which improves yield and reduces labour.
Acquisition cost	High cost for services
Maturity	Nascent (1–3 years)
Additional information	Phone: (+962) 78 7640761 Email: info@sg-agritech.com

Jordan

TA3: Sustainable pest control and crop management

Tematic Area	Technology Name	Level 2 Assessment							
		Final Score	Affordability	Reliability	Easy to Use	Green and Environmentally Friendly	Potential to be Scaled and Mainstreamed Throughout the Crop Value Chain	Enabling Environment	Social acceptance and empowerment potenial
TA4 E- commerce and market acceess	e-FRESCO	0.63	0.09	0.09	0.09	0.08	0.12	0.10	0.06
	Ghoorcom	0.60	0.09	0.09	0.09	0.09	0.09	0.09	0.06
		Weights	15%	15%	15%	15%	15%	15%	10%





Jordan

TA3: Sustainable pest control and crop management

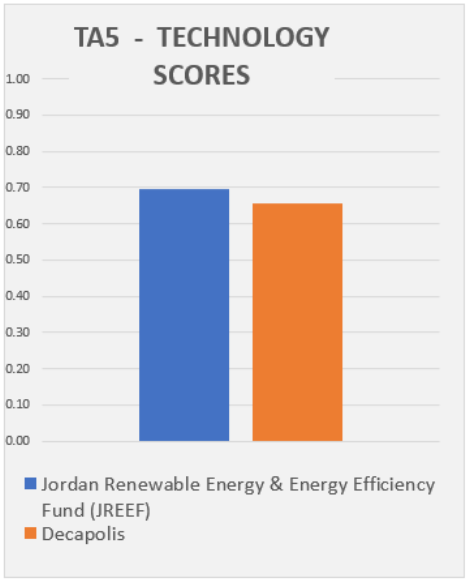
Technology one	
Name	Palmear®
Type	Digital
Description	An AI that listens for weevils in date trees.
Innovation	Early signs of infestation are not visible, but acoustic analysis can detect weevils. The technology uses a small microphone in the head of a needle. At less than two weeks old, the weevil makes detectable noises. Once weevils are detected, trees can be treated with insecticides (which ruins the harvest but saves the tree) or burned.
Benefits for smallholder farmers	Saving trees decreases the potential loss of harvest, keeps other trees healthy and prevents the emissions the dead tree would have released. Early detection decreases the amount of pesticides the farmers have to use, and addressing the infected trees stops further spread of the weevils.
Acquisition cost	Yes
Maturity	Intermediate (3–7 years)
Additional information	Email: info@palmear.ai

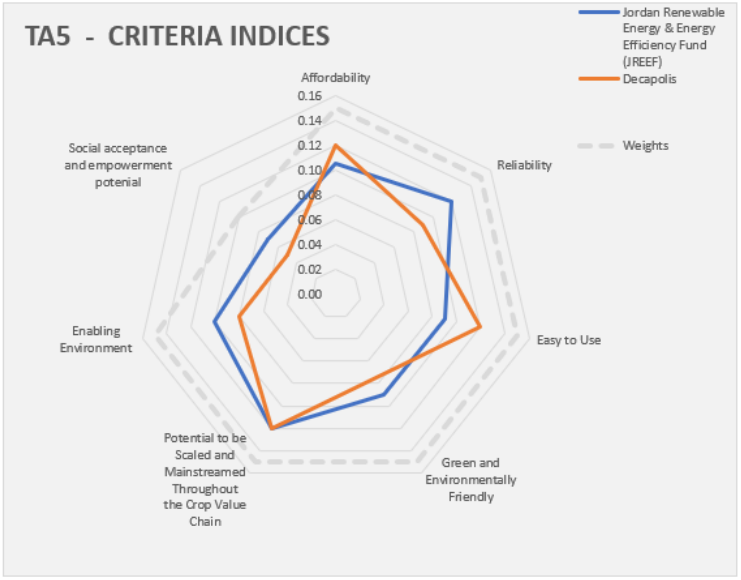
Technology two	
Name	Smart DESERT Mobile
Type	Digital
Description	An app that provides weather updates and disaster risk notices.
Innovation	Uses smart algorithms to predict potential natural disasters including floods, locusts and frost. The app is free, which allows farmers to access information and plan accordingly in a timely manner.
Benefits for smallholder farmers	Allows farmers to prepare for disasters, helping them reduce losses and increase yield stability.
Acquisition cost	None
Maturity	Nascent (1–3 years)
Additional information	Phone: (+962) 77 0410932 Email: info@smartdesertproject.com

Jordan

TA4: E-commerce and market access

Tematic Area	Technology Name	Level 2 Assessment							
		Final Score	Affordability	Reliability	Easy to Use	Green and Environmentally Friendly	Potential to be Scaled and Mainstreamed Throughout the Crop Value Chain	Enabling Environment	Social acceptance and empowerment potenial
TA5 Fintech	Jordan Renewable Energy & Energy Efficiency Fund (JREEF)	0.70	0.11	0.12	0.09	0.09	0.12	0.10	0.07
	Decapolis	0.66	0.12	0.09	0.12	0.08	0.12	0.08	0.05
		Weights	15%	15%	15%	15%	15%	15%	10%





Jordan

TA4: E-commerce and market access

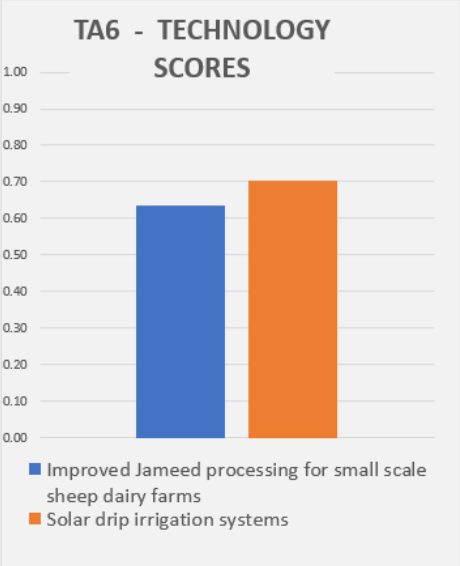
Technology one	
Name	e-FRESCO
Type	Digital
Description	A global virtual marketplace that supports B2B cross-border fresh produce trading. It facilitates marketing and business.
Innovation	It works via an online portal and has e-FRESCO dealers in each country so that small retailers can streamline their demand.
Benefits for smallholder farmers	Streamlines buying and selling for farmers through the rest of the supply chain.
Acquisition cost	None (Other than service fees)
Maturity	Nascent (1–3 years)
Additional information	Phone: (+962) 62 006927 Email: info@e-fresco.io

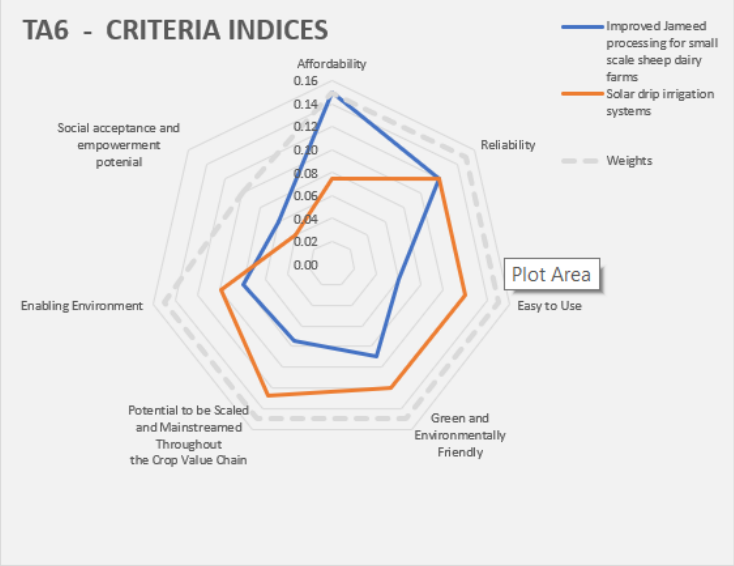
Technology two	
Name	Ghoorcom
Type	Digital
Description	An online marketplace that allows farmers to directly connect with and sell to buyers.
Innovation	Features a blockchain system that verifies the quality by adding a code to every box of produce. The system also offers various electronic payment methods and delivery services.
Benefits for smallholder farmers	Allows farmers to find more consistent buyers, and reduces high interest rate loans from middlemen and late payments.
Acquisition cost	Service fees.
Maturity	Intermediate (3–7 years)
Additional information	Address: King Hussein Business Park, Amman, Jordan Phone: (+962) 79 1239995

Jordan

TA5: Fintech

Tematic Area		Technology Name	Level 2 Assessment							
			Final Score	Affordability	Reliability	Easy to Use	Green and Environmentally Friendly	Potential to be Scaled and Mainstreamed Throughout the Crop Value Chain	Enabling Environment	Social acceptance and empowerment potenial
TA6	Green energy for farmers	Improved Jameed processing for small scale sheep dairy farms	0.64	0.15	0.12	0.06	0.09	0.08	0.08	0.06
		Solar drip irrigation systems	0.70	0.08	0.12	0.12	0.12	0.13	0.10	0.04
			Weights	15%	15%	15%	15%	15%	15%	10%





Jordan
TA5: Fintech

Technology one	
Name	Jordan Renewable Energy and Energy Efficiency Fund (JREEEF)
Type	Other (Finance)
Description	Offers funding of PV technology for farmers. Household end users are also encouraged to install small PV systems. The fund covers 30 percent of their costs, and provides subsidized loans to cover the remaining part in cooperation with local banks.
Innovation	Addresses the high start up costs of PV technologies that often prevent farmers from transitioning to green energy.
Benefits for smallholder farmers	Farmers can more easily afford PV technology and finish paying for it over time.
Acquisition cost	Interest and service fees.
Maturity	Mature (7+ Years)
Additional information	Dr Rasmi Hamzeh, CEO Address: Zaharan St., between 5th & 4th circle, Amman, Jordan Phone: (+962) 65 930026 Email: jreeef@memr.gov.org

Technology two	
Name	Decapolis
Type	Digital
Solution description	A traceability platform and app that uses blockchain to inform farmers about food safety standards and allow them to prove that they comply.
Innovations	Blockchain and digital technology spreads information efficiently and records quality standards.
Benefits for smallholder farmers	Allows smallholder farmers to validate their products' compliance with quality control standards, empowering them to access export markets, generate better income, and ensure their products are within national and international standards.
Acquisition cost	Service fees
Maturity	Nascent (1–3 years)
Additional information	Abedalrahman Habashneh, CEO Email: global.innovation@wfp.org

Jordan

TA6: Green energy solutions for farmers

Jordan

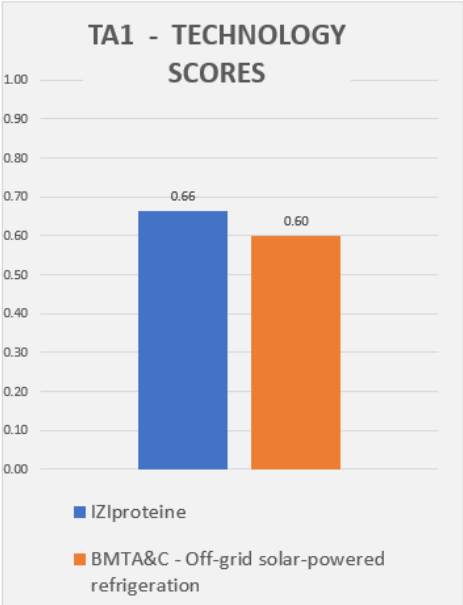
TA6: Green energy solutions for farmers

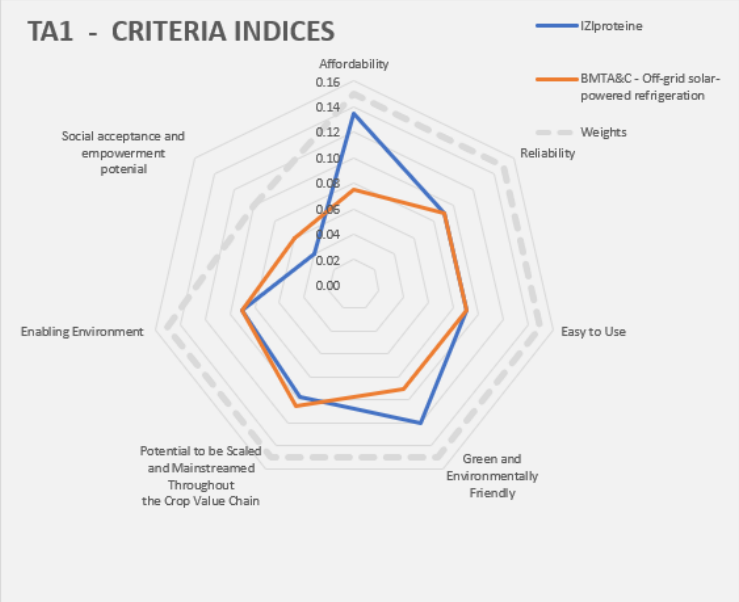
COUNTRY: MOROCCO			No. of technologies	24
Thematic area		**Technology name**	**LEVEL 1**	**LEVEL 2**
TA 1 Post harvest-reducing food loss and waste	1	IZIproteine	0.52	0.66
	2	BMTA&C - Off-grid solar-powered refrigeration	0.39	0.60
	3	Terraa	0.39	
	4	0	0.35	
TA 2 Water management and water saving technologies	1	Supplemental irrigation	0.52	0.66
	2	Jodoor - turnkey soiless greenhouses	0.45	0.62
	3	Alvatech	0.43	
	4	Green Watech	0.43	
TA 3 Sustainable pest control and crop management	1	Conservation Agriculture	0.48	0.65
	2	AbuErdan - Access to tech for poultry farmers	0.45	0.61
	3	SowIt - Precision agriculture app/platform	0.45	
	4	0	0.35	
TA 4 E-commerce and martket access	1	Fellahi	0.45	0.62
	2	Hawli.Haouz - Sheep farmer e-commerce	0.45	0.61
	3	YoLa Fresh	0.41	
	4	Date Valorization	0.35	
TA 5 Fintech	1	Mobile money - Orange Money, Wana Money/Inwi Money, Met Cash	0.50	0.68
	2	Mourafaka- Agricultural cooperatives	0.48	0.64
	3	AlAmana - Microcredit program	0.41	
	4	0	0.35	
TA 6 Green energy for farmers	1	Solar Future S.A.R.L.	0.50	0.66
	2	Biodome Maroc - Removable and portable biodigester	0.45	0.61
	3	0	0.43	
	4	0	0.30	

Type	
Description	A milk fat separation technique that separates skimmed milk to be turned into Jameed without churning, reducing labour, time, energy and water consumption.
Innovation	Saves energy and water and produces a high-quality product.
Benefits for smallholder farmers	Jameed from this method has higher protein and a lighter color, and the ghee produced has a higher fat content, which are all desirable traits.
Acquisition cost	None
Maturity	Nascent (1–3 years)
Additional information	An improved method of making Jameed for small-scale dairy farms by Muhi El-Dine Hilali, Diversification & Sustainable Intensification of Production Systems, ICARDA Phone: (+962) 65 903120 Email: m.hilali@cgiar.org

5. Morocco

5.1 Introduction to the agriculture sector and its challenges





increased water efficiency, smallholder farms often suffer from water restrictions on collective irrigation schemes, which prevents them from sufficiently irrigating their farms. Furthermore, it is difficult for smallholder farmers to formally own their land, which prevents them from obtaining credit or permits (Dove, 2021). Technology that makes water more accessible or decreases water requirements could have significant impacts on smallholder farmers in drier areas, and blockchain or digital marketplace platforms that impact farmers' interactions with buyers and others in the value chain, which could streamline and formalize business dealings.

Recent policy in Morocco has prioritized local agricultural cooperatives and their rights, which has led to increased creation of new cooperatives (Pereira, L. D. & Santos, N., 2018). Morocco has also focused on water transfer from the north to the desert in the south to improve water shortages. Drip and modern irrigation systems are being supported through a national program, and the country has made efforts to adopt traditional techniques, such as conservation agriculture and more resilient crops (Dove, 2021). Introducing and supporting the adoption of green technologies would allow farmers, cooperatives and communities to manage their local resources more sustainably.

5.2 Morocco Country Profile

5.3 Technology profiles and assessment rankings

Morocco

TA1: Post-harvest techniques to reduce food loss and waste

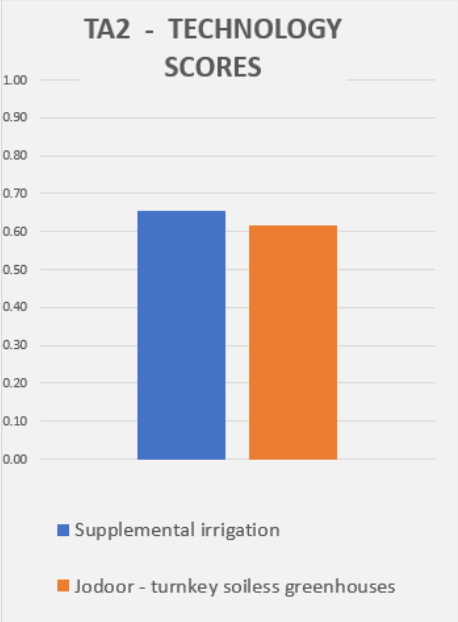
Morocco

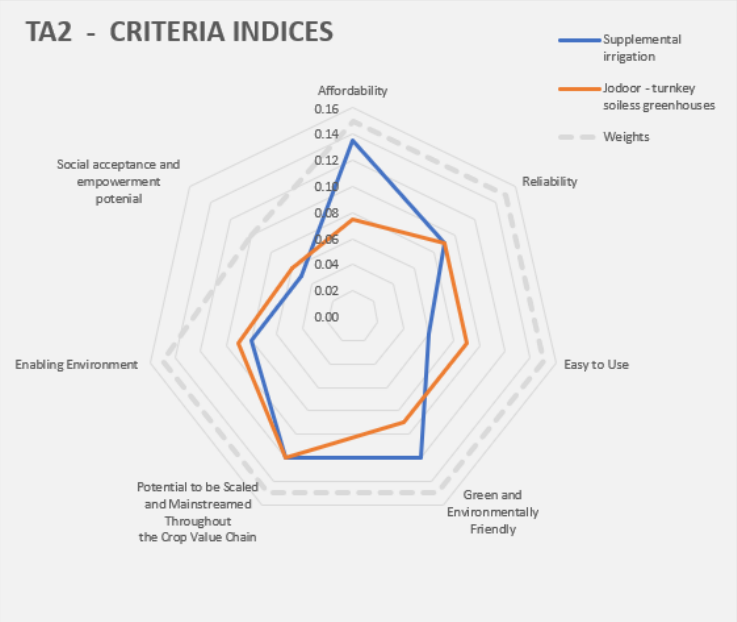
TA1: Post-harvest techniques to reduce food loss and waste

		Level 2 Assessment							
Tematic Area	Technology Name	Final Score	Affordability	Reliability	Easy to Use	Green and Environmentally Friendly	Potential to be Scaled and Mainstreamed Throughout the Crop Value Chain	Enabling Environment	Social acceptance and empowerment potenial
TA2 Water management and water saving technologies	Supplemental irrigation	0.66	0.14	0.09	0.06	0.12	0.12	0.08	0.05
	Jodoor - turnkey soiless greenhouses	0.62	0.08	0.09	0.09	0.09	0.12	0.09	0.06
		Weights	15%	15%	15%	15%	15%	15%	10%

Description

component for animal feed, and a sustainable organic fertilizer.





Innovation	Requires no electricity or water. It is affordable thanks to a pay-as-you-go business model that does not require internet access.
Benefits for smallholder farmers	Capable of extending the life of harvested crops from 2–20 days on average. One fridge can hold up to 5 tonnes of produce.
Acquisition cost	Cost per hour (unknown; technology still in prototype phase).
Maturity	Nascent (1–3 years)
Additional information	Address: Mohammed VI Polytechnic University Lot 660, Hay Moulay Rachid Ben Guerir, Morocco Email: contact@bmtac.com

Morocco

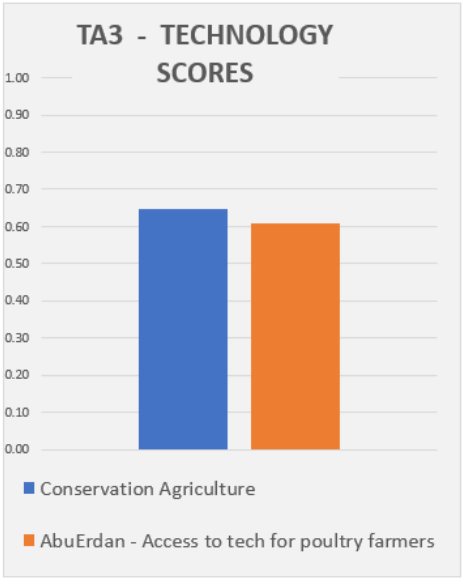
TA2: Water management and water-saving technologies

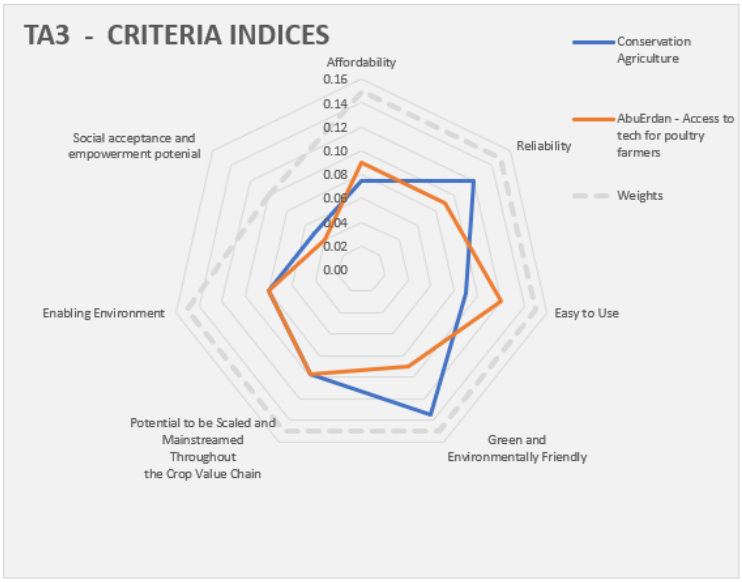
Morocco

TA2: Water management and water-saving technologies

Tematic Area	Technology Name	Level 2 Assessment							
		Final Score	Affordability	Reliability	Easy to Use	Green and Environmentally Friendly	Potential to be Scaled and Mainstreamed Throughout the Crop Value Chain	Enabling Environment	Social acceptance and empowerment potenial
TA3 Sustainable pest control and crop management	Conservation Agriculture	0.65	0.08	0.12	0.09	0.14	0.10	0.08	0.05
	AbuErdan - Access to tech for poultry farmers	0.61	0.09	0.09	0.12	0.09	0.10	0.08	0.04
	Weights		15%	15%	15%	15%	15%	15%	10%

Description	If the year or season in semi-arid and arid regions is not providing sufficient moisture





Type	Innovation
Description	Delivers ready-to-use soilless greenhouses.
Innovation	The greenhouses can produce +100 varieties of pesticide-free leafy vegetables year-round, while saving 80 percent water and fertilizer.
Benefits for smallholder farmers	Creates an outlet for sustainable income while reducing the impacts of climate change and the drudgery of work, allowing more women to play an active role in the agricultural sector
Acquisition cost	High cost of installation, moderate costs for maintenance.
Maturity	Mature (7+ years)
Additional information	Phone: (+212) 66 4460393

Morocco

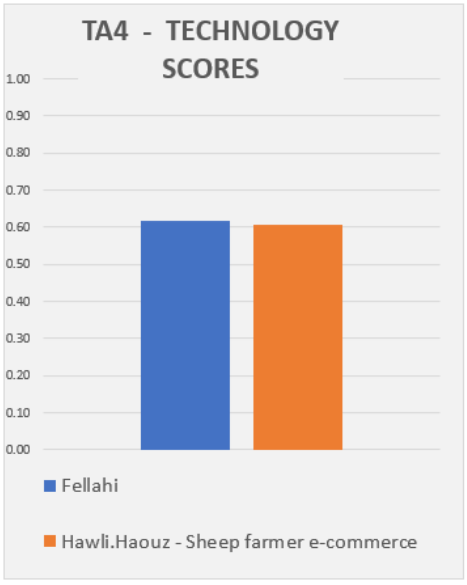
TA3: Sustainable pest control and crop management

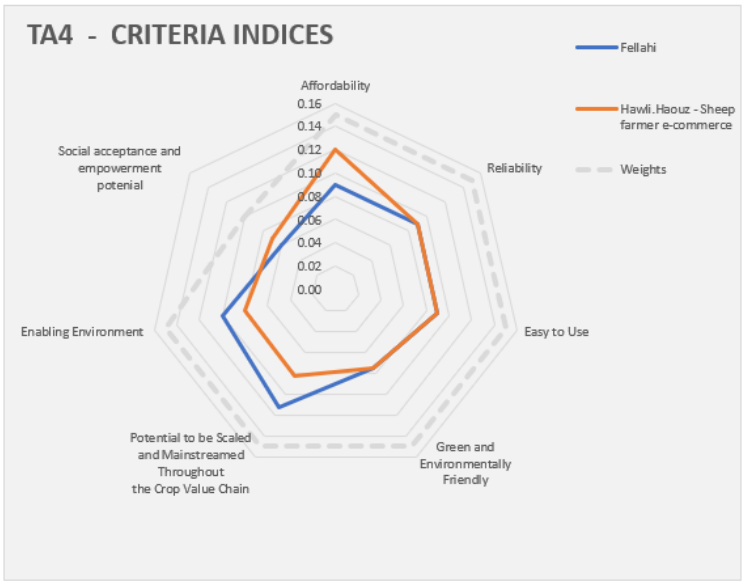
Morocco

TA3: Sustainable pest control and crop management

Tematic Area	Technology Name	Level 2 Assessment							
		Final Score	Affordability	Reliability	Easy to Use	Green and Environmentally Friendly	Potential to be Scaled and Mainstreamed Throughout the Crop Value Chain	Enabling Environment	Social acceptance and empowerment potenial
TA4 E- commerce and market acceess	Fellahi	0.62	0.09	0.09	0.09	0.08	0.11	0.10	0.06
	Hawli.Haouz - Sheep farmer e-commerce	0.61	0.12	0.09	0.09	0.08	0.08	0.08	0.07
	Weights	15%	15%	15%	15%	15%	15%	15%	10%

Description moisture and crop diversification to replace monocropping.





Type	Digital
Description	Uses tech and data to offer analytics to poultry farmers.
Innovation	Leverages new technologies like artificial intelligence, machine learning and predictive analytics to offer poultry producers ways to take corrective actions on time. Their services include an IoT and Cloud enabled app that can be easily set up.
Benefits for smallholder farmers	Data analysis leads to more efficient practices at all stages of poultry farming. This technology could be implemented at smaller scales to target smallholder farmers.
Acquisition cost	High cost for services.
Maturity	Mature (7+ Years)
Additional information	Address: 2 Bahgat Aly St., Zamalek, Cairo, Egypt Email: info@abuerdan.com Watch introductory video

Morocco

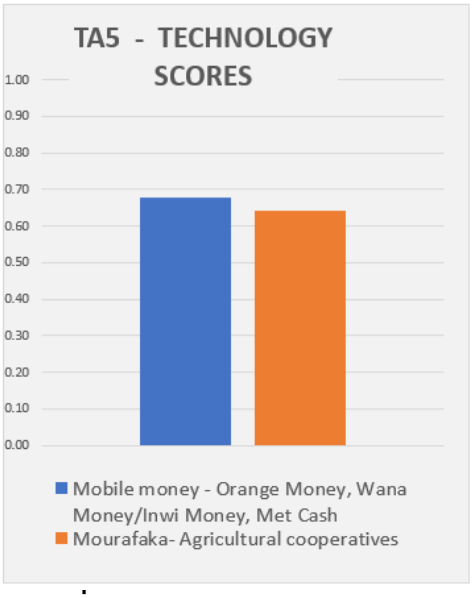
TA4: E-commerce and market access

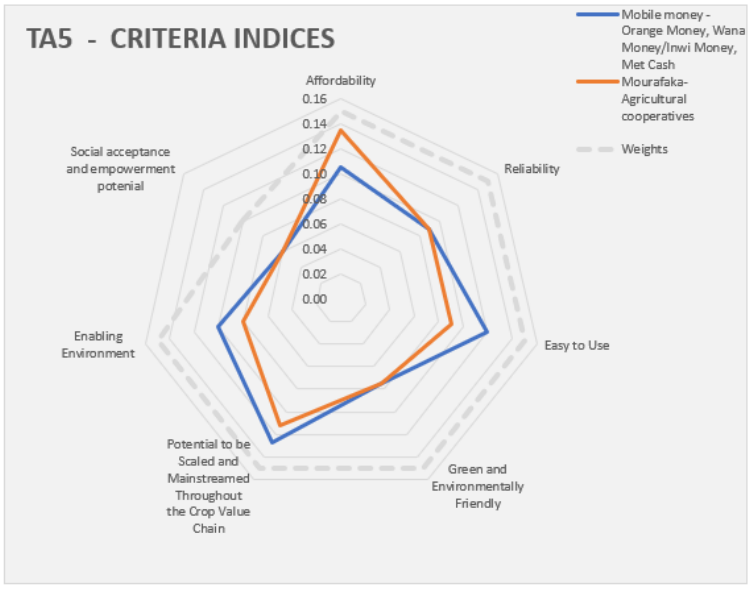
Morocco

TA4: E-commerce and market access

Tematic Area	Technology Name	Level 2 Assessment							
		Final Score	Affordability	Reliability	Easy to Use	Green and Environmentally Friendly	Potential to be Scaled and Mainstreamed Throughout the Crop Value Chain	Enabling Environment	Social acceptance and empowerment potenial
TA5 Fintech	Mobile money - Orange Money, Wana Money/Inwi Money, Met Cash	0.68	0.11	0.09	0.12	0.08	0.13	0.10	0.06
	Mourafaka- Agricultural cooperatives	0.64	0.14	0.09	0.09	0.08	0.11	0.08	0.06
		Weights	15%	15%	15%	15%	15%	15%	10%

Description	households and businesses. It offers a short, sustainable and efficient circuit that brings fresh products of high nutritional quality to customers.





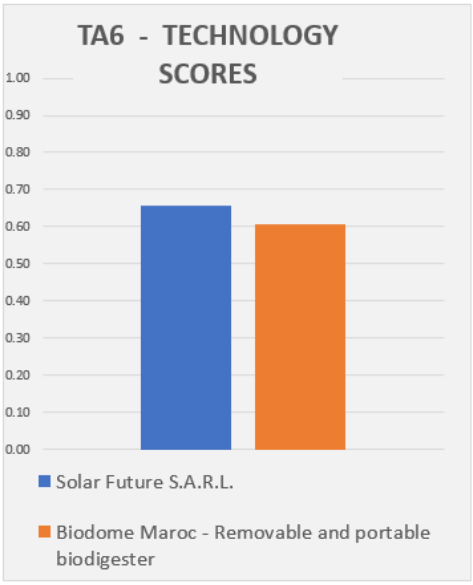
Innovation	Developed to help sheep farmers access the market better. It is especially useful for isolated small-scale sheep farmers.
Benefits for smallholder farmers	Useful for streamlining sales, especially during Eid al-Adha.
Acquisition cost	None
Maturity	Mature (7+ years)
Additional information	Project contact: Naoufel Telahigue Email: n.telahigue@ifad.org

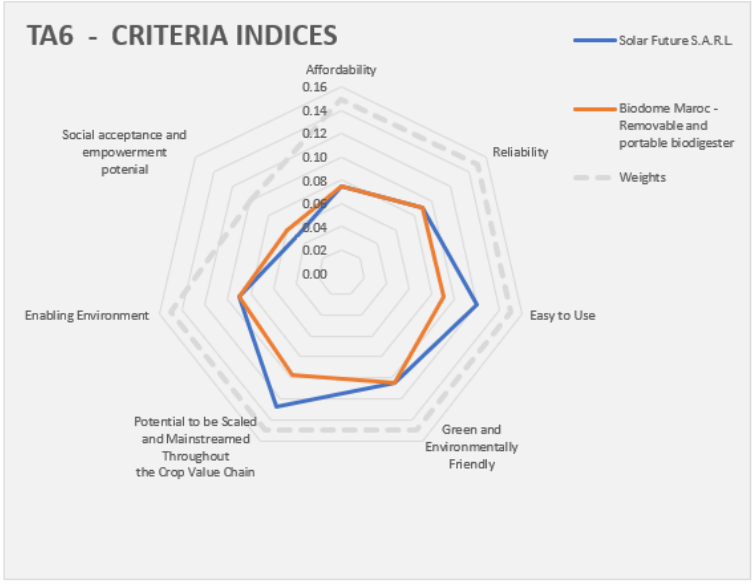
6 Since the data collection phase, Fellahi is no longer active.

Morocco
TA5: Fintech

Morocco
TA5: Fintech

Tematic Area	Technology Name	Level 2 Assessment							
		Final Score	Affordability	Reliability	Easy to Use	Green and Environmentally Friendly	Potential to be Scaled and Mainstreamed Throughout the Crop Value Chain	Enabling Environment	Social acceptance and empowerment potenial
TA6 Green energy for farmers	Solar Future S.A.R.L.	0.66	0.08	0.09	0.12	0.11	0.13	0.09	0.05
	Biodome Maroc - Removable and portable biodigester	0.61	0.08	0.09	0.09	0.11	0.10	0.09	0.06
		Weights	15%	15%	15%	15%	15%	15%	10%





Description	of mobile money options exist in Morocco, which are tied to local phone companies
Description	It focuses on strategic identification of cooperatives' needs, collective training of managers and individual coaching depending on needs.
Innovation	Cooperatives can train members and take advantage of group-oriented opportunities.
Benefits for smallholder farmers	Cooperatives can communicate community needs, access opportunities and share resources.
Acquisition cost	None
Maturity	Mature (7+ years)
Additional information	Address: 13, Dayet Aoua St., Agdal, Rabat, Morocco Phone : (+212) 05 37771033; Fax: (+212) 05 37771005 Agricultural cooperatives' sustainability and the relevance of start-up support programs: Evidence from cooperatives' level in Morocco by Aomar Ibourk and Karim El Aynaoui

Morocco

TA6: Green energy solutions for farmers

Morocco

TA6: Green energy solutions for farmers

Technology one	
Name	Solar Future
Type	Innovation
Description	Remotely monitored off-grid PV systems to power drip irrigation.
Innovation	Solar power for drip irrigation and irrigation pumps save money and energy. Drip irrigation saves water compared to conventional irrigation.
Benefits for smallholder farmers	Resource-efficient water management and avoidance of diesel and butane generators results in savings in fuel expenses for farmers, securing of agricultural yields and strengthening climate change adaptability.
Acquisition cost	High cost, but spread over a 6-year loan.
Maturity	Mature (7+ years)
Additional information	Mohamed El Maghraby, Project Developer Renewable Energy Engineering Phone: (+49) 03 01208480 – 70 Email: maghraby@atmosfair.de

Technology two	
Name	Biodome Maroc
Type	Innovation
Description	Biodome's biodigester helps customers dispose of organic waste and produce energy and biofertilizer at home. Biodome offers different types and sizes for different home and professional settings. They are developing a removable and portable biodigester.
Innovation	Biodigesters help dispose of organic waste and produce energy and biofertilizer at small-scale settings.
Benefits for smallholder farmers	This technology provides fuel and fertilizer for farmers, while utilizing waste that would otherwise not be used. This saves costs.
Acquisition cost	Most existing biodigesters units cost USD 800–1 500. The removable and portable biodigester is not fully developed or priced.
Maturity	Nascent (1–3 years)
Additional information	Contact: Fatima Zahra Beraich Phone: (+212) 60 0424642 Email: contact@biodomemaroc.com

6. Nigeria

COUNTRY: **NIGERIA**

No. of Technologies 44

Thematic area		Technology name	LEVEL 1 assessment score	LEVEL 2 assessment score
TA 1 Post harvest-reducing food loss and waste	1	ColdHubs - large solar-powered cold storage	61.00	88.75
	2	Inert Atmosphere Silo (IAS) (various sizes) from NSPRI(recycled and new)	60.00	84.00
	3	AgroHive: digital talent request platform supply of skilled agricultural staff.	50.00	
	4	Parabolic shaped solar dryer (PSSD) from NSPRI	50.00	
TA 2 Water management and water saving technologies	1	Modern pressurized water conveyance distribution system for wheat	58.00	80.00
	2	RMR226 wheat variety	58.00	79.75
	3	Durum Kabore 3 wheat variety	53.00	
	4	Micro-hydropower: smart hydro power turbines (monofloat & free stream)	51.00	
TA 3 Sustainable pest control and crop management	1	Farmspeak Technology: IoT-powered by intelligence (AI) to diagnose poultry diseases	65.00	82.50
	2	Rural Farmers Hub: e-extension services for agronomic recommendations	62.00	81.25
	3	Hello Tractor - Digital platform for tractor rental services	58.00	
	4	Field supervision by drones Beatdrone	45.00	
TA 4 E-commerce and martket access	1	TradeBuza: data-driven digital agriculture platform that empowers smallholder	61.00	79.75
	2	Value chain integration with FarmCorps	55.00	77.25
	3	Farmz2U: A comprehensive agricultural solutions platform for smallholder farmers	55.00	
	4	Alluvial Community Block Farming	43.00	
TA 5 Fintech	1	AFEX's e-commerce platform connects farmers directly to buyers, bypassing middlemen.	60.00	81.00
	2	ThriveAgric: fintech solution providing access to loans, data-driven insights and market access.	65.00	80.25
	3	Tingo Agri-Fintech	58.00	
	4	HerVest: digital peer-to-peer capital reallocation	52.00	
TA 6 Green energy for farmers	1	Sun King: off-grid energy solutions	62.00	94.50
	2	D-Olivette: bio-tank converting human, animal, and farm waste into biogas, clean water, and orga	64.00	84.25
	3	Solaristique: Solar-powered recycled (and tricycled) fridges and freezers for smallholder farmers	60.00	
	4	Evaporative Cooling System (ECS) from NSPRI	56.00	

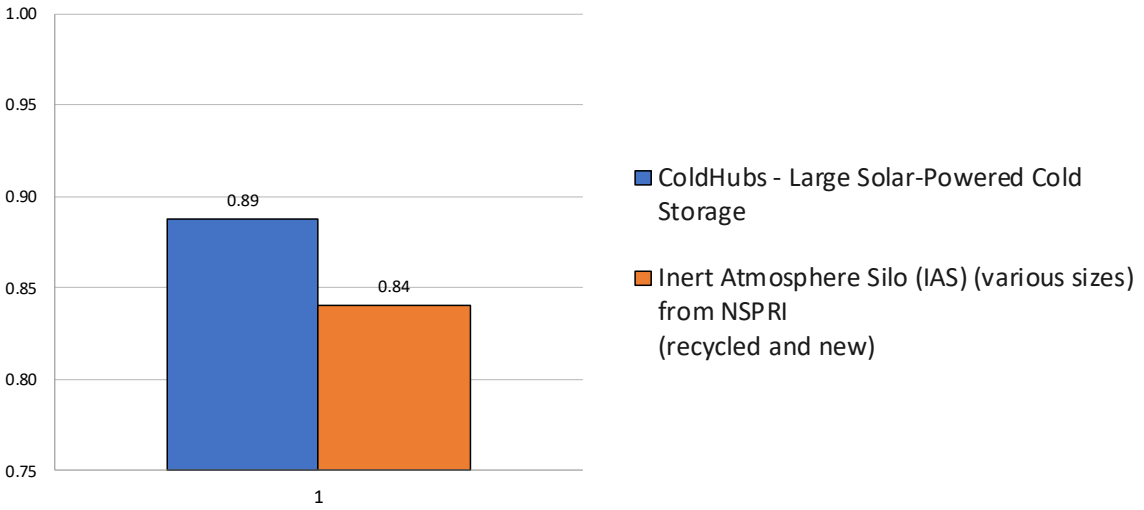
For smallholder farmers, who constitute a significant portion of Nigeria's agricultural workforce, multiple challenges persist. Limited resources, including small landholdings and a lack of access to modern farming equipment, impede their ability to compete effectively in the market. Financial constraints further restrict their opportunities, as accessing loans and credit facilities remains challenging. Additionally, a knowledge gap regarding modern farming techniques and best practices, coupled with difficulties in accessing markets at fair prices and managing pests and diseases, compounds the challenges faced by smallholder farmers.

However, amid these challenges, several opportunities exist for smallholder farmers to improve their livelihoods and enhance their productivity. Increasing availability of agricultural training programs offers valuable insights into modern farming techniques, while emerging microfinance and credit schemes provide much-needed financial support. Cooperative movements present avenues for better market access and resource pooling, while the adoption of digital technology facilitates access to market information and agricultural advice. Moreover, opportunities for value chain integration enable smallholder farmers to engage in value-added activities such as processing and packaging, thereby enhancing their profitability and resilience in the face of adversity.

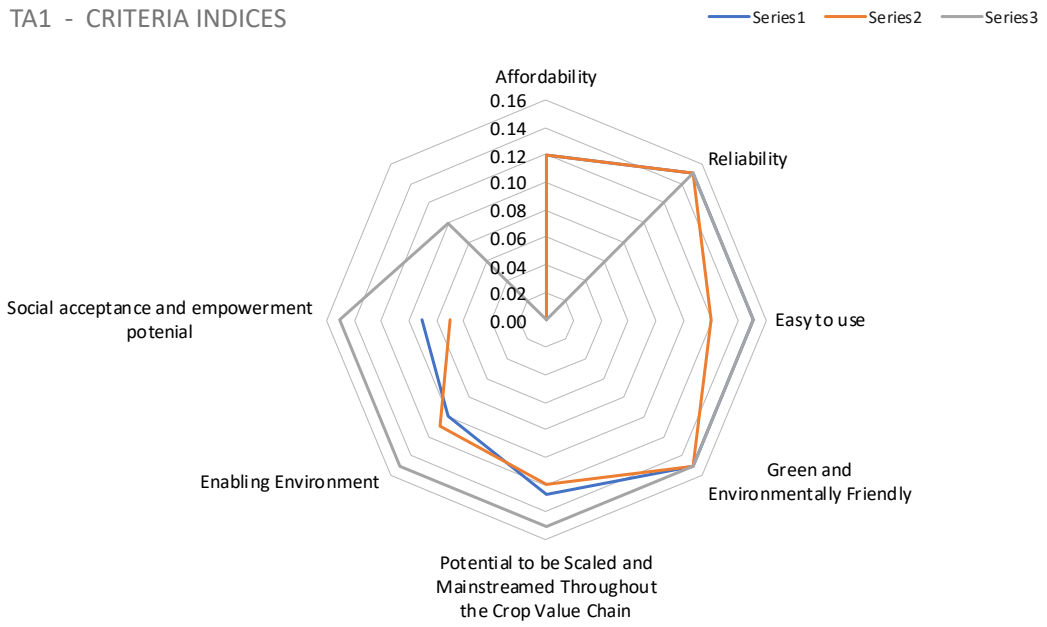
6.2 Nigeria Country Profile

Tematic Area		Technology Name	Level 2 Assessment							
			Final Score	Affordability	Reliability	Easy to use	Green and Environmentally Friendly	Potential to be Scaled and Mainstreamed Throughout the Crop Value Chain	Enabling Environment	Social acceptance and empowerment potenial
TA1	Post harvest-reducing Food Loss and Waste	ColdHubs - Large Solar-Powered Cold Storage	0.89	0.12	0.15	0.15	0.15	0.13	0.10	0.09
		Inert Atmosphere Silo (IAS) (various sizes) from NSPRI (recycled and new)	0.84	0.12	0.15	0.12	0.15	0.12	0.11	0.07
			Weights	15%	15%	15%	15%	15%	15%	10%

TA1 - TECHNOLOGY SCORES



TA1 - CRITERIA INDICES



6.3 Technology company profiles and assessment rankings

Nigeria

TA1: Post-harvest techniques to reduce food loss and waste

Nigeria

TA1: Post-harvest techniques to reduce food loss and waste

Tematic Area		Technology Name	Level 2 Assessment							
			Final Score	Affordability	Reliability	Easy to use	Green and Environmentally Friendly	Potential to be Scaled and Mainstreamed Throughout the Crop Value Chain	Enabling Environment	Social acceptance and empowerment potenial
TA2	Water management and water saving technologies	RMR226 wheat variety	0.80	0.14	0.15	0.09	0.11	0.13	0.11	0.08
		Modern Pressurized Water Conveyance Distribution System for WHEAT	0.80	0.12	0.15	0.12	0.14	0.11	0.10	0.07
		Weights		15%	15%	15%	15%	15%	15%	10%

Description preservation of perishable foods, extending their freshness from 2 days to about 21 days.

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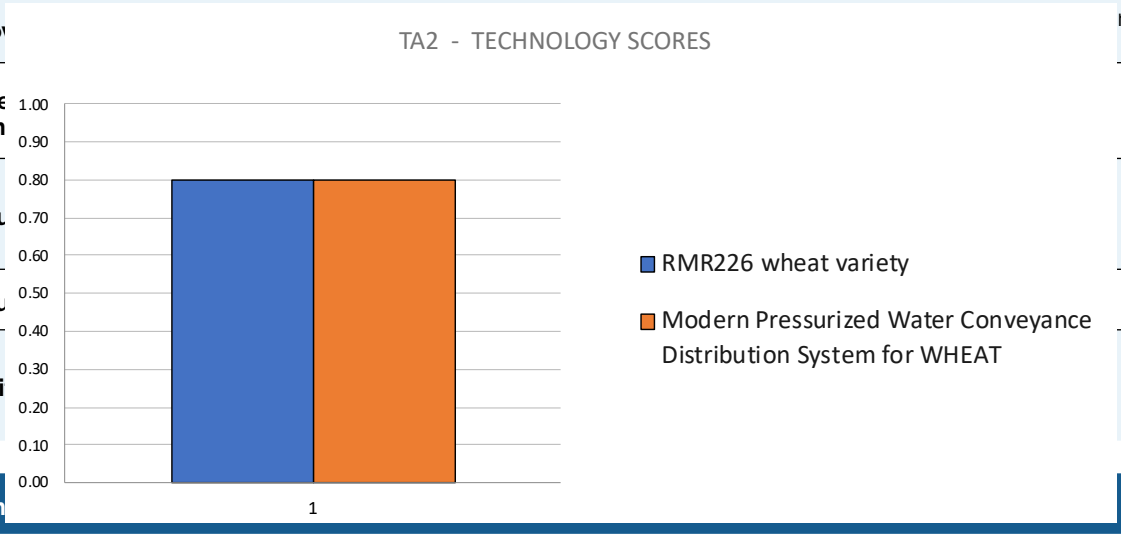

Tech

Name Inert Atmosphere Silo (IAS)

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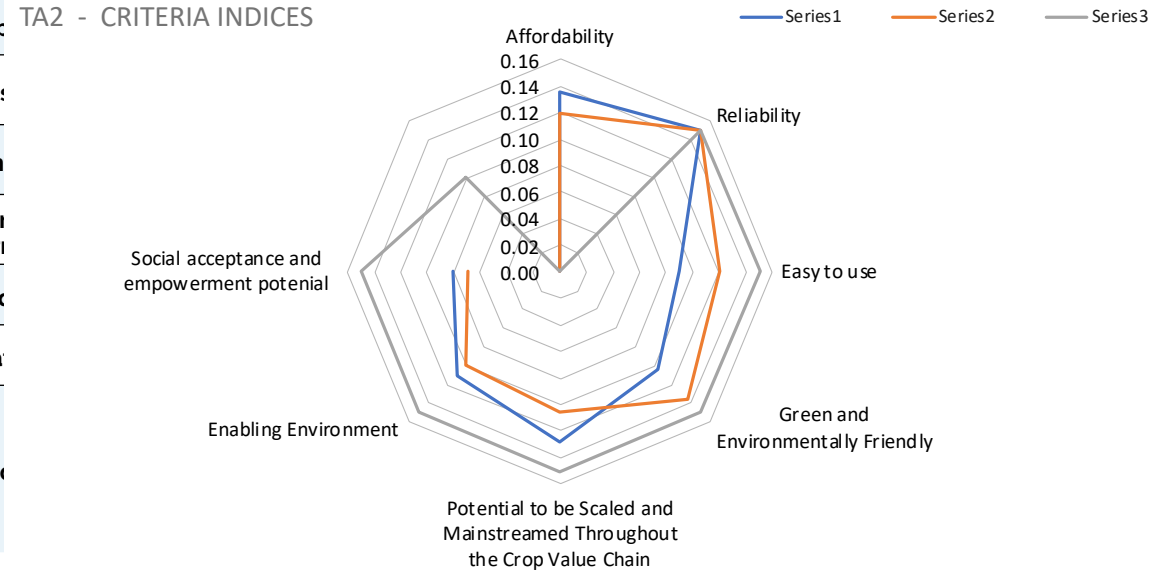

Nigeria

TA2: Water management and water-saving technologies

Nigeria

TA2: Water management and water-saving technologies

Technology one

Tematic Area		Technology Name	Level 2 Assessment							
			Final Score	Affordability	Reliability	Easy to use	Green and Environmentally Friendly	Potential to be Scaled and Mainstreamed Throughout the Crop Value Chain	Enabling Environment	Social acceptance and empowerment potenial
TA3	Sustainable pest control and crop management	Farmspeak Technology: IoT-powered by intelligence (AI) to diagnose poultry diseases	0.83	0.12	0.12	0.15	0.15	0.11	0.11	0.07
		Rural Farmers Hub: e-extension services for agronomic recommendations	0.81	0.14	0.12	0.12	0.12	0.13	0.12	0.07
			Weights	15%	15%	15%	15%	15%	15%	10%

Innovation	Incorporates water conveyance in tubes and drip irrigation, reducing water loss through evaporation and seepage, delivering water directly to plant roots.
Ben farm	ing
Acc	
Mat	
Add	es ic
Tec	
Nam	
Type	Innovation
Desc	ith e
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Bene farm	
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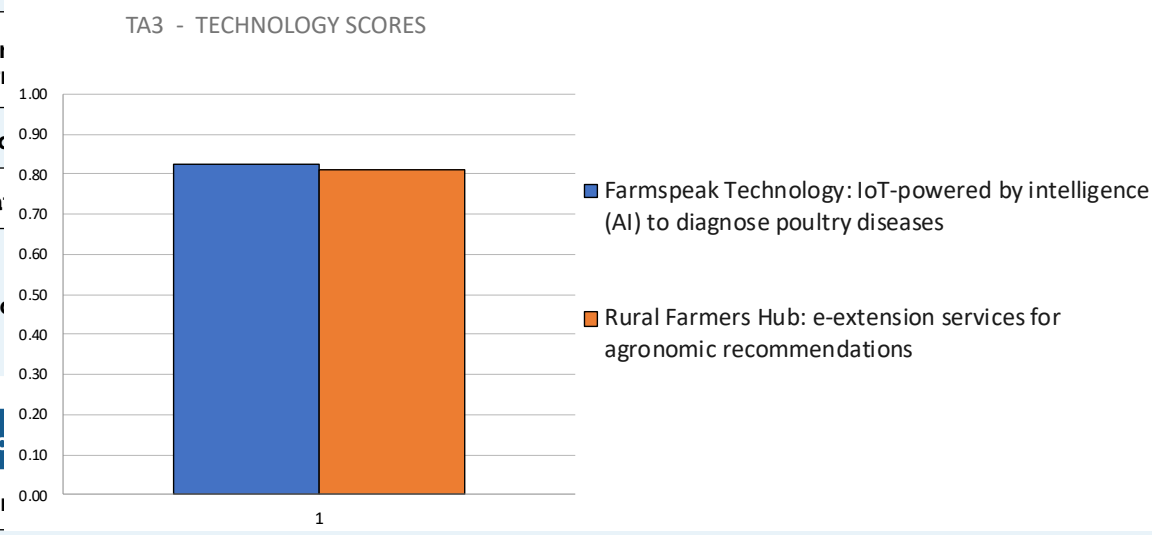
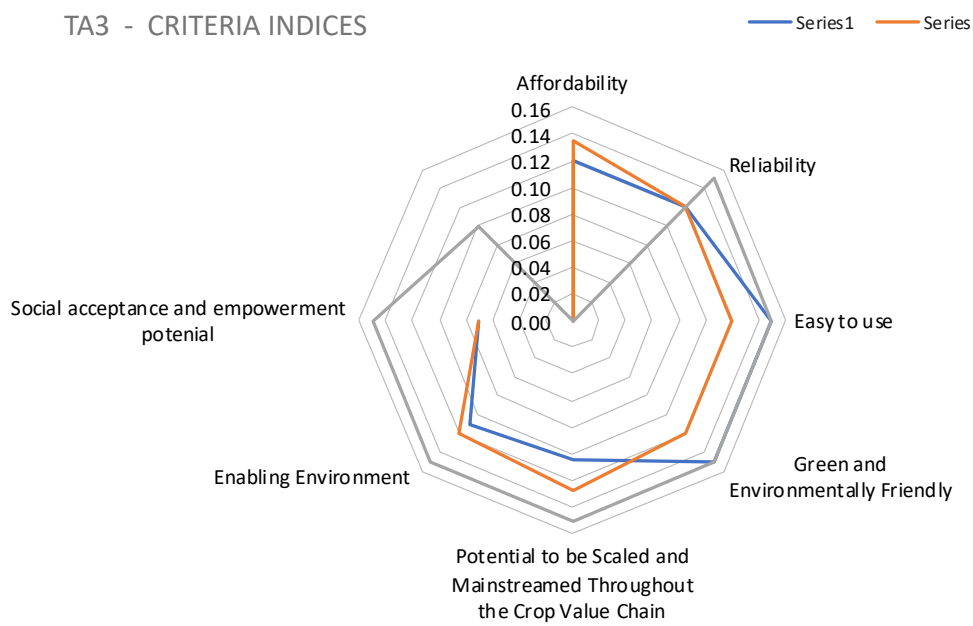




Nigeria

TA3: Sustainable pest control and crop management

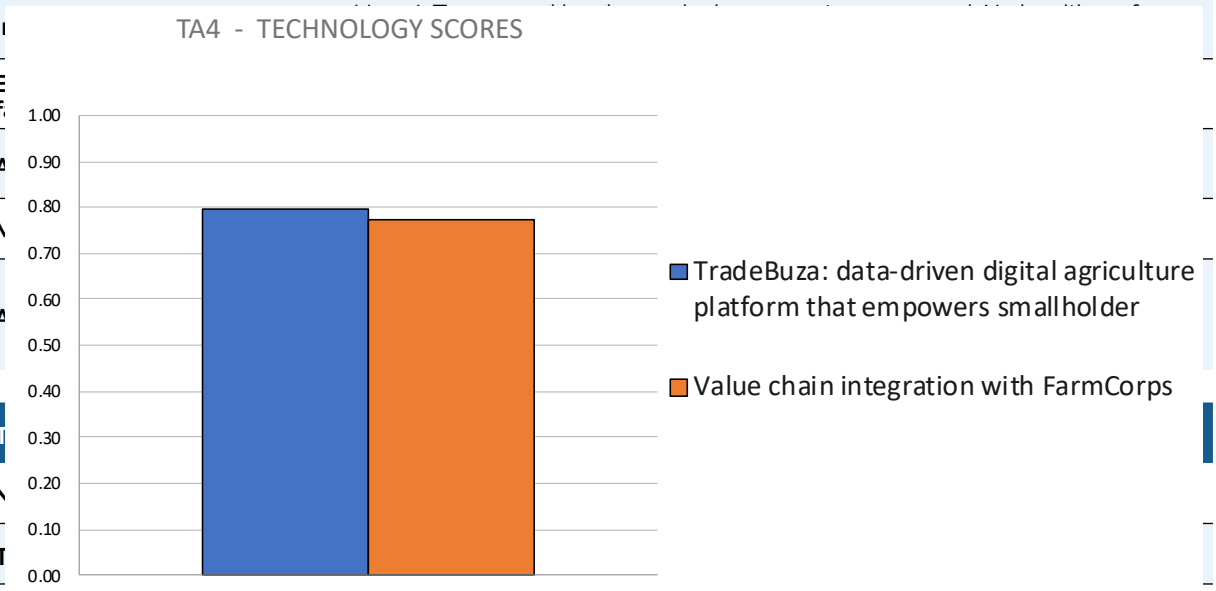
Nigeria

TA3: Sustainable pest control and crop management

Tematic Area		Technology Name	Level 2 Assessment							
			Final Score	Affordability	Reliability	Easy to use	Green and Environmentally Friendly	Potential to be Scaled and Mainstreamed Throughout the Crop Value Chain	Enabling Environment	Social acceptance and empowerment potenial
TA4	E- commerce and market acceess	TradeBuza: data-driven digital agriculture platform that empowers smallholder	0.80	0.14	0.12	0.12	0.12	0.11	0.11	0.08
		Value chain integration with FarmCorps	0.77	0.12	0.15	0.09	0.12	0.11	0.11	0.07
		Weights		15%	15%	15%	15%	15%	15%	10%

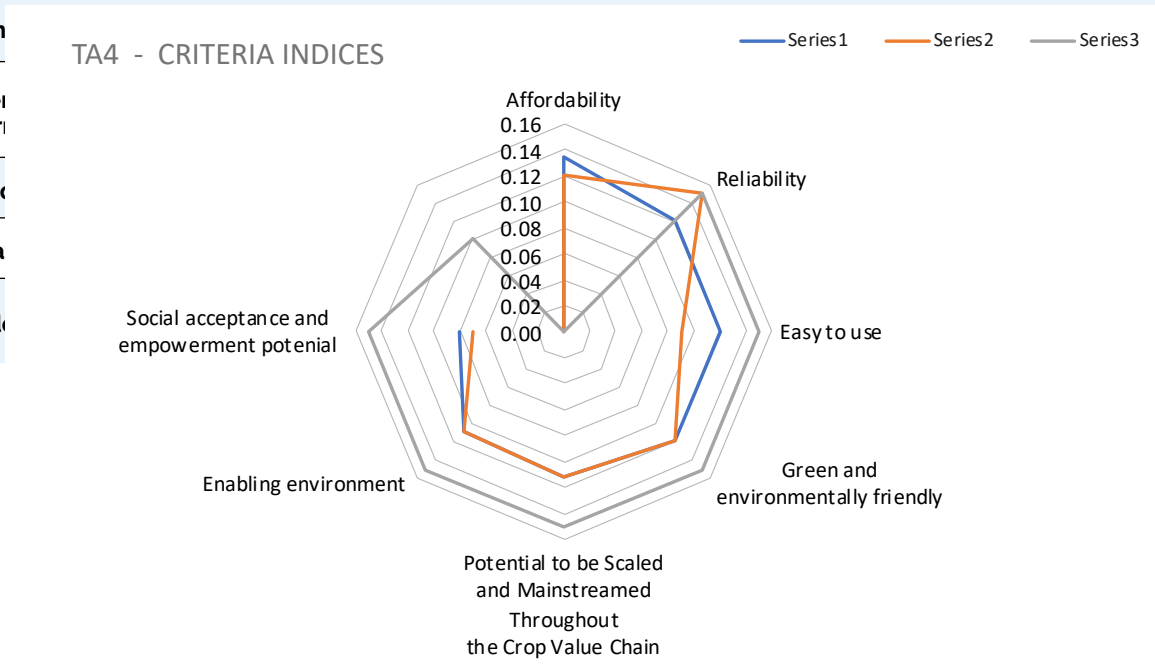
Description

Develops smart monitoring systems for the poultry sector using IoT devices to capture microclimatic parameters and AI for real-time disease diagnosis.



Description

Offers web-based agricultural extension services using satellite data to generate personalized farming recommendations.



Nigeria

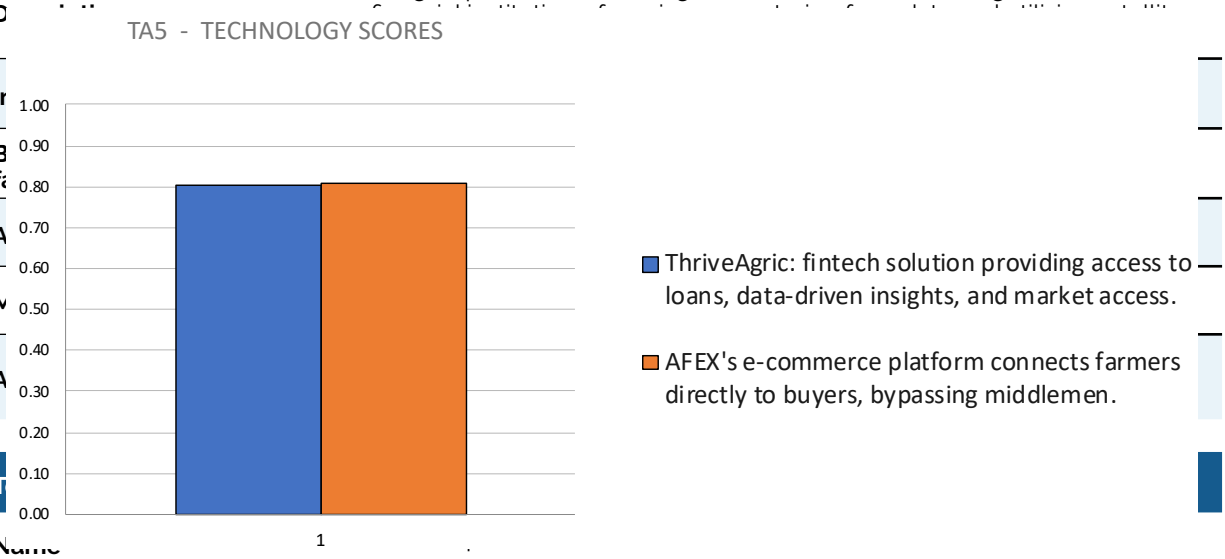
TA4: E-commerce and market access

Nigeria

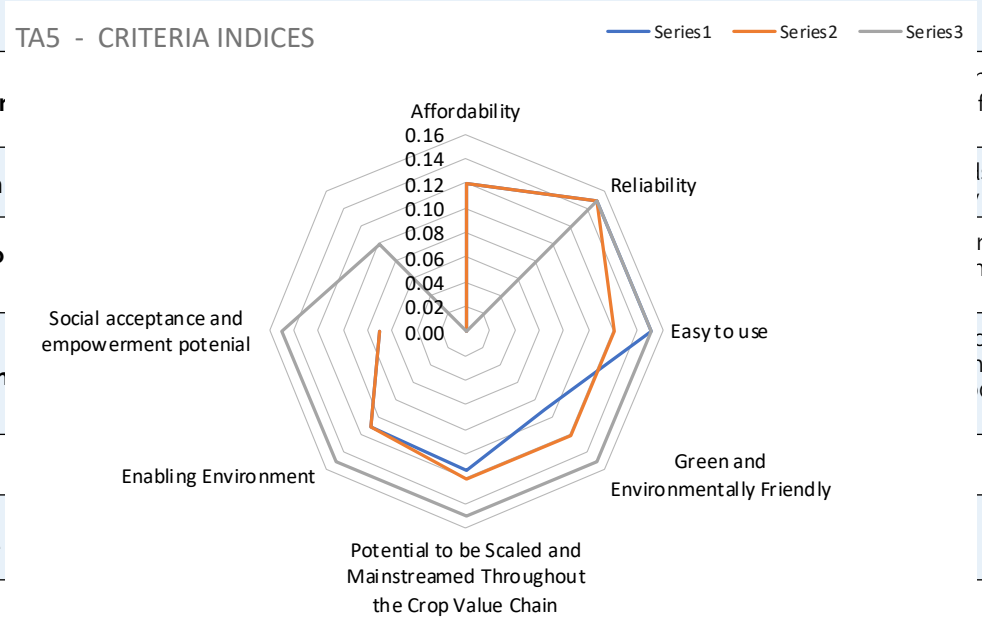
TA4: E-commerce and market access

Tematic Area	Technology Name	Level 2 Assessment							
		Final Score	Affordability	Reliability	Easy to use	Green and Environmentally Friendly	Potential to be Scaled and Mainstreamed Throughout the Crop Value Chain	Enabling Environment	Social acceptance and empowerment potenial
TA5 Fintech	ThriveAgric: fintech solution providing access to loans, data-driven insights, and market access.	0.80	0.12	0.15	0.15	0.09	0.11	0.11	0.07
	AFEX's e-commerce platform connects farmers directly to buyers, bypassing middlemen.	0.81	0.12	0.15	0.12	0.12	0.12	0.11	0.07
		Weights	15%	15%	15%	15%	15%	15%	10%

A digital platform connecting smallholder farmers with agribusinesses to



Type	
Description	nology, for food
Innovation	ls and services.
Benefits fo farmers	roving ng
Acquisitior	orps the 00
Maturity	
Additional	



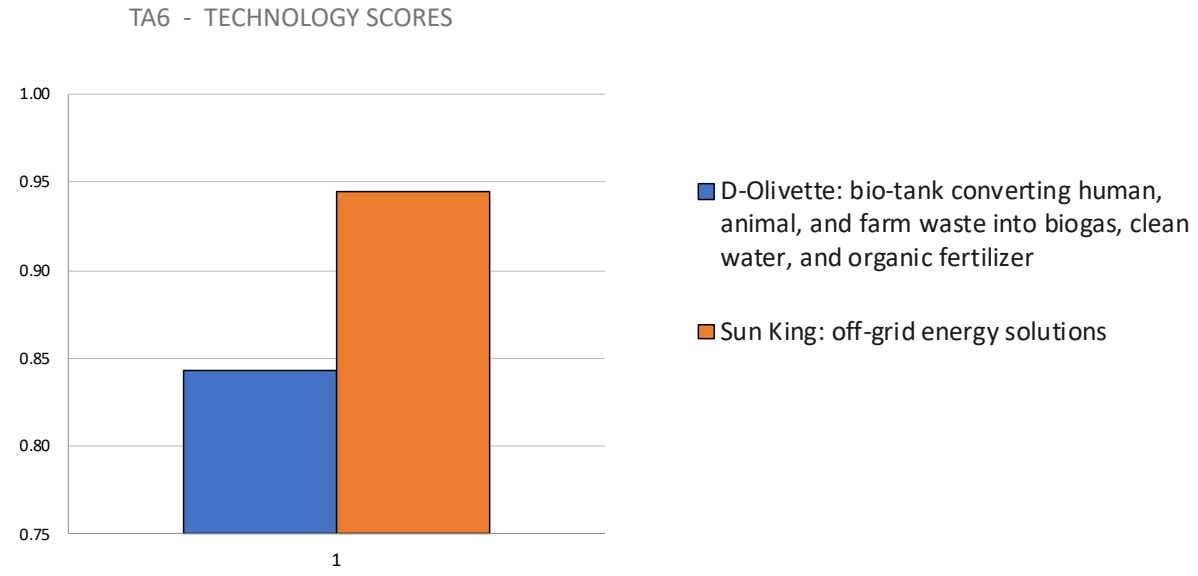
Nigeria
TA5: Fintech

Nigeria
TA5: Fintech

Tematic Area	Technology Name	Level 2 Assessment							
		Final Score	Affordability	Reliability	Easy to use	Green and Environmentally Friendly	Potential to be Scaled and Mainstreamed Throughout the Crop Value Chain	Enabling Environment	Social acceptance and empowerment potential
TA6 Green energy for farmers	D-Olivette: bio-tank converting human, animal, and farm waste into biogas, clean water, and organic fertilizer	0.84	0.14	0.12	0.12	0.15	0.13	0.11	0.08
	Sun King: off-grid energy solutions	0.95	0.14	0.15	0.15	0.15	0.15	0.13	0.08
	Weights		15%	15%	15%	15%	15%	15%	10%

Description

buyers, enabling better control over pricing and direct access to the market.



Technology two

Name

Type

Descripti

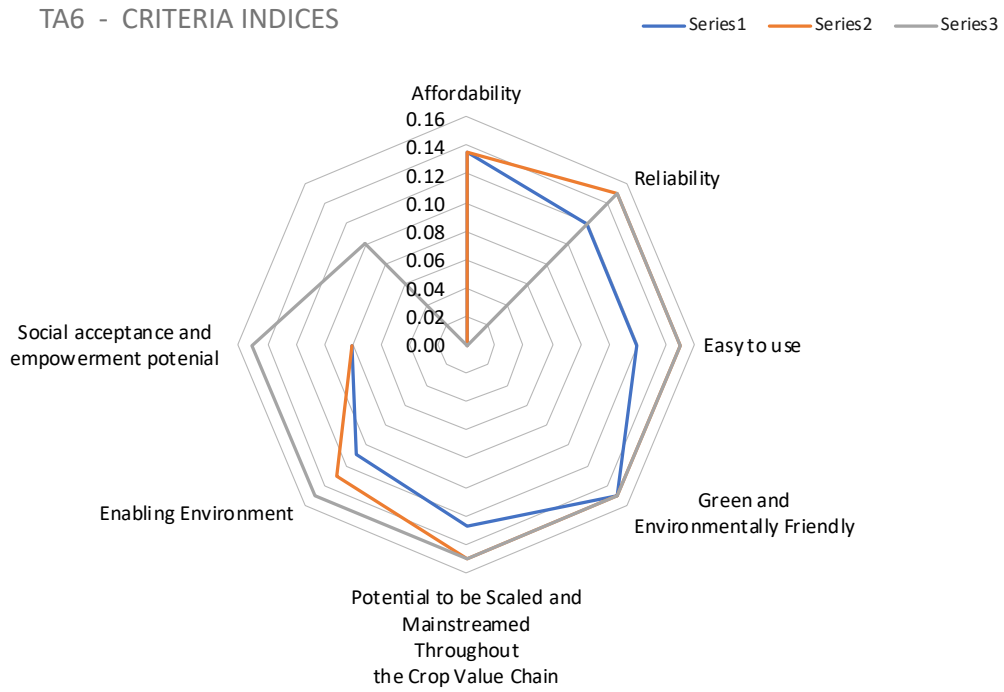
Innovatio

Benefits f farmers

Acquisiti

Maturity

Additiona



Nigeria

TA6: Green energy solutions for farmers

Nigeria

TA6: Green energy solutions for farmers

Technology one	
Name	Sun King
Type	Innovation
Description	Offers a range of products from portable lanterns to comprehensive solar home systems, caterin
Innovation	Provides off-grid solar access or afford traditi
Benefits for smallholder farmers	Enables extended working hours, improved crop management while reducing the reliance on expensive, polluting fuels.
Acquisition cost	Solar deep freezer: NGN 400 000 (USD 550). Capacity: 166 litres, DC Voltage: 12V or 24V, Ambient temperature: +10 to +43°C.
Maturity	Mature (7+ years)
Additional information	Address: 19, Adekunle Fajuyi Way, Ikeja GRA, Lagos, Nigeria Phone: (+234) 80 07865464

Acquisition cost	The Bio-Tank 500–10 000 liters: fro The Kitchen Box, Complete Set: fro Farm Bio-Station: from USD 900; Bio-Slurry Liquid Separator: from U See more products.
Maturity	Intermediate (3–7 years)
Additional information	Address: 4 D-Olivette Close, Itori, O Phone: (+234) 90 58939511 Email: deolivettepress@gmail.com

Technology two	
Name	D-Olivette
Type	Innovation
Description	DOE's Kitchen Box and Bio-tank Digester convert organic waste into biogas, organic fertilizer and clean water using biotech and AI and Big Data solutions.
Innovation	Ranges from small-scale kitchen solutions to large-scale industrial digesters, designed for efficiency and adaptability to the African environment.
Benefits for smallholder farmers	Aids in sustainable waste management, improves soil fertility, provides access to renewable energy and supports clean cooking solutions.

7. Palestine

COUNTRY: **PALESTINE** — No. of technologies 18

Thematic area		Technology name	LEVEL 1 assessment score	LEVEL 2 assessment score
TA 1 Post harvest-reducing food loss and waste	1	Silage and total mixture ration	0.54	0.67
	2	Ayava - distribute solar powered refrigerators	0.43	0.62
	3	0	0.37	
	4	0	0.37	
TA 2 Water management and water saving technologies	1	AgriLive	0.45	0.63
	2	Alvatech	0.43	0.61
	3	Anera - Reyhan Program	0.41	
	4	Hydroponics farming	0.37	
TA 3 Sustainable pest control and crop management	1	Grafting and propagating	0.50	0.62
	2	Organic farming	0.48	0.59
	3	Milk alternatives for livestock	0.45	
	4	Bee pollinator rental	0.45	
TA 4 E-commerce and martket access	1	Agricultural cooperatives	0.45	0.62
	2	Canaan Palestine	0.45	0.62
	3	"Made in Palestine"	0.45	
	4	0	0.37	
TA 5 Fintech	1	PalPay	0.45	0.71
	2	Palestine Agriculture Credit Institution (PACI)	0.45	0.63
	3	0	0.37	
	4	0	0.37	
TA 6 Green energy for farmers	1	Solar powered irrigation systems	0.48	0.66
	2	HomeBiogas - Portable household anaerobic digesters	0.45	0.61
	3	Solar powered desalination system	0.45	
	4	0	0.37	

Palestine's agricultural products are widely successful. Olive oil is the most economically relevant product, both for local consumption, and regional or international exports. Medjoul dates are unique and comply with the highest international standards; fruits and herbs are also internationally sold and highly prized (Marzin, Uwaidat and Sourrisseau, 2019). Smallholder farmers could benefit from green technologies in a variety of ways—marketing, improving consistency and increasing self-sustainability are all benefits that technologies could bring to Palestine's challenging context.

7.2 Palestine Country Profile

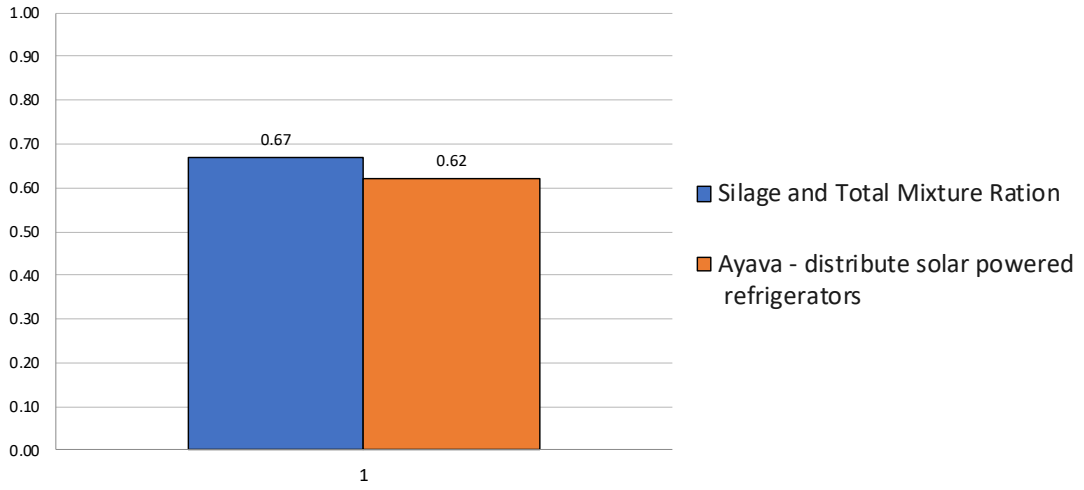
7.3 Technology profiles and assessment rankings

Palestine

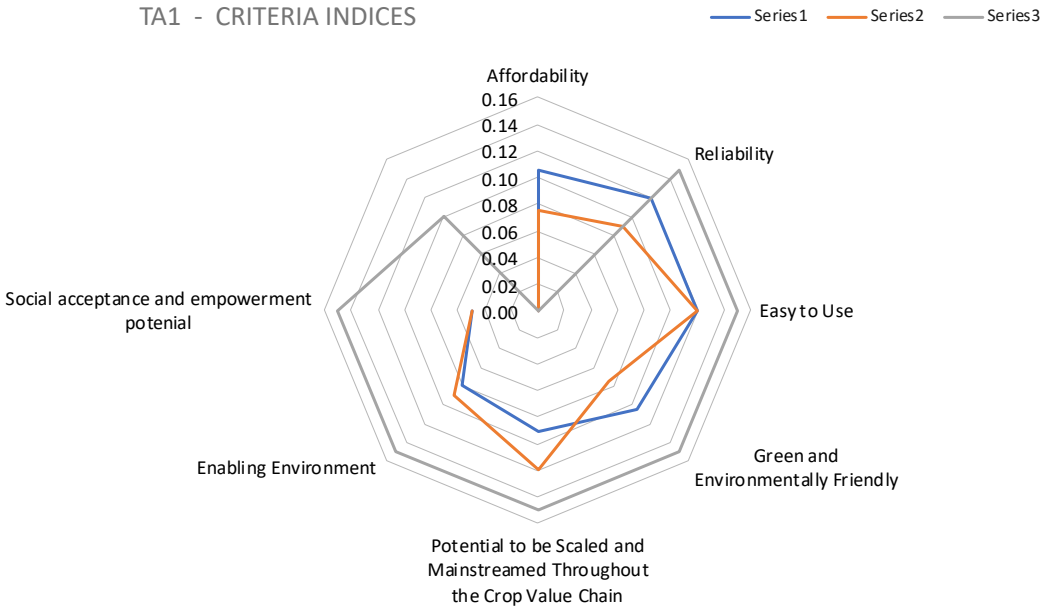
TA1: Post-harvest techniques to reduce food loss and waste

			Level 2 Assessment							
Tematic Area		Technology Name	Final Score	Affordability	Reliability	Easy to Use	Green and Environmentally Friendly	Potential to be Scaled and Mainstreamed Throughout the Crop Value Chain	Enabling Environment	Social acceptance and empowerment potenial
TA1	Post harvest-reducing Food Loss and Waste	Silage and Total Mixture Ration	0.67	0.11	0.12	0.12	0.11	0.09	0.08	0.05
		Ayava - distribute solar powered refrigerators	0.62	0.08	0.09	0.12	0.08	0.12	0.09	0.05
			Weights	15%	15%	15%	15%	15%	15%	10%

TA1 - TECHNOLOGY SCORES



TA1 - CRITERIA INDICES



Palestine

TA1: Post-harvest techniques to reduce food loss and waste

Technology one	
Name	Silage and total mixture ration
Type	Innovation
Description	A high-nutrient lower cost alternative to animal feed.
Innovation	The mixture is made from byproducts such as corn, palm and tomato byproducts, and sometimes corn silage, citrus TMR, haylage, hay mix TMR and green fodder barley sprouts.
Benefits for smallholder farmers	Silage creates new and profitable revenue streams for feed suppliers and crop farmers while significantly decreasing the costs to herders in animal rearing, since feed constitutes 60 percent of the overall rearing costs.
Acquisition cost	Low; this mixture is cheaper than other feed options.
Maturity	Mature (7+ years)
Additional information	Email: arsalan_faheem@dai.com; maha_hayek@dai.com

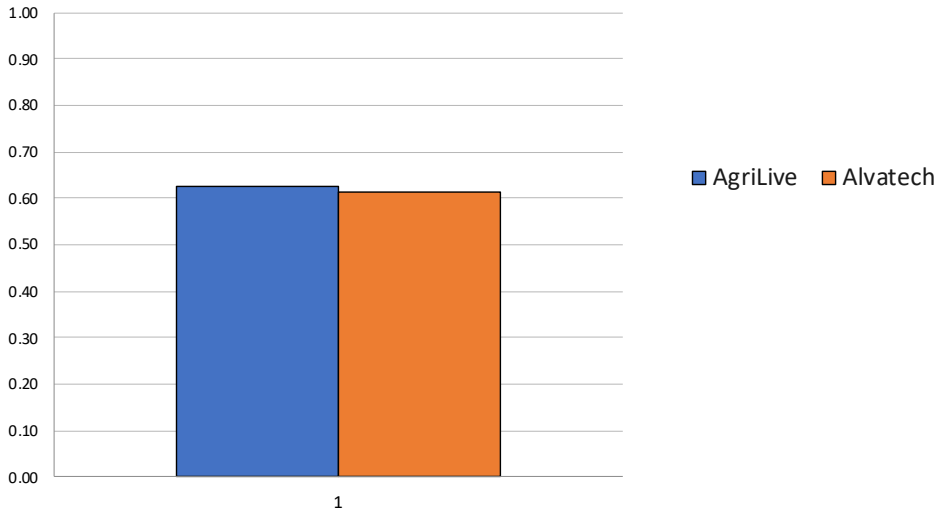
Technology two	
Name	Energy blocks
Type	Innovation
Description	Using waste from olive milling as a substitute for wood. Olive mill waste is chemically treated to remove the smell, and reduce emissions and smoke. It is compressed through a machine and dried in the sun.
Innovation	This process decreases waste from the olive milling process and creates fuel.
Benefits for smallholder farmers	Energy blocks are a cheaper, longer-burning replacement for wood as an energy source, which decreases logging and reduces emissions.
Acquisition cost	Low; this fuel source is cheaper than wood.
Maturity	Nascent (1–3 years)
Additional information	Palestinian entrepreneurs find way to turn olive waste into clean energy by Donna R. Edmunds in The Jerusalem Post

Palestine

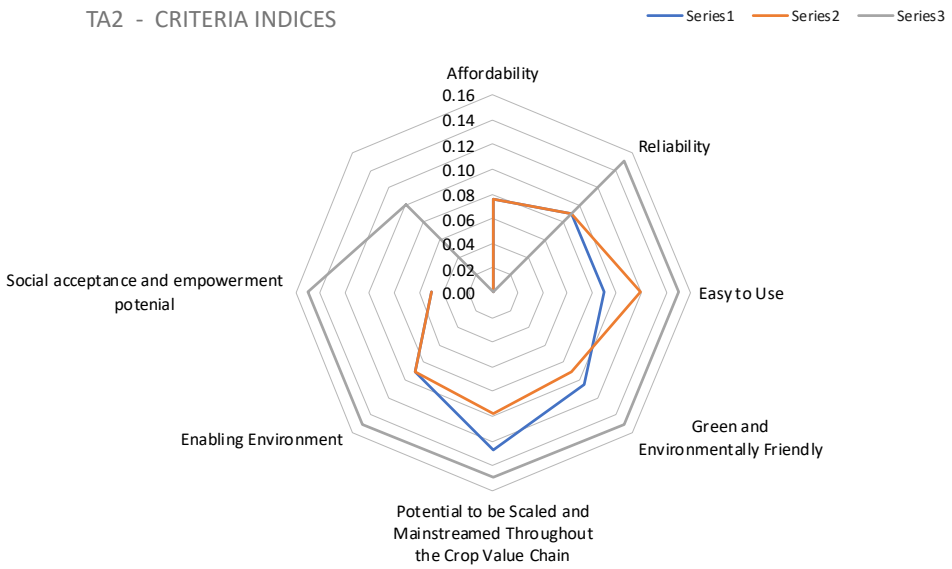
TA2: Water management and water-saving technologies

Tematic Area	Technology Name	Level 2 Assessment							
		Final Score	Affordability	Reliability	Easy to Use	Green and Environmentally Friendly	Potential to be Scaled and Mainstreamed Throughout the Crop Value Chain	Enabling Environment	Social acceptance and empowerment potenial
TA2 Water management and water saving technologies	AgriLive	0.63	0.08	0.09	0.09	0.11	0.13	0.09	0.05
	Alvatech	0.61	0.08	0.09	0.12	0.09	0.10	0.09	0.05
		Weights	15%	15%	15%	15%	15%	15%	10%

TA2 - TECHNOLOGY SCORES



TA2 - CRITERIA INDICES



Palestine

TA2: Water management and water-saving technologies

Technology one	
Name	AgriLive
Type	Innovation
Description	A high-tech platform specialized in smart irrigation and fertilization (fertigation).
Innovation	Can be used through a smartphone app or the web and allows remote programming, control and monitoring. Alvatech provides data collection over solar-powered IoT devices (sleeping nodes) and data analysis through AI algorithms.
Benefits for smallholder farmers	Helps farmers with adjusting the quantities of irrigation and fertilizers. This will lead to higher yields at the lowest possible cost.
Acquisition cost	High cost for purchase and installation.
Maturity	Nascent (1–3 years)
Additional information	Developed by Snipe Mobile : (+970) 59 4303002 Email: info@snipe.ps

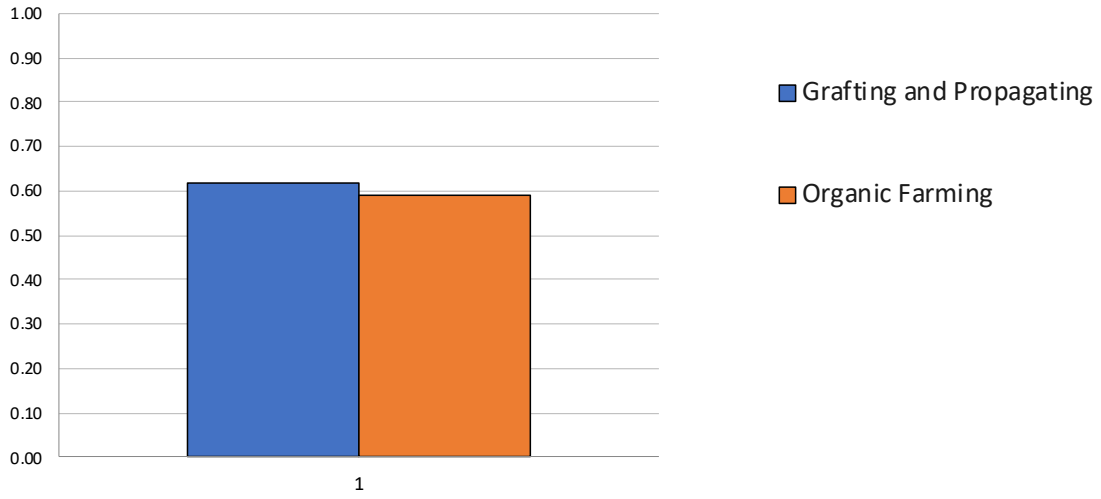
Technology two	
Name	Alvátech
Type	Innovation
Description	A solar powered water treatment to mitigate water and soil salinization.
Innovation	A non-chemical, sustainable treatment that changes the molecule behavior of water and allows high-salinity water to be efficiently absorbed by crops. The device looks like a water pipe and can be installed above or below ground; it decreases the salinity around the root of the plant, and requires little maintenance and no waste management. It increases the plant's ability to absorb fertilizers and break up salt crusts to allow roots to grow more freely.
Benefits for smallholder farmers	These devices increase crop yield and health in areas with high salinity water.
Acquisition cost	Cost of purchase and installation.
Maturity	Nascent (1–3 years)
Additional information	Email: info@alvatech.co.uk

Palestine

TA3: Sustainable pest control and crop management

Tematic Area		Technology Name	Level 2 Assessment							
			Final Score	Affordability	Reliability	Easy to Use	Green and Environmentally Friendly	Potential to be Scaled and Mainstreamed Throughout the Crop Value Chain	Enabling Environment	Social acceptance and empowerment potenial
TA3	Sustainable pest control and crop management	Grafting and Propagating	0.62	0.12	0.09	0.06	0.08	0.11	0.09	0.07
		Organic Farming	0.59	0.14	0.09	0.00	0.11	0.12	0.08	0.06
			Weights	15%	15%	15%	15%	15%	15%	10%

TA3 - TECHNOLOGY SCORES



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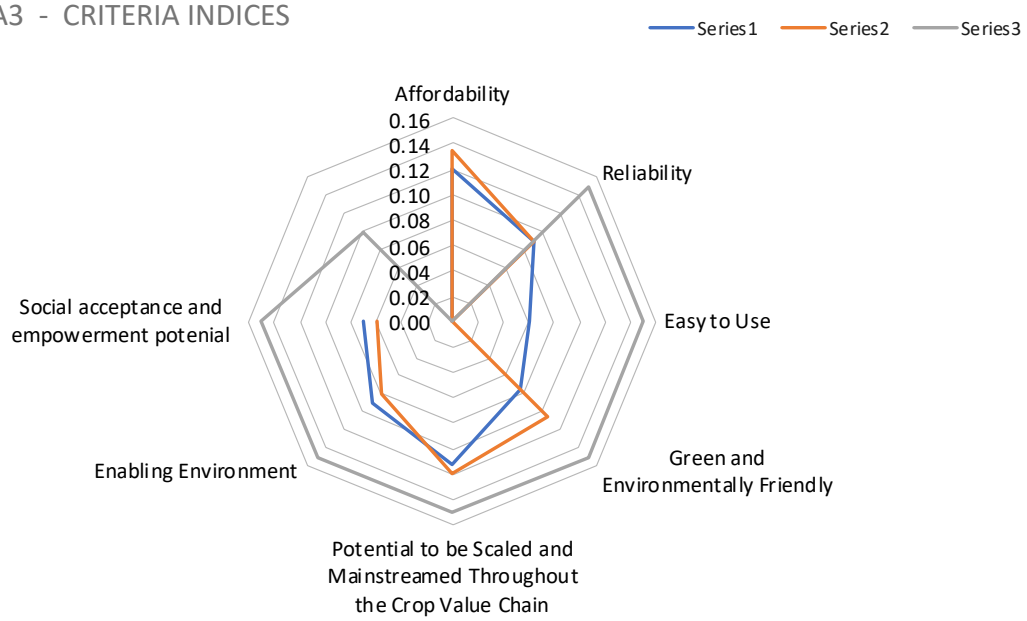


Palestine

TA3: Sustainable pest control and crop management

Technology one	
Name	Grafting and propagating
Type	Traditional
Description	The process of rooting cuttings and grafting seedlings.
Innovation	This method is a faster way to multiply the capacity of plants. Olive trees especially benefit from propagation as a way to quickly multiply olive production, but watermelon, cucumber, and tomato grafting has also been implemented in Palestine. Grafting and propagating is especially relevant to nurseries who sell to small-scale farmers.
Benefits for smallholder farmers	Quickly multiply and grow seedlings with less production costs and lower costs to farmers. The saved production costs allow nurseries and farmers to produce higher quality seedlings and increase profits compared to traditional seedlings.
Acquisition cost	None
Maturity	Mature (7+ years)
Additional information	Palestinian Market Development Programme (PMDP)

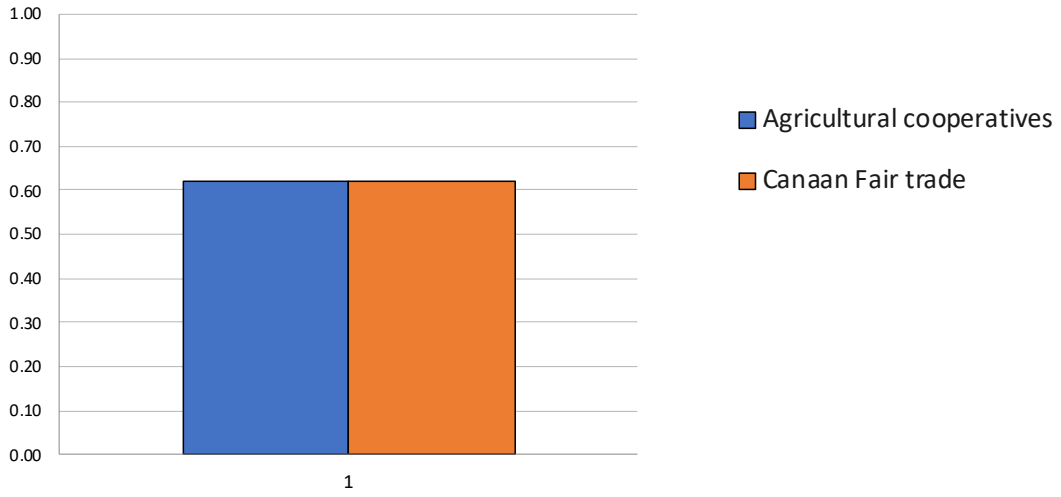
Technology two	
Name	Organic farming
Type	Traditional
Description	Farming without pesticides and chemical fertilizers.
Innovation	Removes the negative environmental effects that chemical fertilizers and pesticides produce.
Benefits for smallholder farmers	Helps combat the shortage of resources, especially fertilizers, and preserves water, making it cheaper and better for the environment.
Acquisition cost	None
Maturity	Mature (7+ years)
Additional information	Palestine Center for Organic Agriculture Association; Company of Organic Agriculture in Palestine (COAP)

Palestine

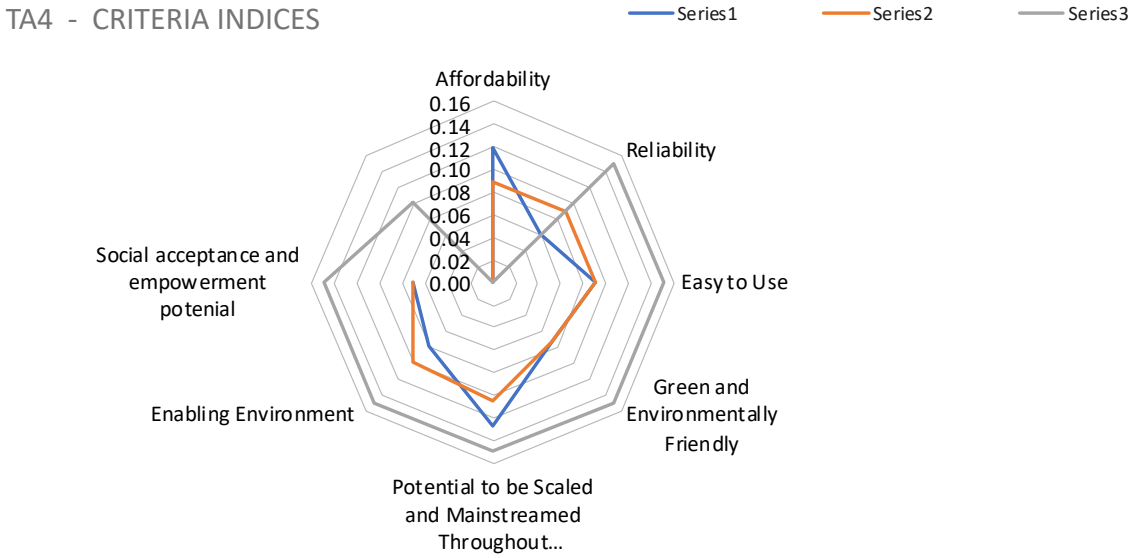
TA4: E-commerce and market access

Tematic Area	Technology Name	Level 2 Assessment							
		Final Score	Affordability	Reliability	Easy to Use	Green and Environmentally Friendly	Potential to be Scaled and Mainstreamed Throughout the Crop Value Chain	Enabling Environment	Social acceptance and empowerment potenial
TA4 E- commerce and market acceess	Agricultural cooperatives	0.62	0.12	0.06	0.09	0.08	0.13	0.08	0.07
	Canaan Fair trade	0.62	0.09	0.09	0.09	0.08	0.11	0.10	0.07
		Weights	15%	15%	15%	15%	15%	15%	10%

TA4 - TECHNOLOGY SCORES



TA4 - CRITERIA INDICES



Palestine

TA4: E-commerce and market access

Technology one	
Name	Agricultural cooperatives
Type	Traditional
Description	Agriculture cooperatives are legal entities that represent farmers in a community to achieve a common objective. Many cooperatives in Palestine have topical specialties like beekeeping, livestock and irrigation.
Innovation	Providing access to agricultural information and solutions, as well as sharing resources among members.
Benefits for smallholder farmers	Farmers can gain access to information, solutions and resources that would otherwise not be available to them.
Acquisition cost	None
Maturity	Nascent (1–3 years)
Additional information	General Union of Palestinian Peasants and Agricultural Cooperatives

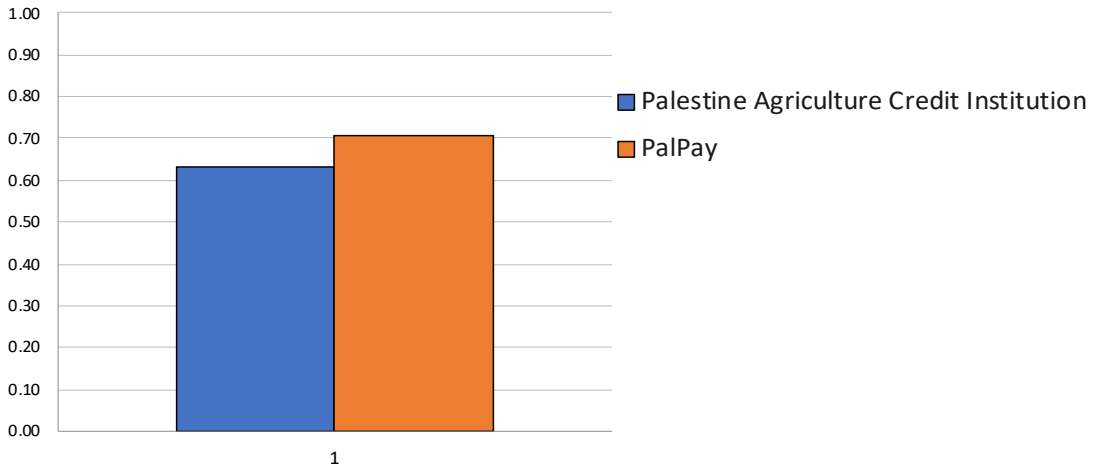
Technology two	
Name	Canaan Palestine
Type	Digital
Description	A platform that sources high-value crops (olives, almonds, jojoba, etc.) from Palestinian small farms.
Innovation	Adds value to the product by emphasizing the uniqueness of smallholder products, connects products to consumers.
Benefits for smallholder farmers	Farmers have wider access to markets and benefit from the valorization of their products.
Acquisition cost	None
Maturity	Intermediate (3–7 years)
Additional information	Address: Kufor Qud Road, Burqin, Palestine Phone: (+970) 42 431991 Email: info@canaanpalestine.com Shop for products

Palestine

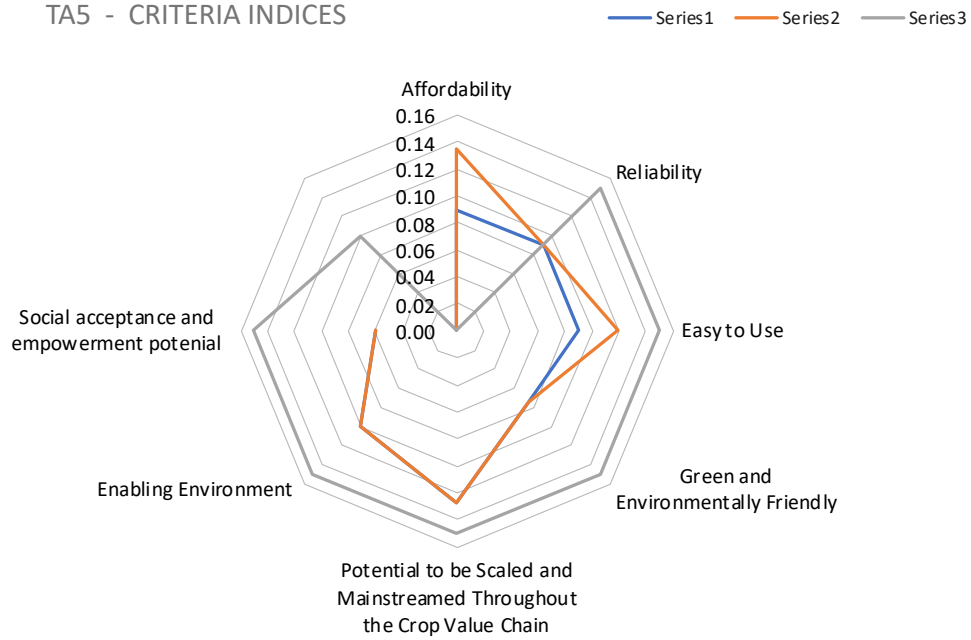
TA5: Fintech

Tematic Area	Technology Name	Level 2 Assessment							
		Final Score	Affordability	Reliability	Easy to Use	Green and Environmentally Friendly	Potential to be Scaled and Mainstreamed Throughout the Crop Value Chain	Enabling Environment	Social acceptance and empowerment potenial
TA5 Fintech	Palestine Agriculture Credit Institution	0.63	0.09	0.09	0.09	0.08	0.13	0.10	0.06
	PalPay	0.71	0.14	0.09	0.12	0.08	0.13	0.10	0.06
		Weights	15%	15%	15%	15%	15%	15%	10%

TA5 - TECHNOLOGY SCORES



TA5 - CRITERIA INDICES



Palestine
TA5: Fintech

Technology one	
Name	Palpay
Type	Digital
Description	An electronic collection system developed by the Bank of Palestine, First National Bank and PCNC IT Solutions.
Innovation	Electronic pay options increase formality, speed and security of payments.
Benefits for smallholder farmers	A more streamlined digital payment method can help farmers receive payments faster and more securely.
Acquisition cost	Low; service fees.
Maturity	Mature (7+ years)
Additional information	Email: info@palpay.ps

Technology two	
Name	Palestine Agricultural Credit Institution (PACI)[7]
Type	Other (Finance)
Description	A loan institution to help farmers with financing and lending.
Innovation	Utilizes the unified credit inquiry system developed by the Palestine Monetary Authority.
Benefits for smallholder farmers	Helps farmers access financing.
Acquisition cost	None
Maturity	Nascent (1–3 years)
Additional information	Aid for Palestinian farmers set to go, farmers cross fingers by Aziza Nofal in Al-Monitor.

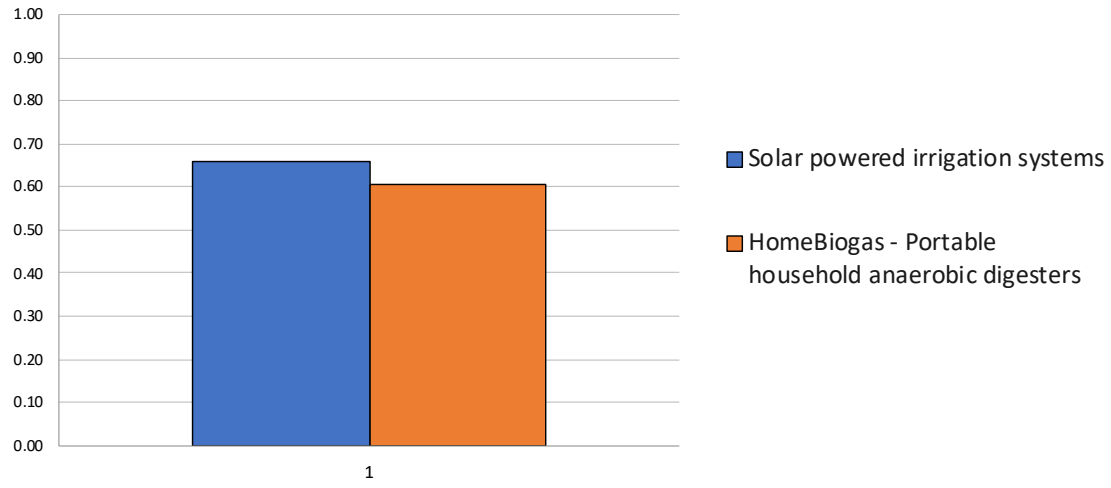
7 The PACI website was inactive at the time of the publishing of this report.

Palestine

TA6: Green energy solutions for farmers

Tematic Area	Technology Name	Level 2 Assessment							
		Final Score	Affordability	Reliability	Easy to Use	Green and Environmentally Friendly	Potential to be Scaled and Mainstreamed Throughout the Crop Value Chain	Enabling Environment	Social acceptance and empowerment potenial
TA6 Green energy for farmers	Solar powered irrigation systems	0.66	0.08	0.09	0.12	0.11	0.13	0.09	0.05
	HomeBiogas - Portable household anaerobic digesters	0.61	0.08	0.09	0.09	0.11	0.10	0.09	0.06
		Weights	15%	15%	15%	15%	15%	15%	10%

TA6 - TECHNOLOGY SCORES



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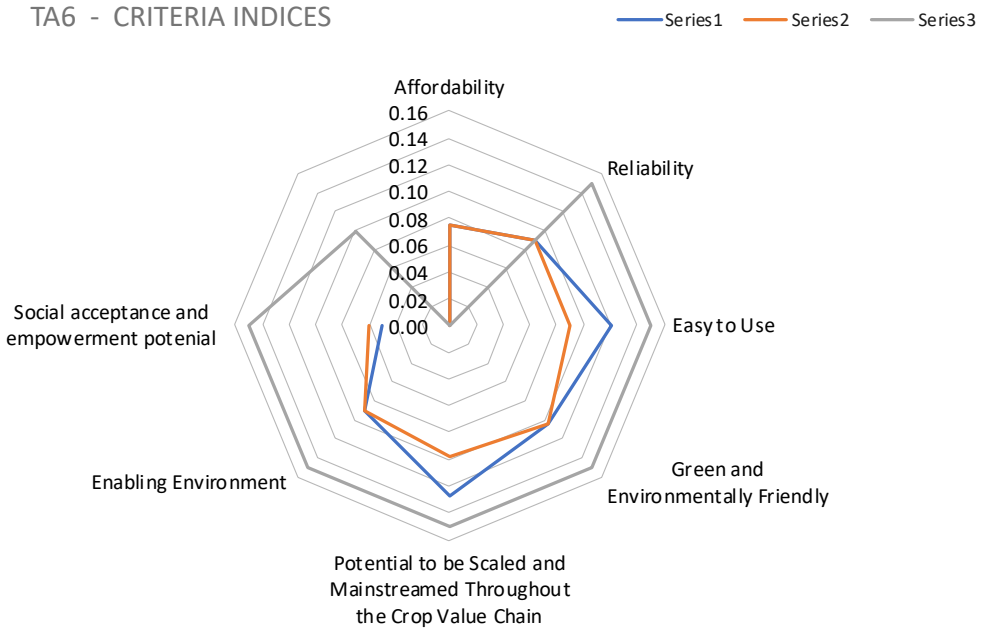
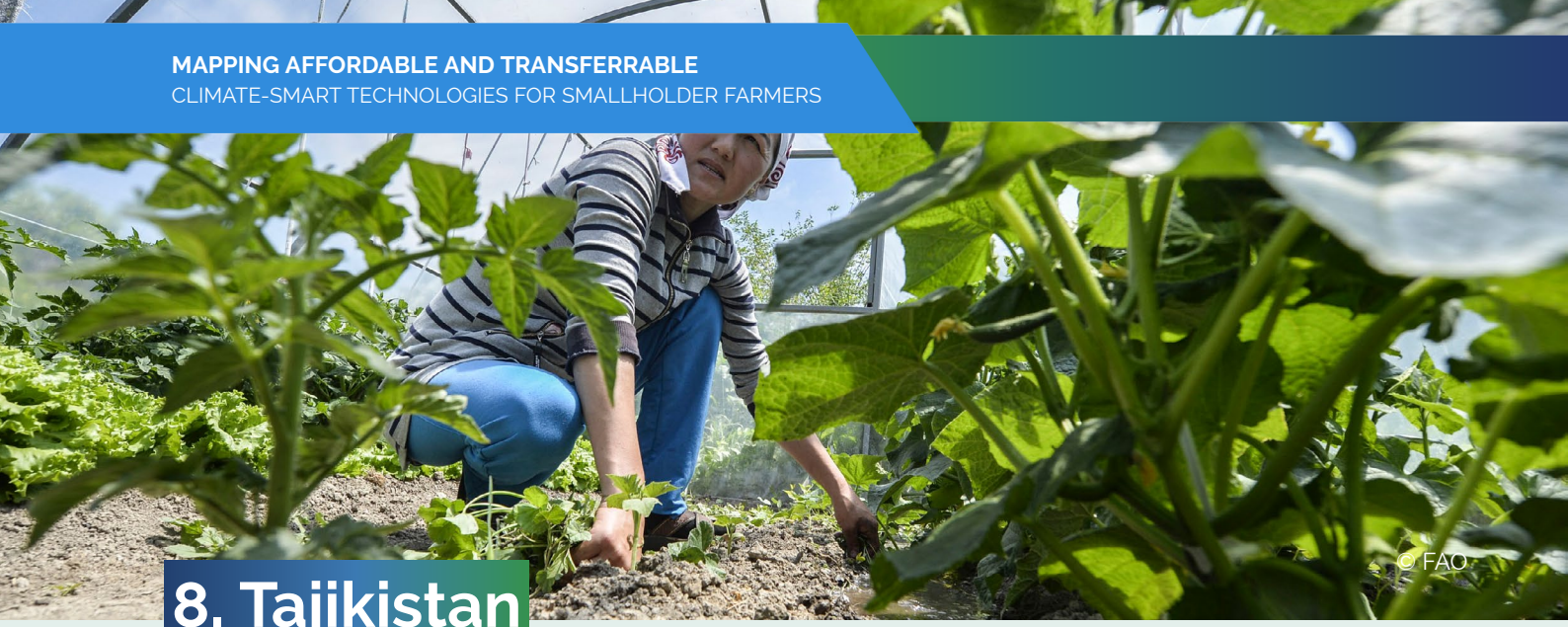


Palestine

TA6: Green energy solutions for farmers

Technology one	
Name	Solar powered irrigation systems (SPIS)
Type	Innovation
Description	Technologies that use solar power to irrigate crops.
Innovation	SPIS often store energy during the day and irrigate at night to decrease water evaporation. These systems save water and energy and reduce soil runoff.
Benefits for smallholder farmers	Saves much of the energy that would otherwise be used for water pumping, and reduces the amount of water needed for irrigation.
Acquisition cost	High cost for purchase and installation.
Maturity	Mature (7+ years)
Additional information	Assessment of solar-powered irrigation systems in the West Bank (Palestine) by FAO

Technology two	
Name	HomeBiogas
Type	Innovation
Description	A portable household anaerobic digester.
Innovation	Turns waste into energy and creates fertilizer as a byproduct.
Benefits for smallholder farmers	It is fully off-grid and creates energy and fertilizer out of existing waste products.
Acquisition cost	HomeBiogas's smallest digester: USD 1 420
Maturity	Mature (7+ years)
Additional information	https://www.homebiogas.com/contact-us/



8. Tajikistan

8.1 Introduction to the agriculture sector and its challenges

Tajikistan's agriculture grapples with several challenges stemming from its unique climate and topography. Extreme weather conditions, including hot summers and cold winters, present difficulties for crop cultivation and livestock rearing. The prevalence of mountainous terrain limits the availability of arable land and complicates transportation and market access. Despite abundant water resources, uneven distribution and seasonal availability pose challenges for irrigation and consistent crop cultivation. Soil erosion and degradation, exacerbated by overgrazing and poor agricultural practices, further diminish agricultural productivity. Additionally, inadequate rural infrastructure, such as roads and storage facilities, hinders efficient transportation and storage of agricultural produce.

Amid these challenges, Tajikistan's agriculture holds significant opportunities for growth and innovation. The diverse microclimates across different regions allow for the cultivation of a wide range of crops, including fruits, vegetables and cereals. The country's climate and orography are conducive to growing high-value crops like nuts, fruits (especially apricots and apples) and medicinal herbs, which can be lucrative on the international market. The relatively pristine natural environments offer opportunities for organic farming to meet the rising global demand for organic products. Furthermore, leveraging Tajikistan's substantial hydropower resources for sustainable irrigation and energy needs in agriculture is promising. The scenic landscapes and traditional agricultural practices also present opportunities for agrotourism, providing an additional revenue stream for farmers. Moreover, there are prospects for international partnerships and investments aimed at improving agricultural technology, infrastructure and practices.

Smallholder farmers in Tajikistan face specific challenges that hinder their productivity and economic viability. Limited access to markets reduces opportunities for selling produce and obtaining fair prices. Inadequate infrastructure results in post-harvest losses and lower profitability due to inefficient distribution of agricultural products. Furthermore, restricted access to finance and credit impedes investment in equipment, seeds and farming practices. The limited adoption of modern farming techniques and technology, coupled with climate change impacts and water scarcity, further challenges productivity and predictability. Dependency on traditional farming methods, especially with small land holdings, restricts economies of scale and competitiveness. Additionally, challenges in accessing quality inputs and knowledge gaps in market demands and standards hinder smallholder farmers' ability to thrive. Bureaucratic hurdles and lack of government support, including in policy formulation and subsidies, exacerbate these challenges, underscoring the need for comprehensive interventions to support smallholder farmers in Tajikistan.

8.2 Tajikistan Country Profile

COUNTRY: **TAJIKISTAN** — No. of technologies 33

Thematic area		Technology name	LEVEL 1 assessment score	LEVEL 2 assessment score
TA 1 Post harvest-reducing food loss and waste	1	Sustainable orchard-to-market model for Tajikistan's surplus fruits	0.60	0.81
	2	AgroMap	0.56	0.76
	3	New fruit drying techniques	0.55	
	4	Cold storage	0.51	
TA 2 Water management and water saving technologies	1	Intensive orchard with drip irrigation system	0.55	0.78
	2	Water-efficient agrometeorological services	0.58	0.78
	3	Affordable gravity-fed drip irrigation	0.53	
	4	Electronic billing system for water usage in Tajikistan	0.51	
TA 3 Sustainable pest control and crop management	1	Agroinform distance consultation system	0.55	0.78
	2	Plant Protection Handbook from A to Z (multiple apps)	0.53	0.74
	3	Solarization	0.52	
	4	Agri-Calculators	0.50	
TA 4 E-commerce and martket access	1	Agroinform Trade / eTrade	0.55	0.78
	2	Agros.tj	0.51	0.71
	3	Technokarta	0.50	
	4	HOSIL.TJ	0.50	
TA 5 Fintech	1	CLARA (Cash-flow Linked Agriculture Risk Assessment tool)	0.58	0.79
	2	Humo mobile banking app	0.55	0.78
	3	Zypl.AI: AI-powered credit underwriting system	0.50	
	4	Oxus app	0.48	
TA 6 Green energy for farmers	1	Off-grid solar power system for poultry farming	0.60	0.84
	2	Passive solar greenhouses	0.60	0.80
	3	Solar drier for apricot production	0.58	
	4	Apricot branch biomass fuel	0.54	

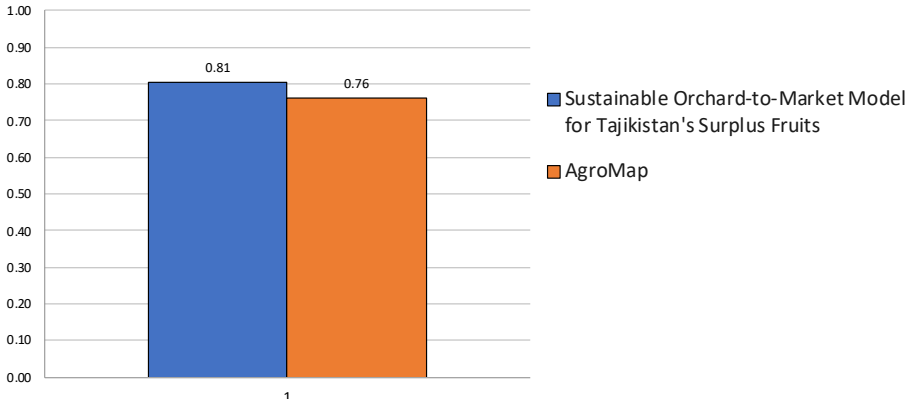
8.3 Technology profiles and assessment rankings

Tajikistan

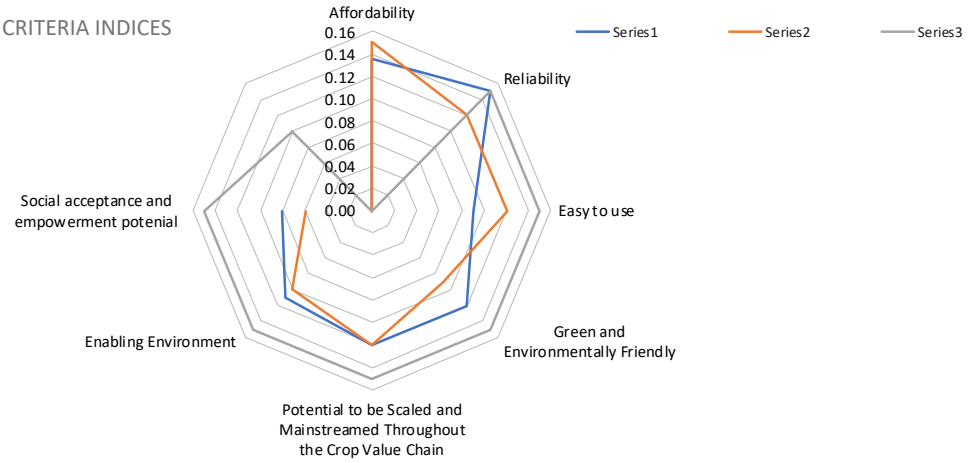
TA1: Post-harvest techniques to reduce food loss and waste

			Level 2 Assessment							
Tematic Area		Technology Name	Final Score	Affordability	Reliability	Easy to use	Green and Environmentally Friendly	Potential to be Scaled and Mainstreamed Throughout the Crop Value Chain	Enabling Environment	Social acceptance and empowerment potenial
TA1	Post harvest-reducing Food Loss and Waste	Sustainable Orchard-to-Market Model for Tajikistan's Surplus Fruits	0.81	0.14	0.15	0.09	0.12	0.12	0.11	0.08
		AgroMap	0.76	0.15	0.12	0.12	0.09	0.12	0.10	0.06
			Weights	15%	15%	15%	15%	15%	15%	10%

TA1 - TECHNOLOGY SCORES



TA1 - CRITERIA INDICES



Tajikistan

TA1: Post-harvest techniques to reduce food loss and waste

Technology one	
Name	Sustainable orchard-to-market model for surplus fruits
Type	Traditional
Description	Green Nature, founded by Bahor Marodalieva, focuses on transforming surplus fruits from family orchards in Tajikistan into value-added products like mulberry bars, juices, jams and teas.
Innovation	Develops diverse flavors and product types, with a commitment to eco-friendly practices and future plans for sustainable packaging.
Benefits for smallholder farmers	Provides a reliable market for local produce, supports sustainable agricultural practices, generates local employment and contributes to community development.
Acquisition cost	None
Maturity	Mature (7+ years)
Additional information	Economic and social connections: A multi-input area development financing facility for Tajikistan by USAID and AKDN Practiced by Green Nature, Khorog, Badakhshan Bahor Marodalieva: Green Nature - An eco-friendly, empowering business model in Aga Khan Development Network (AKDN)

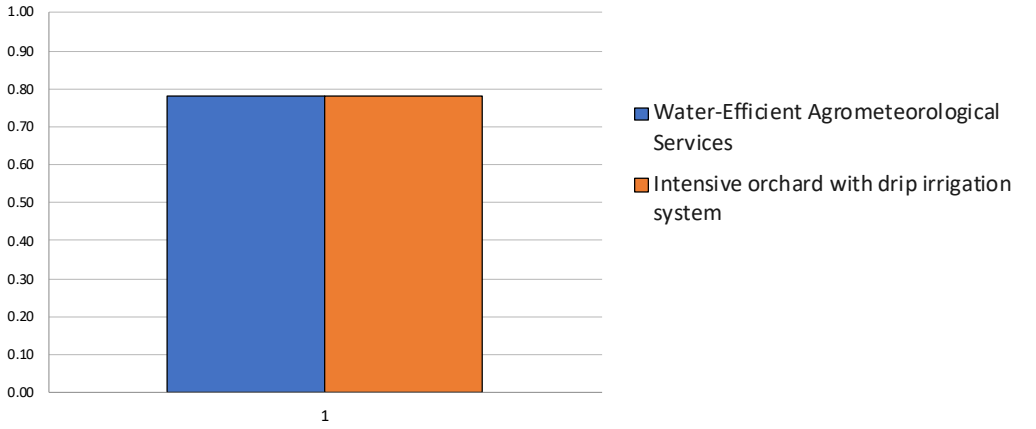
Technology two	
Name	AgroMap
Type	Digital
Description	A comprehensive geoinformation system that enhances supply chain efficiency and reduces post-harvest food waste for smallholder farmers.
Innovation	Provides real-time crop data, market access, optimized trade routes, data-driven decision making, storage and processing facilities information, and climate and environmental data.
Benefits for smallholder farmers	Aids in planning harvests, connecting with markets, optimizing trade routes, making informed planting decisions, and minimizing post-harvest waste.
Acquisition cost	None
Maturity	Intermediate (3–7 years)
Additional information	Developed by Neksigol Navovar and AgroInform.TJ in Tajikistan and AgroInformAsia in Kyrgyzstan as part of AgroSpace.

Tajikistan

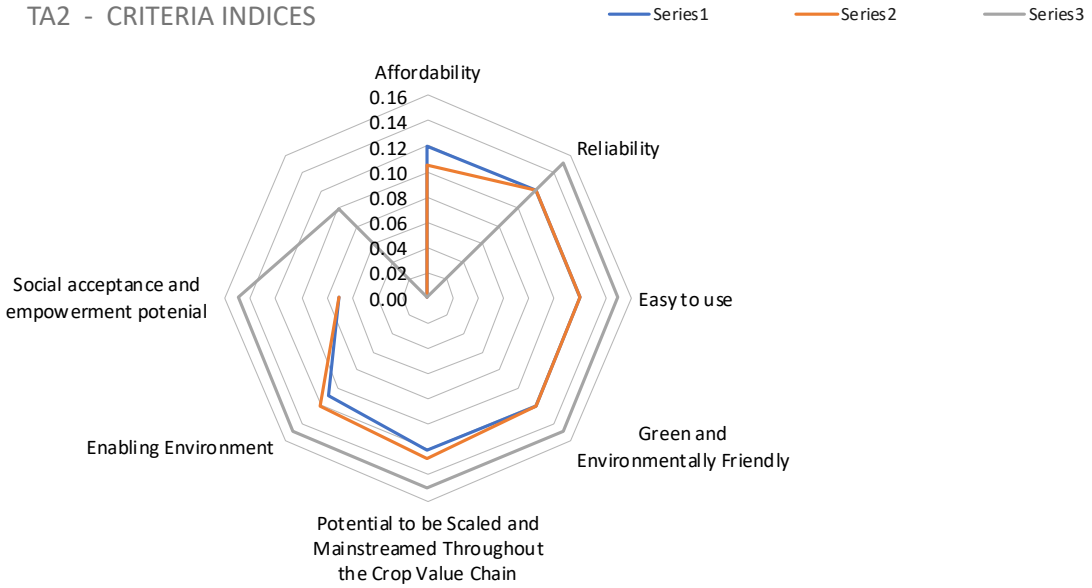
TA2: Water management and water-saving technologies

Tematic Area		Technology Name	Level 2 Assessment							
			Final Score	Affordability	Reliability	Easy to use	Green and Environmentally Friendly	Potential to be Scaled and Mainstreamed Throughout the Crop Value Chain	Enabling Environment	Social acceptance and empowerment potenial
TA2	Water management and water saving technologies	Water-Efficient Agrometeorological Services	0.78	0.12	0.12	0.12	0.12	0.12	0.11	0.07
		Intensive orchard with drip irrigation system	0.78	0.11	0.12	0.12	0.12	0.13	0.12	0.07
		Weights	15%	15%	15%	15%	15%	15%	15%	10%

TA2 - TECHNOLOGY SCORES



TA2 - CRITERIA INDICES



Tajikistan

TA2: Water management and water-saving technologies

Technology one	
Name	Intensive orchard with drip irrigation system
Type	Innovation
Description	An efficient water use and nutrient delivery system for crops, particularly beneficial in drier areas of Tajikistan, increasing yield and water conservation.
Innovation	Utilizes a drip irrigation system for direct water and nutrient delivery to roots, significantly reducing water waste and promoting sustainable farming.
Benefits for smallholder farmers	Enhances agricultural productivity, economic efficiency with substantial savings, quick return on investment, and access to support and funding.
Acquisition cost	USD 8 500, with a payback period of 2 years, energy savings of 16.2 GJ/year and water savings of 8 450 m^3/year
Maturity	Mature (7+ years)
Additional information	Intensive orchard with drip irrigation system by EBRD and GEFF.

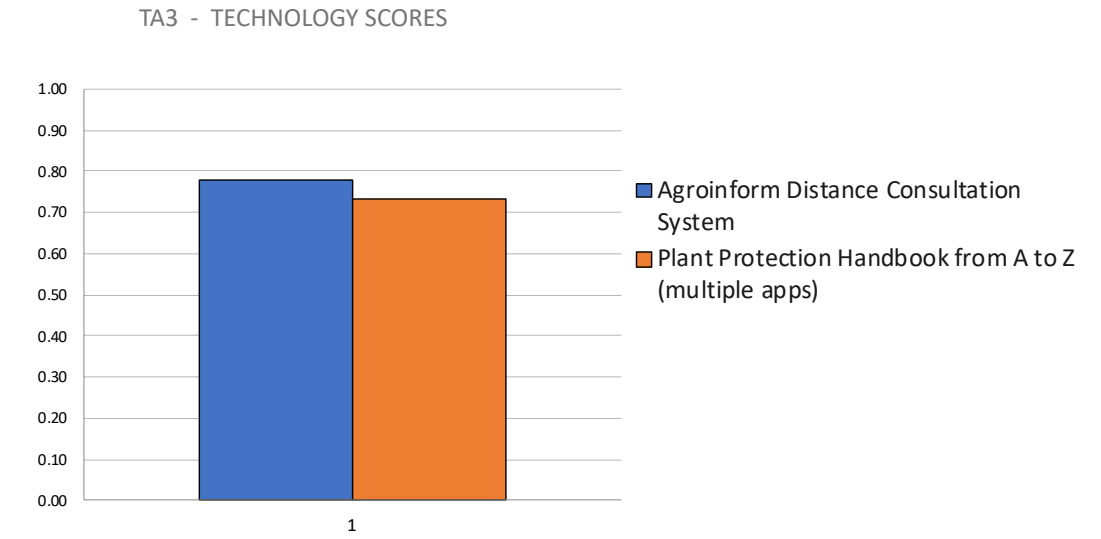
Technology two	
Name	Water efficient agrometeorological services
Type	Digital
Description	Advanced agrometeorological services utilizing automated weather stations to provide data for optimized water usage in agriculture in Tajikistan.
Innovation	Includes weather forecasting and disease prediction, enabling farmers to plan irrigation and manage water resources effectively.
Benefits for smallholder farmers	Assists in efficient water planning, reduces water waste, ensures optimal crop growth, and supports adaptation to climate change.
Acquisition cost	Rough estimate[8] to setup and run a basic service: Total setup cost: USD 150 000–250 000 Total ongoing operative cost/year: USD 50 000–100 000
Maturity	Intermediate (3–7 years)
Additional information	FAO water-efficient agrometeorological services.

8 It is difficult to estimate the acquisition cost as it is project-based and no financial data is available; further on-site assessment is required.

Tajikistan

TA3: Sustainable pest control and crop management

Tematic Area		Technology Name	Level 2 Assessment							
			Final Score	Affordability	Reliability	Easy to use	Green and Environmentally Friendly	Potential to be Scaled and Mainstreamed Throughout the Crop Value Chain	Enabling Environment	Social acceptance and empowerment potenial
TA3	Sustainable pest control and crop management	Agroinform Distance Consultation System	0.78	0.12	0.12	0.15	0.09	0.13	0.10	0.07
		Plant Protection Handbook from A to Z (multiple apps)	0.74	0.12	0.12	0.15	0.09	0.11	0.09	0.06
		Weights		15%	15%	15%	15%	15%	15%	10%



Tajikistan

TA3: Sustainable pest control and crop management

Technology one	
Name	Agroinform distance consultation system
Type	Digital
Description	A mobile application that connects farmers with experts for remote consultations on agricultural matters, facilitating communication via text, voice and video calls.
Innovation	Enables improved access to expert advice, reduces travel costs, and offers faster, more efficient consultations for informed decision-making.
Benefits for smallholder farmers	Provides convenient access to expert advice, leading to better crop and business outcomes, regardless of the location.
Acquisition cost	None
Maturity	Nascent (1–3 years)
Additional information	Download app from Google Play

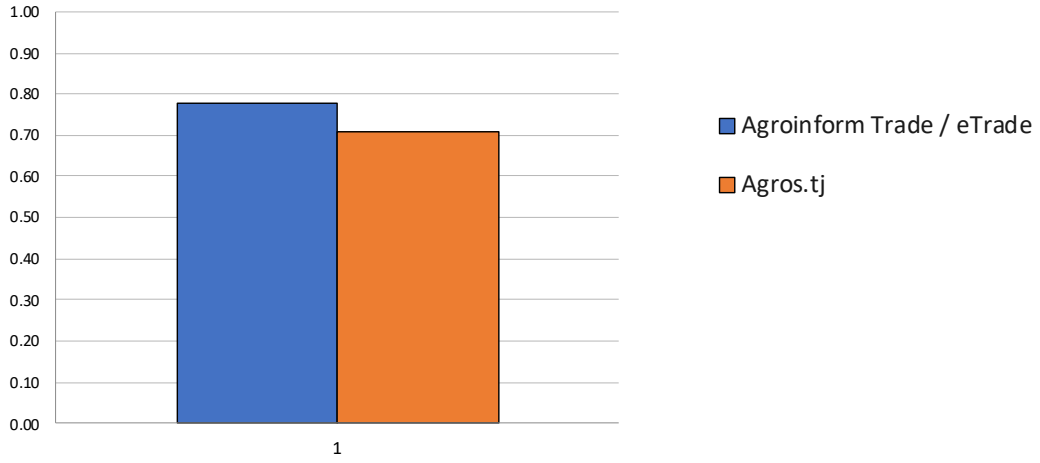
Technology two	
Name	Plant protection handbook from A to Z
Type	Digital
Description	A series of apps serving as a reference for effective plant protection, providing information on pest and disease control in crop cultivation, with specific apps for black currant, tomatoes and general plant protection.
Innovation	Offers offline access, multilanguage support, connects farmers with suppliers, and provides regularly updated, region-specific agricultural content.
Benefits for smallholder farmers	Enhances farmers' knowledge on plant protection, helps in managing pests and diseases effectively, and supports sustainable crop management.
Acquisition cost	None
Maturity	Nascent (1–3 years)
Additional information	Download app from Google Play

Tajikistan

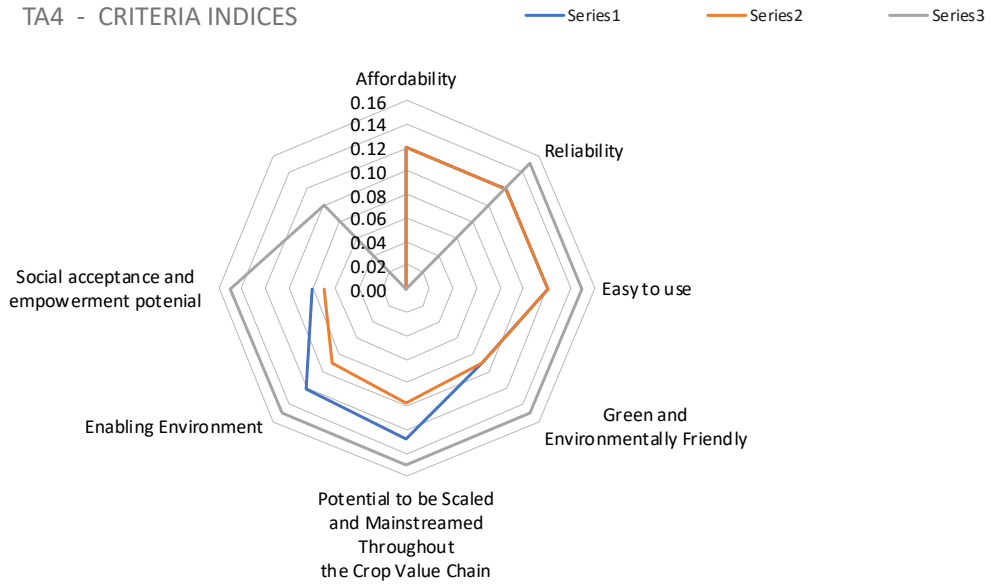
TA4: E-commerce and market access

Tematic Area	Technology Name	Level 2 Assessment							
		Final Score	Affordability	Reliability	Easy to use	Green and Environmentally Friendly	Potential to be Scaled and Mainstreamed Throughout the Crop Value Chain	Enabling Environment	Social acceptance and empowerment potenial
TA4 E- commerce and market acceess	Agroinform Trade / eTrade	0.78	0.12	0.12	0.12	0.09	0.13	0.12	0.08
	Agros.tj	0.71	0.12	0.12	0.12	0.09	0.10	0.09	0.07
		Weights	15%	15%	15%	15%	15%	15%	10%

TA4 - TECHNOLOGY SCORES



TA4 - CRITERIA INDICES



Tajikistan

TA4: E-commerce and market access

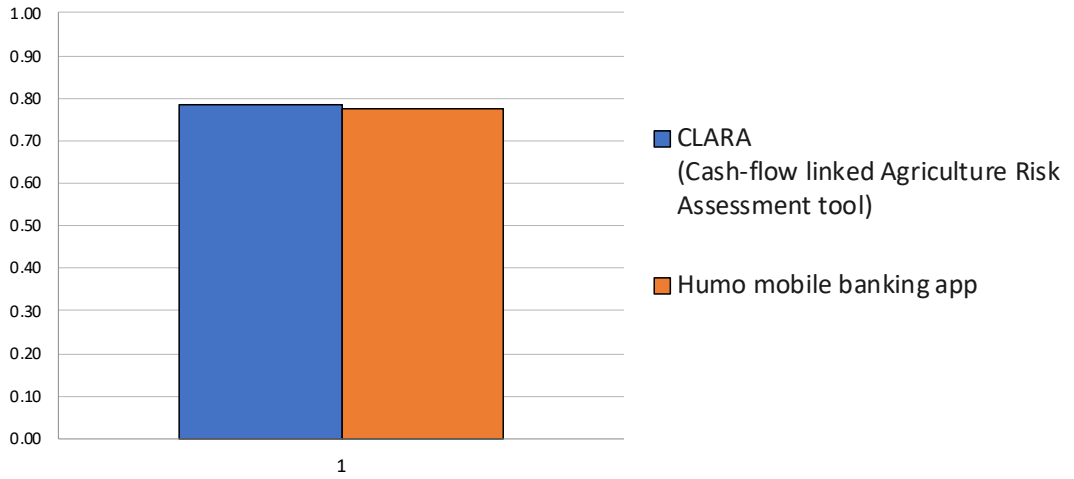
Technology one	
Name	Agroinform Trade
Type	Digital
Description	An online platform that connects smallholder farmers with buyers, traders and logistics providers, offering tools and services for selling products and accessing new markets.
Innovation	Includes buyer and trader search, product listings, negotiation and ordering features, and logistics services integration.
Benefits for smallholder farmers	Increases market access, enables negotiation of fairer prices, reduces post-harvest losses and improves livelihoods.
Acquisition cost	None
Maturity	Mature (7+ years)
Additional information	Download app from Google Play

Technology two	
Name	Agros.TJ
Type	Digital
Description	An app-based marketplace platform for fruits and vegetables, allowing farmers to buy and sell agricultural products and access agricultural information.
Innovation	Facilitates trade of agricultural products, provides access to farming information, and enables connections among farmers.
Benefits for smallholder farmers	Enhances access to agricultural products and information, improves farming practices, and facilitates peer learning and knowledge exchange.
Acquisition cost	None
Maturity	Nascent (1–3 years)
Additional information	Phone: (+992) 92 6172236 Email: agros.tj@mail.ru Download app from Google Play

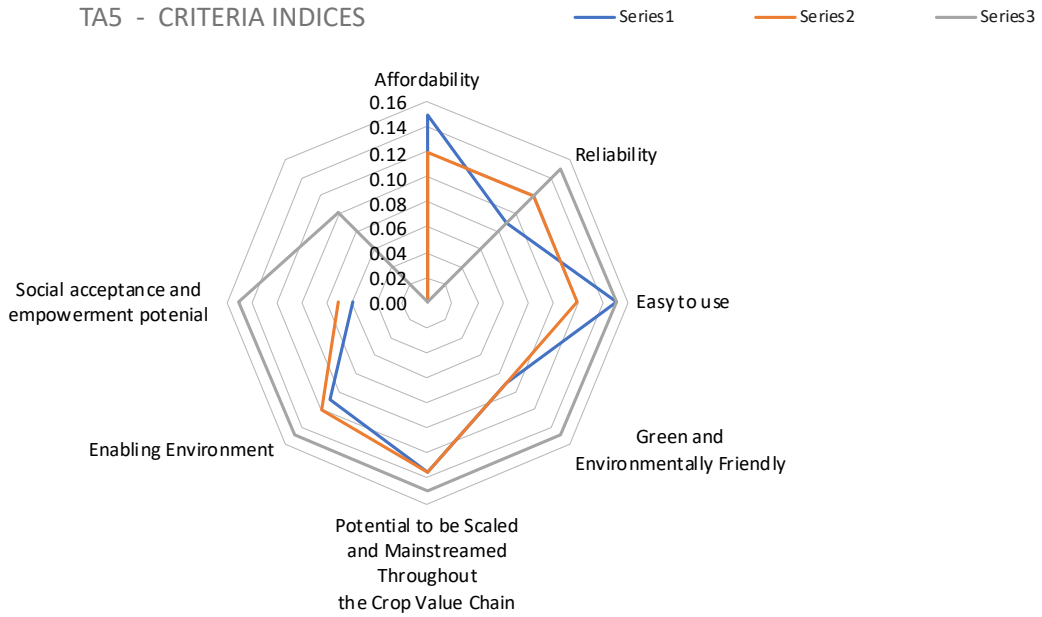
Tajikistan
TA5: Fintech

Tematic Area		Technology Name	Level 2 Assessment							
			Final Score	Affordability	Reliability	Easy to use	Green and Environmentally Friendly	Potential to be Scaled and Mainstreamed Throughout the Crop Value Chain	Enabling Environment	Social acceptance and empowerment potenial
TA5	Fintech	CLARA (Cash-flow linked Agriculture Risk Assessment tool)	0.79	0.15	0.09	0.15	0.09	0.14	0.11	0.06
		Humo mobile banking app	0.78	0.12	0.12	0.12	0.09	0.14	0.12	0.07
		Weights	15%	15%	15%	15%	15%	15%	15%	10%

TA5 - TECHNOLOGY SCORES



TA5 - CRITERIA INDICES



Tajikistan
TA5: Fintech

Technology one	
Name	**CLARA (Cash Flow Linked Agriculture Risk Assessment Tool)**
Type	Digital
Description	CLARA from CIBT is a web-based tool designed to assess the credit risk of agricultural borrowers in Tajikistan using a cash flow-based approach.
Innovation	Provides a user-friendly and accessible web-based application for both farmers and lenders, with an intuitive interface for entering farming operation data.
Benefits for smallholder farmers	Increases access to credit, may lead to improved loan terms, and aids in better financial planning and productivity.
Acquisition cost	None
Maturity	Intermediate (3–7 years)
Additional information	Address: 53, Aini Avenue, Dushanbe, Tajikistan IFC helps to introduce an innovative tool for rapid and effective agri-risk assessment in Tajikistan in Asia Plus

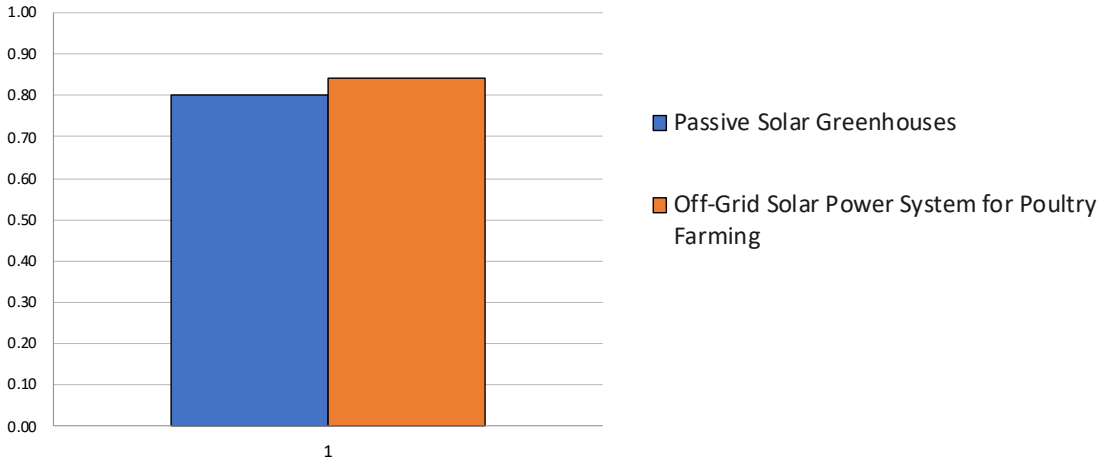
Technology two	
Name	Humo
Type	Digital
Description	A mobile banking app that provides financial services including loans, deposits, money transfers, banking cards, and online banking to individuals and businesses in Tajikistan.
Innovation	Offers comprehensive mobile banking services tailored to the needs of smallholder farmers and other users in Tajikistan.
Benefits for smallholder farmers	Provides financial education, market information, agricultural advice, and microinsurance, improving farmers' financial literacy and decision-making capabilities.
Acquisition cost	None
Maturity	Mature (7+ years)
Additional information	Address: 148/1 N. Qaraboev St., Dushanbe, Tajikistan Phone: (+992) 44 6405544

Tajikistan

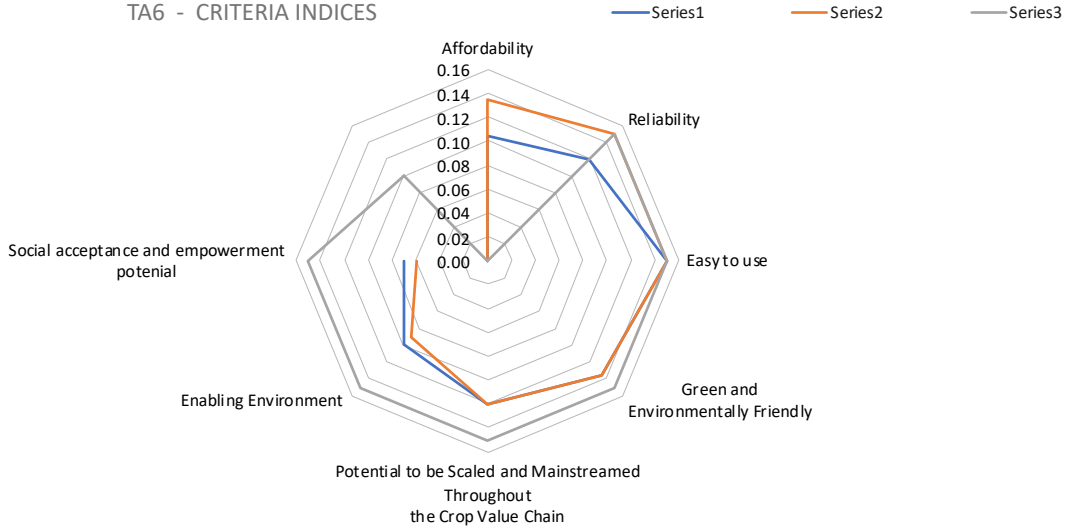
TA6: Green energy solutions for farmers

Tematic Area		Technology Name	Level 2 Assessment							
			Final Score	Affordability	Reliability	Easy to use	Green and Environmentally Friendly	Potential to be Scaled and Mainstreamed Throughout the Crop Value Chain	Enabling Environment	Social acceptance and empowerment potenial
TA6	Green energy for farmers	Passive Solar Greenhouses	0.80	0.11	0.12	0.15	0.14	0.12	0.10	0.07
		Off-Grid Solar Power System for Poultry Farming	0.84	0.14	0.15	0.15	0.14	0.12	0.09	0.06
		Weights		15%	15%	15%	15%	15%	15%	10%

TA6 - TECHNOLOGY SCORES



TA6 - CRITERIA INDICES



Tajikistan

TA6: Green energy solutions for farmers

Technology one	
Name	Off-grid solar power system for poultry farming
Type	Innovation
Description	An off-grid solar power system designed for poultry farming, providing a reliable energy source in areas with frequent electricity blackouts, essential for powering equipment like incubators and brooders.
Innovation	Generates 5 kW of electricity, effectively supporting night-time operations, and enhancing productivity and sustainability of poultry farming.
Benefits for smallholder farmers	Addresses electricity shortage challenges, reduces business losses, and promotes the use of renewable energy in farming.
Acquisition cost	Estimated cost: USD 9 500–12 250
Maturity	Mature (7+ years)
Additional information	Asian Development Bank project details Watch introductory video

Technology two	
Name	Passive solar greenhouses
Type	Innovation
Description	Passive solar greenhouses use solar energy for temperature regulation, storing energy during the day and releasing it at night to maintain stable temperatures, extending the growing season.
Innovation	Utilizes water-filled cans or black-painted walls for energy storage, ideal for early or late seasons to prevent frost and enable longer growing seasons.
Benefits for smallholder farmers	Enhances production capacity, allows for crop diversification, and benefits farmers in climate-challenged regions.
Acquisition cost	Estimated total cost: USD 10 400
Maturity	Mature (7+ years)
Additional information	Provided by Geres; Bioclimatic houses and support for agricultural development in Tajikistan in Geres Projects; In Tajikistan, Geres is working to ensure greater resilience and better living conditions for rural communities in Geres Project News.

9. Tunisia

9.1 Introduction to the agriculture sector and its challenges

Tunisia, situated in North Africa with a Mediterranean coastline, grapples with a unique set of challenges and opportunities within its agricultural sector. Geographically, the country features diverse terrain, including fertile plains in the north and arid regions in the interior and south, leading to varying agricultural potential across different regions. Climatic factors such as irregular rainfall patterns and the threat of desertification pose significant challenges to agricultural productivity, while economic constraints such as limited access to credit, and outdated farming techniques hinder progress in the sector. Cultural factors, including traditional farming practices and land ownership issues further compound these challenges, alongside inadequate infrastructure, such as transportation and storage facilities.

Tunisia's agricultural sector employs 16 percent of the labour force and contributes 8 percent of the GDP. Its contribution has declined since the 1990s in favor of imported food. Most agricultural activity takes place in the northern and central parts of Tunisia, which has more rainfall than the desert south (UNESCWA, 2020). Rainfall in Tunisia is very geographically uneven; the north receives 594 mm on average, while the south receives only 150 mm (IUCN ROWA, 2019). Technologies and practices to manage Tunisia's uneven rainfall could greatly impact smallholder rainfed farms.

Tunisia has 4.9 million hectares of agricultural land, 402 000 of which are irrigated. The main crops in the northeastern region are fruits and vegetables; olives and dates are most common in the other areas (UNESCWA, 2020). Water withdrawals used for irrigation are at 77.4 percent (FAO, undated). Tunisia has 345 m^3 of water per capita in 2020, which qualifies it as a water scarce country (World Bank, 2020). Limited water resources, droughts, and high risk of soil degradation and desertification are ongoing challenges for Tunisia (Serbaji, Bouaziz and Weslati, 2023). Agritechnologies that save water are beneficial for both farmers and for the country.

For smallholder farmers, who form the backbone of Tunisia's agricultural workforce, several challenges persist. Limited access to resources such as land and modern farming equipment inhibits their ability to compete effectively in the market. Financial constraints, including difficulty in accessing loans and credit facilities, impede their capacity for investment and growth. Moreover, a knowledge gap regarding sustainable farming practices and market-oriented approaches presents barriers to smallholder farmer productivity and profitability.

Nevertheless, opportunities abound for smallholder farmers to improve their livelihoods and enhance agricultural productivity. Agricultural extension services and training programs offer valuable support in disseminating modern farming techniques and best practices. Microfinance initiatives tailored for small-scale farmers provide avenues for accessing capital and credit, empowering farmers to invest in their businesses and adopt new technologies. Furthermore, cooperative movements enable smallholder farmers to leverage collective strength in accessing markets, purchasing inputs, and sharing knowledge and resources. Embracing digital technology, such as mobile applications for market information and weather forecasts, enhances smallholder farmers' ability to make informed decisions and adapt to changing conditions.

9.2 Tunisia Country Profile

COUNTRY: TUNISIA			No. of technologies	30
Thematic		**Technology name**	**LEVEL 1**	**LEVEL 2**
TA 1 Post harvest-reducing food loss and waste	1	Solar milk cooling systems	0.45	0.65
	2	Comporoll	0.48	0.57
	3	Mobile seed cleaning and treatment unit	0.39	
	4	Mobile feed grinders	0.39	
TA 2 Water management and water saving technologies	1	Macrocatchment rainwater harvesting	0.48	0.72
	2	IREY (Irrigation Reference to Enhance Yield)	0.52	0.66
	3	Small Scale desalination stations for irrigation	0.41	
	4	Ezzayra - Smart Irrigation, fertilization and crop management	0.41	
TA 3 Sustainable pest control and crop management	1	Permaculture/local seeds	0.53	0.72
	2	Conservation agriculture	0.50	0.65
	3	Spineless Cactus Pear (Opuntia ficus-indica)	0.49	
	4	Robocare -AI and Drones	0.48	
TA 4 E-commerce and martket access	1	Codeonline	0.48	0.67
	2	Farm Trust/Lamma	0.45	0.63
	3	Wassaloo	0.45	
	4	Optimalogistic	0.45	
TA 5 Fintech	1	Advans	0.41	0.63
	2	Pro-invest MobiPOS	0.45	0.61
	3	ENDA Tamweel	0.41	
	4	Taysir Microfinance	0.39	
TA 6 Green energy for farmers	1	Solar powered irrigation systems	0.50	0.67
	2	Bioenergy from whey/cheese byproducts	0.54	0.59
	3	Methania	0.50	
	4	Small-scale/Off-grid solar energy appliances (PULSE)	0.48	

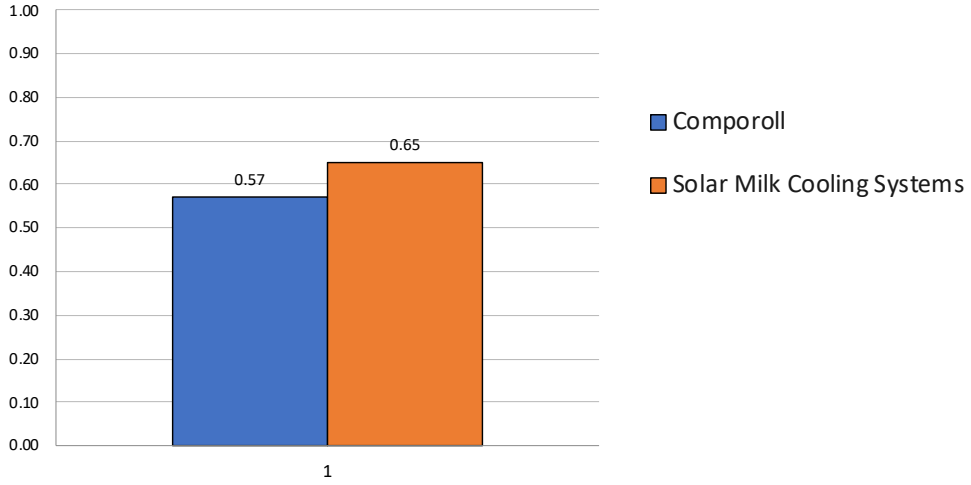
9.3 Technology profiles and assessment rankings

Tunisia

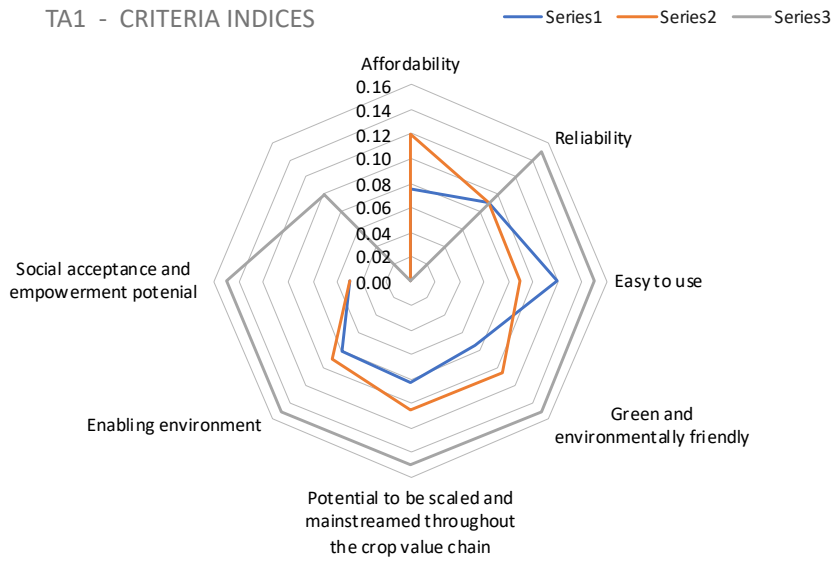
TA1: Post-harvest techniques to reduce food loss and waste

			Level 2 Assessment							
Tematic Area		Technology Name	Final Score	Affordability	Reliability	Easy to Use	Green and Environmentally Friendly	Potential to be Scaled and Mainstreamed Throughout the Crop Value Chain	Enabling Environment	Social acceptance and empowerment potenial
TA1	Post harvest-reducing Food Loss and Waste	Comporoll	0.57	0.08	0.09	0.12	0.08	0.08	0.08	0.05
		Solar Milk Cooling Systems	0.65	0.12	0.09	0.09	0.11	0.11	0.09	0.05
			Weights	15%	15%	15%	15%	15%	15%	10%

TA1 – Technology scores



TA1 - CRITERIA INDICES



Tunisia

TA1: Post-harvest techniques to reduce food loss and waste

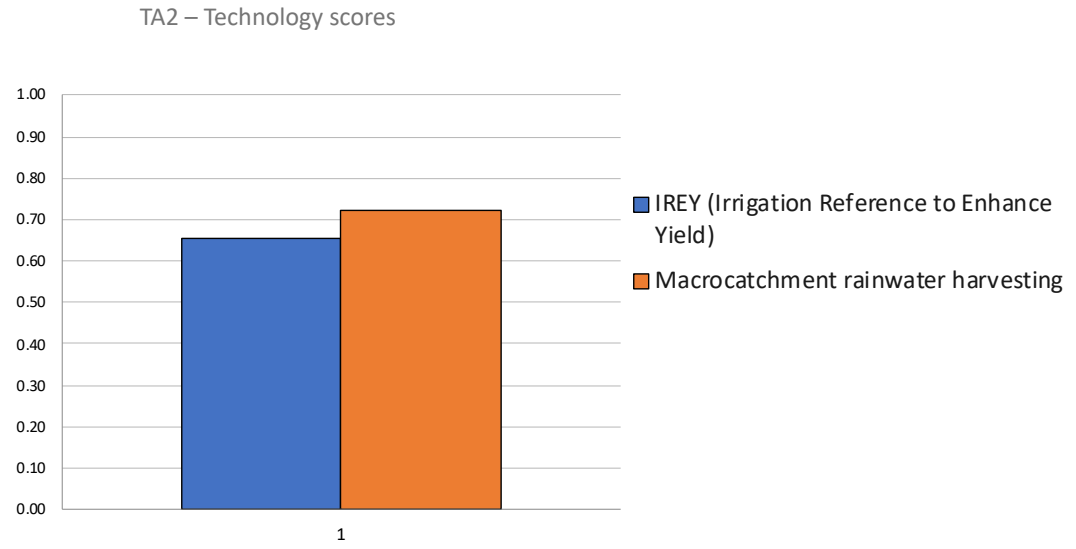
Technology one	
Name	Solar milk cooling systems
Type	Innovation
Description	Facilitates the cooling of milk on the farm or during transport using ice.
Innovation	Ice is produced with a solar powered freezer, which can cool 30 litres of milk on the farm or during transport.
Benefits for smallholder farmers	Based entirely on renewable energy and makes milk safer. Farmers can collect evening milk and morning milk together without worrying about one spoiling the other. Additionally, evening milk that would otherwise not be collected can result in extra income.
Acquisition cost	System total price: EUR 2 700
Maturity	Mature (7+ years)
Additional information	Solar milk cooling study case in Sidi Bouzeid, Tunisia by F. Mrabet, V. Torres Toledo, A. Salvatierra Rojas and J. Müller Email: info440e@uni-hohenheim.de

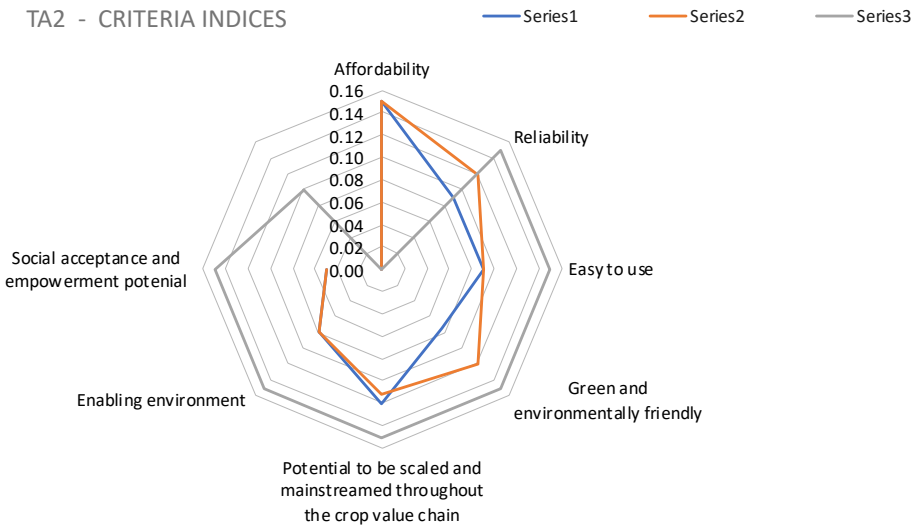
Technology two	
Name	Comporoll
Type	Innovation
Description	A technology that collects organic waste and transforms it into compost through rolling for aeration.
Innovation	The container rotates to facilitate aeration and has drainage holes to manage moisture levels. Using manual energy for stirring and rotation, the system creates compost from food waste and agricultural waste in 2–3 months.
Benefits for smallholder farmers	Affordable creation of compost that provides nutrients for crops with little energy or supply input.
Acquisition cost	TND 790–1 900 depending on size (ranging from 75–300L)
Maturity	Nascent (1–3 years)
Additional information	Address: Residence le Montplaisir, B45, Montplaisir, Tunisia Phone: (+216) 71950180 Email: contact@comporoll.com.tn Products: https://comporoll.com.tn/our-products/

Tunisia

TA2: Water management and water-saving technologies

Tematic Area		Technology Name	Level 2 Assessment							
			Final Score	Affordability	Reliability	Easy to Use	Green and Environmentally Friendly	Potential to be Scaled and Mainstreamed Throughout the Crop Value Chain	Enabling Environment	Social acceptance and empowerment potenial
TA2	Water management and water saving technologies	IREY (Irrigation Reference to Enhance Yield)	0.66	0.15	0.09	0.09	0.08	0.12	0.08	0.05
		Macrocatchment rainwater harvesting	0.72	0.15	0.12	0.09	0.12	0.11	0.08	0.05
			Weights	15%	15%	15%	15%	15%	15%	10%





Tunisia

TA2: Water management and water-saving technologies

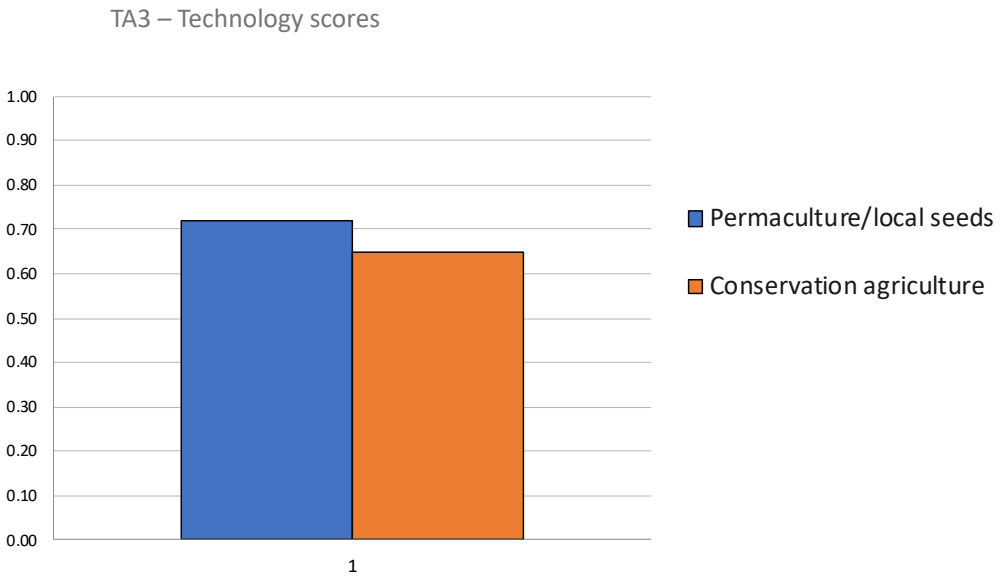
Technology one	
Name	Macrocatchment rainwater harvesting
Type	Traditional
Description	A traditional technique where earthen dams (tabias) on the slopes can catch water and soil from flooding.
Innovation	When high-intensity rain falls, flooding over steep slopes carries soil to the valley bottoms. Earthen dams (tabias) on the slopes can catch this material and level it off to form agriculture fields with water and nutritious soil. Ideal for areas where the majority of rain falls as high-intensity, low-frequency downpours.
Benefits for smallholder farmers	Capturing rainwater with this method preserves water from high-intensity downpours and ensures that runoff soil is deposited in valley bottoms. When floods or catastrophes have occurred, these traditional bunds sustain less damage than other agricultural bunds and are quicker to fix since they use local materials.
Acquisition cost	None
Maturity	Mature (7+ years)
Additional information	Traditional agricultural water management in Tunisia: contributions to environmental sustainability by Jennifer Hill and Wendy Woodland. Address: University of the West of England, Bristol, United Kingdom. E-mail: Jennifer.Hill@uwe.ac.uk

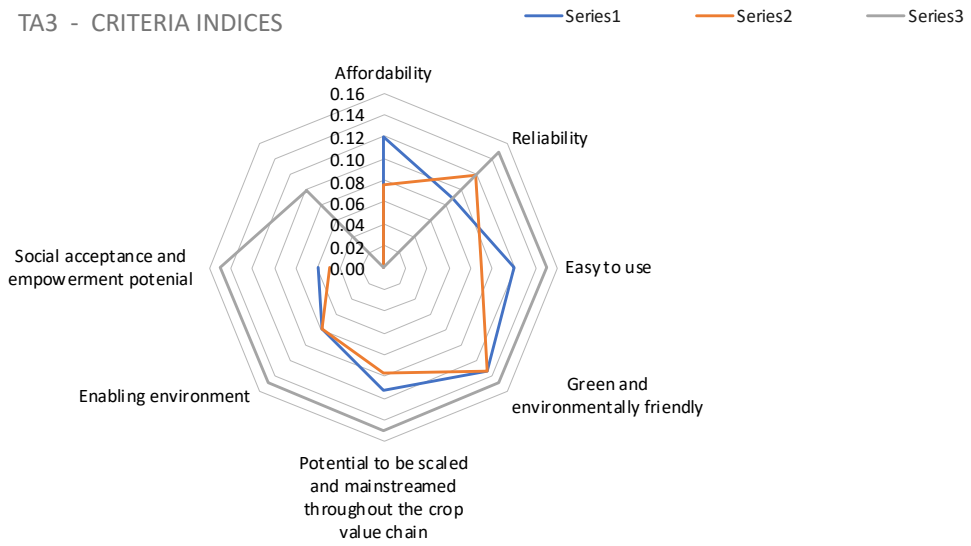
Technology two	
Name	IREY (Irrigation Reference to Enhance Yield)
Type	Digital
Description	IREY uses information about the farm and its crops to provide irrigation schedules to farmers in real time via an application.
Innovation	This portal and app disseminate information in an accessible manner in real time.
Benefits for smallholder farmers	The portal and app use water balance methodology and weather data to calculate crop evapotranspiration without needing to visit sites, so that farmers can make more informed opinions about water usage in real time.
Acquisition cost	None
Maturity	Intermediate (3–7 years)
Additional information	Watch introductory video Email: wapor@fao.org

Tunisia

TA3: Sustainable pest control and crop management

Tematic Area	Technology Name	Level 2 Assessment							
		Final Score	Affordability	Reliability	Easy to Use	Green and Environmentally Friendly	Potential to be Scaled and Mainstreamed Throughout the Crop Value Chain	Enabling Environment	Social acceptance and empowerment potenial
TA3 Sustainable pest control and crop management	Permaculture/local seeds	0.72	0.12	0.09	0.12	0.14	0.11	0.08	0.06
	Conservation agriculture	0.65	0.08	0.12	0.09	0.14	0.10	0.08	0.05
		Weights	15%	15%	15%	15%	15%	15%	10%





Tunisia

TA3: Sustainable pest control and crop management

Technology one	
Name	Permaculture and local seeds
Type	Traditional
Description	Local seeds are hardier and cheaper to access.
Innovation	Hybrid seeds are often used because of high yields in the short-term, but the necessity of re-purchasing seeds every year and the increased need for water and pesticides makes them expensive.
Benefits for smallholder farmers	Permaculture seeds are more likely to adapt to Tunisia's specific climate, resist pests, tolerate drought and can be replanted.
Acquisition cost	None
Maturity	Mature (7+ years)
Additional information	L'Association Tunisienne de Permaculture (ATP) Address: 4, El Hajeb Abdelwahab St., Tunis, Tunisia Phone: (+216) 31 401 300 Email: contact@permaculturetunisie.org

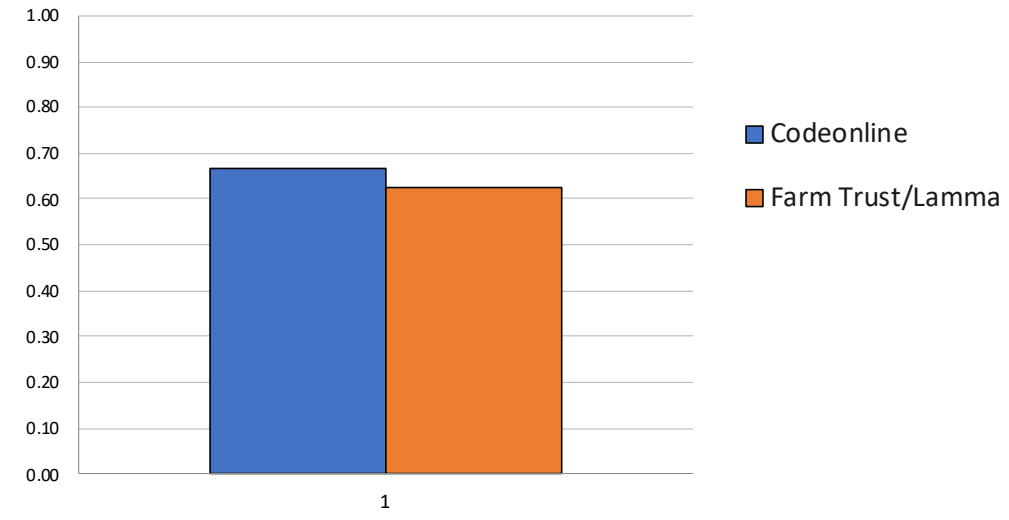
Technology two	
Name	Conservation agriculture (CA)
Type	Traditional
Description	Includes three principles: no tillage, permanent soil cover to lock in moisture, and crop diversification to replace monocropping.
Innovation	Reduces soil erosion by half and captures greenhouse gases (GHGs). Less tillage and more soil cover mean crops need less water. Diversifying crops can lead to using more local crops, which are hardier.
Benefits for smallholder farmers	Increases yields and crop resistance to climate change and inconsistent weather.
Acquisition cost	None
Maturity	Mature (7+ years)
Additional information	The conservation agriculture in northwest of Morocco (Merchouch area): The impact of no-till systems on physical properties of soils in semi-arid climate by A. El Mekkaoui, R. Moussadek, R. Mrabet, S. Chakiri, A. Douaik, A. Ghanimi and A. Zouahri Email: abdelali.elmekkaoui10@gmail.com

Tunisia

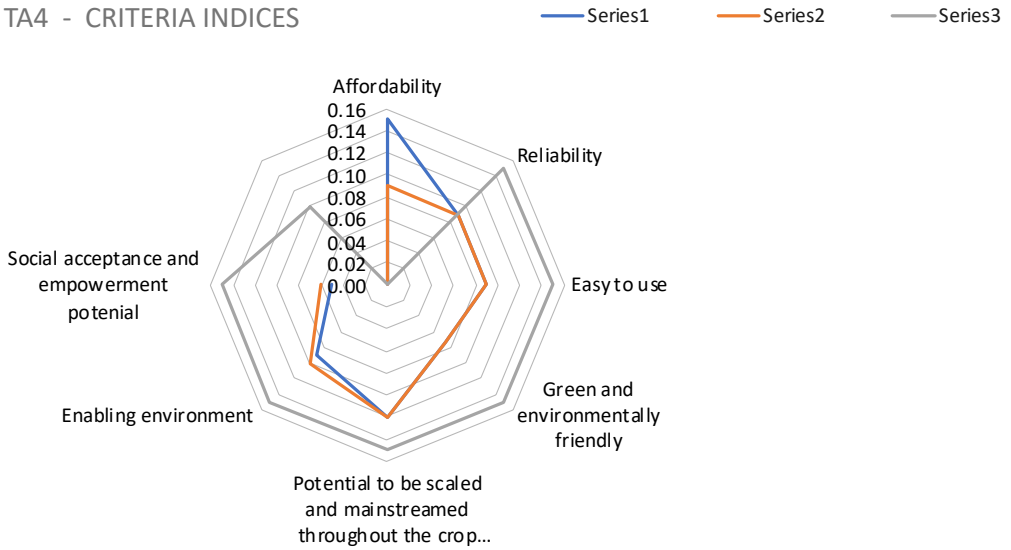
TA4: E-commerce and market access

		Level 2 Assessment							
Tematic Area	Technology Name	Final Score	Affordability	Reliability	Easy to Use	Green and Environmentally Friendly	Potential to be Scaled and Mainstreamed Throughout the Crop Value Chain	Enabling Environment	Social acceptance and empowerment potenial
TA4 E- commerce and market acceess	Codeonline	0.67	0.15	0.09	0.09	0.08	0.12	0.09	0.05
	Farm Trust/Lamma	0.63	0.09	0.09	0.09	0.08	0.12	0.10	0.06
	Weights		15%	15%	15%	15%	15%	15%	10%

TA4 – Technology scores



TA4 - CRITERIA INDICES



Tunisia

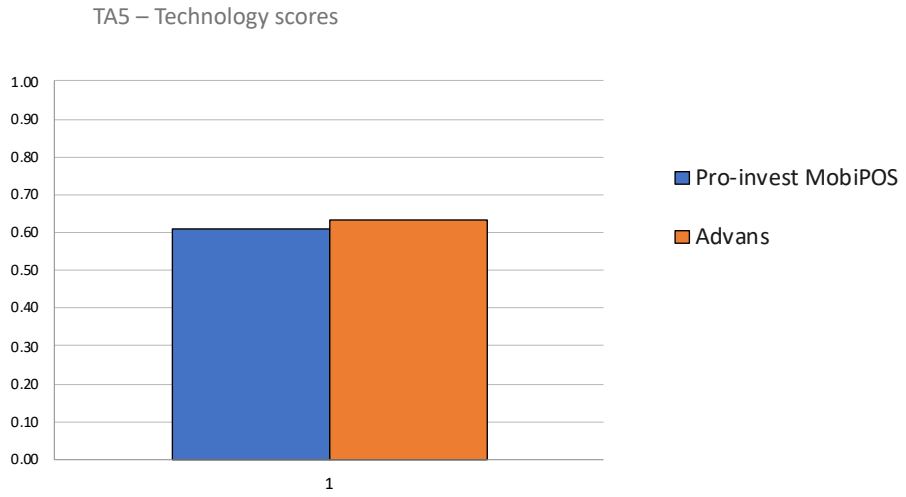
TA4: E-commerce and market access

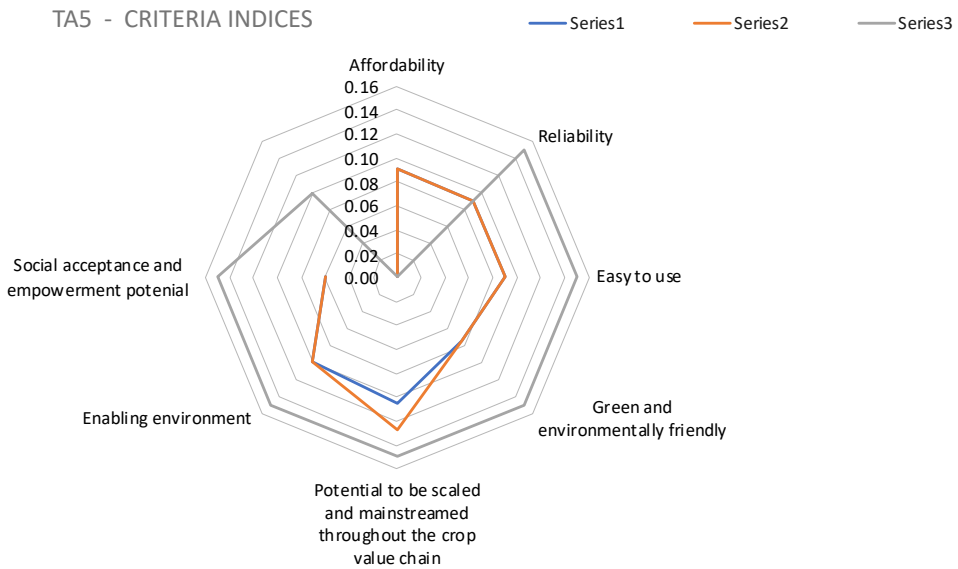
Technology one	
Name	Codeonline
Type	Digital
Description	An app that allows citizens to identify the prices of food and other products and to report violations, especially price violations.
Innovation	Streamlines communications and facilitates networked communication.
Benefits for smallholder farmers	Helps farmers ensure they are selling their products at fair prices.
Acquisition cost	None
Maturity	Nascent (1–3 years)
Additional information	Download app from Google Play

Technology two	
Name	Farm Trust and Lamma
Type	Digital
Description	An e-commerce platform for fruits and vegetables in Tunisia that provides traceability through blockchain.
Innovation	Farm Trust evaluates the produce to ensure its quality, then tracks it until the customer purchases it. It works through a dedicated central warehouse, relay points and a network of logistics partners.
Benefits for smallholder farmers	Offers farmers enhanced market access, increased transparency, and fairer prices for their produce through improved traceability and quality assurance measures.
Acquisition cost	Low, service fees
Maturity	Nascent (1–3 years)
Additional information	Phone: (+216) 28 061122 Email: contact@farm-trust.com Download app from Google Play A farmer speaks about planting and selling avocados in this video.

Tunisia
TA5: Fintech

Tematic Area	Technology Name	Level 2 Assessment							
		Final Score	Affordability	Reliability	Easy to Use	Green and Environmentally Friendly	Potential to be Scaled and Mainstreamed Throughout the Crop Value Chain	Enabling Environment	Social acceptance and empowerment potenial
TA5 Fintech	Pro-invest MobiPOS	0.61	0.09	0.09	0.09	0.08	0.11	0.10	0.06
	Advans	0.63	0.09	0.09	0.09	0.08	0.13	0.10	0.06
		Weights	15%	15%	15%	15%	15%	15%	10%





Tunisia
TA5: Fintech

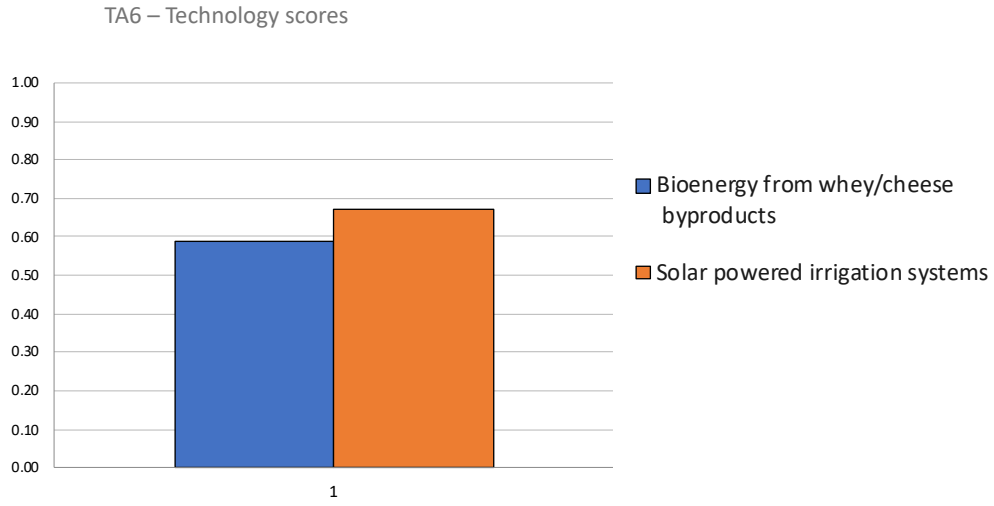
Technology one	
Name	Advans Tunisie
Type	Digital
Description	A microfinance institution offering savings and loan products, geared primarily towards entrepreneurs.
Innovation	Provides financial opportunities to small-scale endeavors.
Benefits for smallholder farmers	Offers microfinance to farmers and agricultural entrepreneurs.
Acquisition cost	Service fees and interest rates.
Maturity	Nascent (1–3 years)
Additional information	Phone: (+216) 36 410510 Email: contact@advanstunisie.com

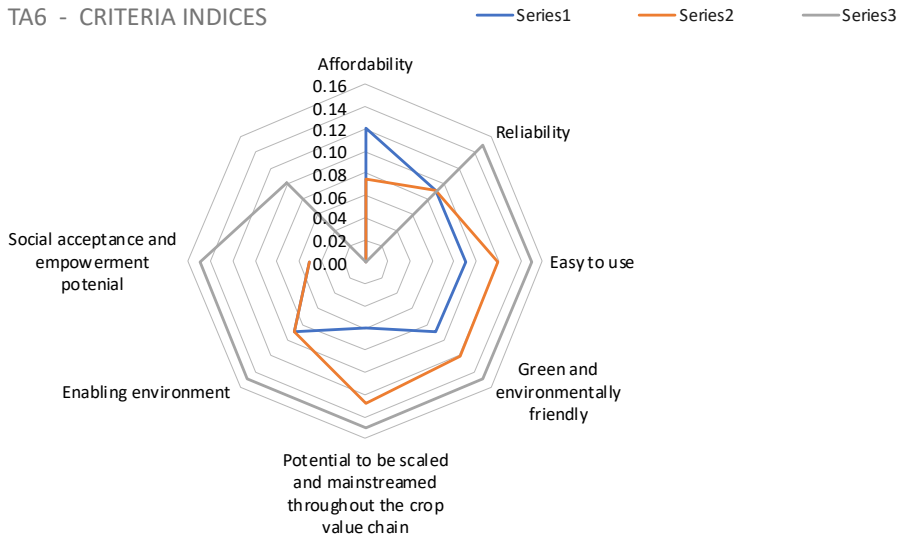
Technology two	
Name	Pro-Invest MobiPOS
Type	Digital
Description	Improves access to inputs, finance and business support services for young retail shop owners in rural areas.
Innovation	Covers inventory management, transactions and payment bottlenecks. Focused mostly on youth financial inclusion.
Benefits for smallholder farmers	Services make rural retail operations more efficient.
Acquisition cost	None. MobiPOS was a free pilot trial.
Maturity	Nascent (1–3 years)
Additional information	n/a

Tunisia

TA6: Green energy solutions for farmers

Tematic Area	Technology Name	Level 2 Assessment							
		Final Score	Affordability	Reliability	Easy to Use	Green and Environmentally Friendly	Potential to be Scaled and Mainstreamed Throughout the Crop Value Chain	Enabling Environment	Social acceptance and empowerment potenial
TA6 Green energy for farmers	Bioenergy from whey/cheese byproducts	0.59	0.12	0.09	0.09	0.09	0.06	0.09	0.05
	Solar powered irrigation systems	0.67	0.08	0.09	0.12	0.12	0.13	0.09	0.05
		Weights	15%	15%	15%	15%	15%	15%	10%





Tunisia

TA6: Green energy solutions for farmers

Technology one	
Name	Solar powered irrigation systems (SPIS)
Type	Innovation
Description	Uses solar power to irrigate crops
Innovation	Stores energy during the day and irrigates at night to decrease water evaporation. These systems save water and energy, and also reduce soil runoff.
Benefits for smallholder farmers	Saves much of the energy that would otherwise be used for water pumping and reducing the amount of water needed for irrigation.
Acquisition cost	High cost for system purchase and installation.
Maturity	Mature (7+ years)
Additional information	Impact of solar pumping irrigation systems in Tunisia by the German Corporation for International Cooperation (GIZ) Email: nexus@giz.de

Technology two	
Name	Bioenergy from whey and cheese byproducts
Type	Innovation
Description	Using whey and cheese byproducts to create bioethanol as a way to valorize whey and create additional profit for dairy farmers.
Innovation	Uses waste byproducts to create energy.
Benefits for smallholder farmers	Creates an avenue for additional profits through bioenergy.
Acquisition cost	None. No cost to farmers whose byproducts are being used, some cost for the process itself.
Maturity	Mature (7+ years)
Additional information	The diary biofinery: Integrating treatment process for Tunisian cheese whey valorization by J. Mabrouki, M.A. Abbassi, B. Khiari, S. Jellali, A. Zorpas and M. Jeguirim. Email: mejdi.jeguirim@uha.fr

10. Türkiye

10.1 Introduction to the agriculture sector and its challenges

Türkiye's agriculture sector faces various challenges affecting its sustainability and productivity. Climate change-induced weather patterns and water scarcity pose significant threats to crop yields, exacerbated by the country's high population density, which limits available arable land. Reliance on traditional farming methods and the excessive use of pesticides and fertilizers contribute to soil degradation and environmental issues. Furthermore, farmers encounter difficulties in accessing markets and coping with price fluctuations, which undermines their economic stability.

Despite these challenges, there are numerous opportunities for growth and innovation in the sector. Adoption of modern farming techniques and precision agriculture can enhance productivity and sustainability. Leveraging its strategic geographical location enables Türkiye to access European and Asian markets, tapping into significant export potential. Moreover, the growing global demand for organic and sustainable products creates opportunities for diversification. Exploiting diverse landscapes and cultural heritage through agrotourism offers avenues for additional revenue generation. Additionally, government incentives and policies supporting agricultural development further contribute to the sector's potential growth.

Smallholder farmers in Türkiye face specific challenges impacting their livelihoods and productivity, such as limited access to financing, which limits their ability to invest in farm improvements, and land fragmentation and small landholdings, which limit economies of scale. Moreover, the lag in adopting modern agricultural practices hampers productivity and efficiency, and market connectivity issues inhibit access to larger markets. However, opportunities exist for smallholder farmers to thrive, including government support through subsidies and training programs, catering to the growing demand for organic produce, cooperative farming models, and leveraging agrotourism to showcase Türkiye's cultural and natural heritage.

10.2 Türkiye Country Profile

COUNTRY: **Türkiye**

No. of technologies 35

Thematic area		Technology name	LEVEL 1 assessment score	LEVEL 2 assessment score
TA 1 Post harvest-reducing food loss and waste	1	Biopols food storage technology	0.55	0.78
	2	AI and IoT to predict prodict and extend lifetime: FreshSens	0.56	0.73
	3	Microencapsulation biocontrol: Nanomik	0.50	
	4	AnadOlive turning waste from olive into valuable product	0.45	
TA 2 Water management and water saving technologies	1	FlowMeter by Doktar Technologies	0.60	0.81
	2	Seracell smart greenhouse solutions	0.58	0.75
	3	Agrovisio	0.58	
	4	Filiz Agricultural Sensor Station by Doktar Technologies	0.55	
TA 3 Sustainable pest control and crop management	1	Farmolog	0.59	0.82
	2	PestTrap - Digital pest tracking station by Doktar Technologies	0.55	0.78
	3	SoilScanner - Digital soil analysis device by Doktar Technologies	0.53	
	4	Vodafone Türkiye Digital Agriculture Project	0.50	
TA 4 E-commerce and martket access	1	Pazardan online marketplace	0.61	0.81
	2	Trusty by ForFarming	0.55	0.76
	3	Tarla.io: SMS, email, app alert about market & more	0.54	
	4	İmeceMobil	0.52	
TA 5 Fintech	1	Tarfin: get now, pay at harvest	0.58	0.74
	2	AgrioFinans smart contract and financial services	0.56	0.73
	3	TARSIM comprehensive farmers' insurance	0.55	
	4	BUSO blockchain-based platform	0.45	
TA 6 Green energy for farmers	1	Agrivoltaics from Enerjisa	0.64	0.92
	2	Geothermal greenhouses	0.63	0.86
	3	Harnessing variable low wind with "sails" from Grawindy	0.57	
	4	Zero-Tillage (ZT) farming for winter wheat	0.54	

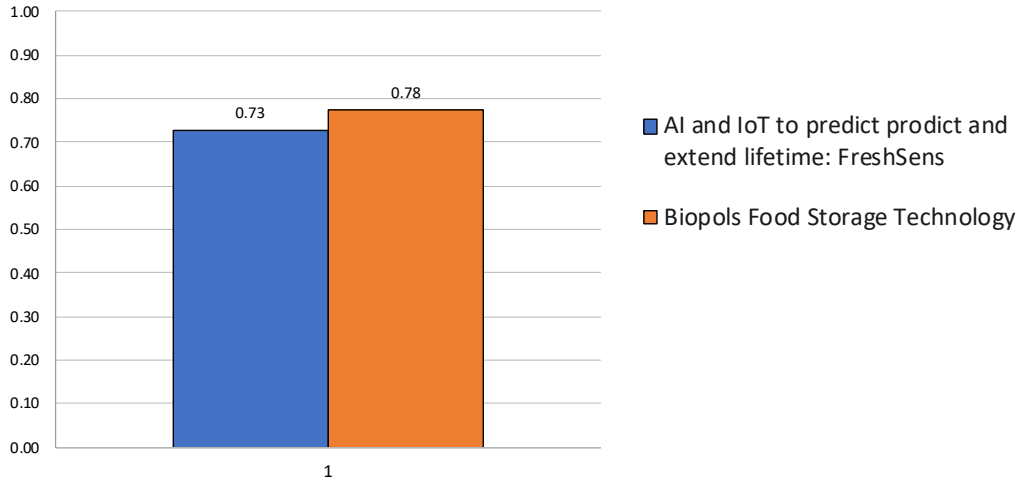
10.3 Technology profiles and assessment rankings

Türkiye

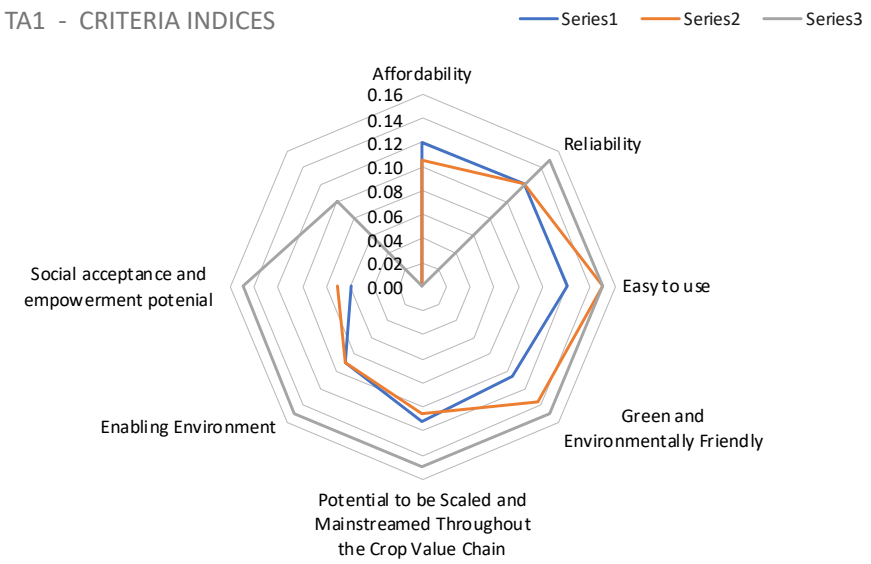
TA1: Post-harvest techniques to reduce food loss and waste

			Level 2 Assessment							
Tematic Area		Technology Name	Final Score	Affordability	Reliability	Easy to use	Green and Environmentally Friendly	Potential to be Scaled and Mainstreamed Throughout the Crop Value Chain	Enabling Environment	Social acceptance and empowerment potenial
TA1	Post harvest-reducing Food Loss and Waste	AI and IoT to predict prodict and extend lifetime: FreshSens	0.73	0.12	0.12	0.12	0.11	0.11	0.09	0.06
		Biopols Food Storage Technology	0.78	0.11	0.12	0.15	0.14	0.11	0.09	0.07
			Weights	15%	15%	15%	15%	15%	15%	10%

TA1 - TECHNOLOGY SCORES



TA1 - CRITERIA INDICES



Türkiye

TA1: Post-harvest techniques to reduce food loss and waste

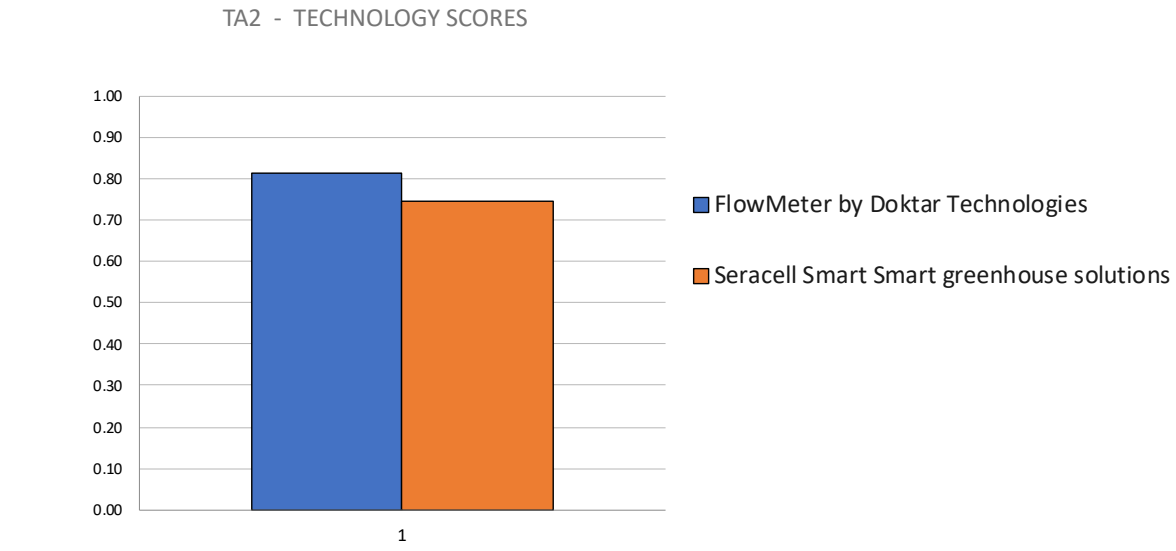
Technology one	
Name	Biopols food storage technology
Type	Innovation
Description	Antibacterial and antioxidant food coatings and packaging developed from food wastes and fungal chitosan, aiming to extend the shelf life of food products and provide an eco-friendly alternative to plastic packaging.
Innovation	Utilizes the extraction and application of fungal chitosan for natural and sustainable food preservation.
Benefits for smallholder farmers	Reduces food waste, extends shelf life of produce and offers an environmentally friendly packaging solution.
Acquisition cost	USD 100–200/tonne of food products coated with fungal chitosan.
Maturity	Intermediate (3–7 years)
Additional information	Address: Hoşnudiye, 781. Sk. No. 6/4, 26180 Tepebaşı/Eskişehir, Türkiye Email: bilgi@biopols.co

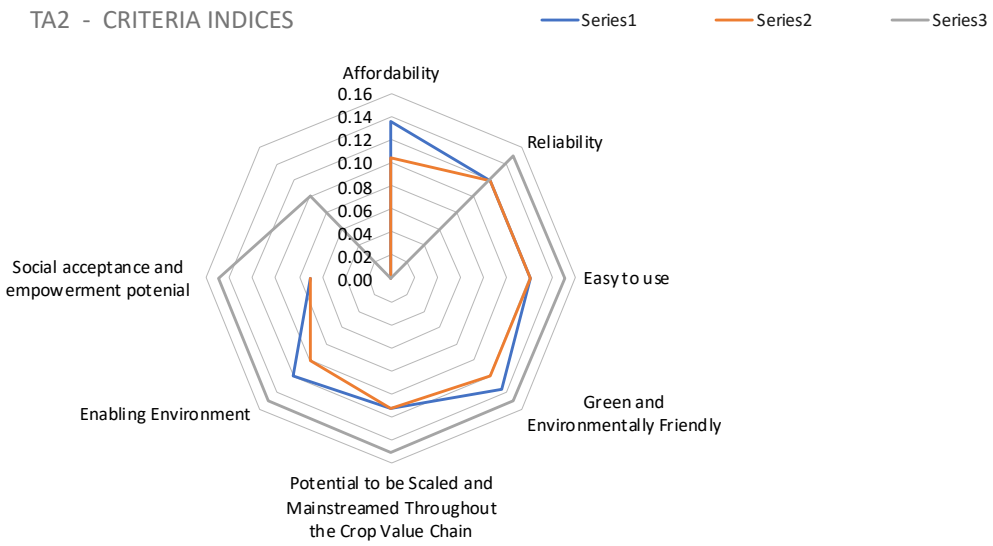
Technology two	
Name	FreshSens
Type	Digital
Description	An AI-powered platform supported by IoT to prevent perishable loss by predicting and extending their lifetime post-harvest, using controlled atmosphere (CA) modules and IoT sensors.
Innovation	Combines AI for predictive analysis, IoT sensors for real-time monitoring, and a CA system for controlling the storage environment.
Benefits for smallholder farmers	Reduces food waste, extends shelf life of perishables and increases profits through better timing for selling produce.
Acquisition cost	Estimate: Total hardware cost: USD 1 500–3 000; Total software cost: USD 250–500 per year; Total installation cost: USD 500–1 000.
Maturity	Nascent (1–3 years)
Additional information	Address: FreshSens Teknoloji (R&D) Denizli Yolu Bulvarı Teknopark Sitesi B Blok No.12, Kötekli Menteşe, Muğla, Türkiye Email: info@freshsens.ai

Türkiye

TA2: Water management and water-saving technologies

			Level 2 Assessment							
Tematic Area		Technology Name	Final Score	Affordability	Reliability	Easy to use	Green and Environmentally Friendly	Potential to be Scaled and Mainstreamed Throughout the Crop Value Chain	Enabling Environment	Social acceptance and empowerment potenial
TA2	Water management and water saving technologies	FlowMeter by Doktar Technologies	0.81	0.14	0.12	0.12	0.14	0.11	0.12	0.07
		Seracell Smart Smart greenhouse solutions	0.75	0.11	0.12	0.12	0.12	0.11	0.10	0.07
			Weights	15%	15%	15%	15%	15%	15%	10%





Türkiye

TA2: Water management and water-saving technologies

Technology one	
Name	FlowMeter
Type	Digital
Description	An advanced tool for sustainable irrigation management, accurately measuring flow rates and providing detailed irrigation reports to optimize water usage.
Innovation	Features advanced flow rate measurement, compatibility with various water meters, sustainable power options and an app for insightful irrigation reports.
Benefits for smallholder farmers	Enhances water usage efficiency, reduces water waste and improves crop yields through better irrigation management.
Acquisition cost	Total setup cost: USD 1 600–3 200; Total ongoing cost: USD 400–800/year.
Maturity	Nascent (1–3 years)
Additional information	Provided by Doktar Technologies; Address: Teknokent, İTÜ Maslak Kampüsü, Reşitpaşa Mah. Katar Cad, Arı Çk. No.3 Binası B3, 34467 Sarıyer, İstanbul, Türkiye

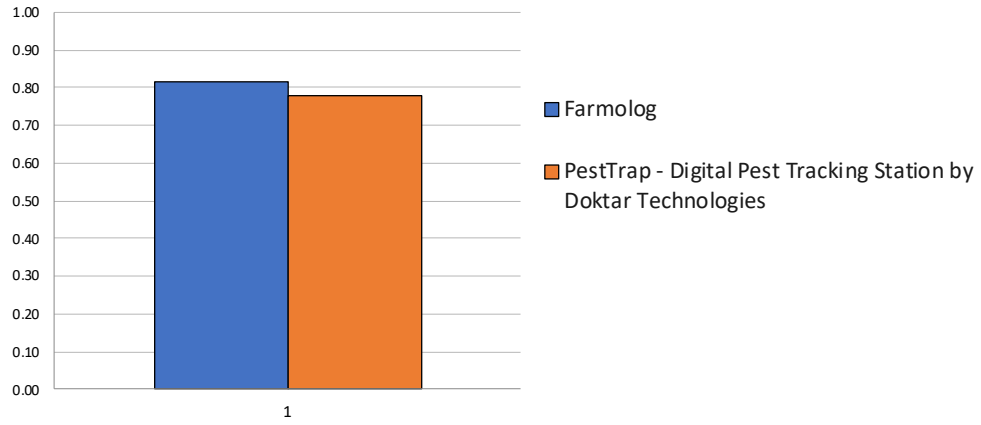
Technology two	
Name	Seracell smart greenhouse solutions
Type	Digital
Description	Smart greenhouse solutions with sensors for soil moisture and nutrient levels, automatic irrigation adjustments and climate control for optimized plant growth.
Innovation	Utilizes AI for data analysis, advanced sensor technology and remote management capabilities for precise greenhouse control.
Benefits for smallholder farmers	Saves water, improves crop yields, reduces pest and disease risks, and increases overall farming efficiency.
Acquisition cost	Estimate for a good level of automation: Total setup cost: USD 5 250–10 500; Total ongoing cost: USD 900–1 800/year.
Maturity	Nascent (1–3 years)
Additional information	Address: Üniversiteler Mah. 1606 Cad. Bilkent Cyberpark B Blok 2.Kat No. 229, Çankaya, Ankara, Türkiye Email: info@seracell.com.tr

Türkiye

TA3: Sustainable pest control and crop management

Tematic Area		Technology Name	Level 2 Assessment							
			Final Score	Affordability	Reliability	Easy to use	Green and Environmentally Friendly	Potential to be Scaled and Mainstreamed Throughout the Crop Value Chain	Enabling Environment	Social acceptance and empowerment potenial
TA3	Sustainable pest control and crop management	Farmolog	0.82	0.14	0.15	0.12	0.11	0.14	0.10	0.07
		PestTrap - Digital Pest Tracking Station by Doktar Technologies	0.78	0.11	0.12	0.12	0.15	0.11	0.10	0.07
			Weights	15%	15%	15%	15%	15%	15%	10%

TA3 - TECHNOLOGY SCORES



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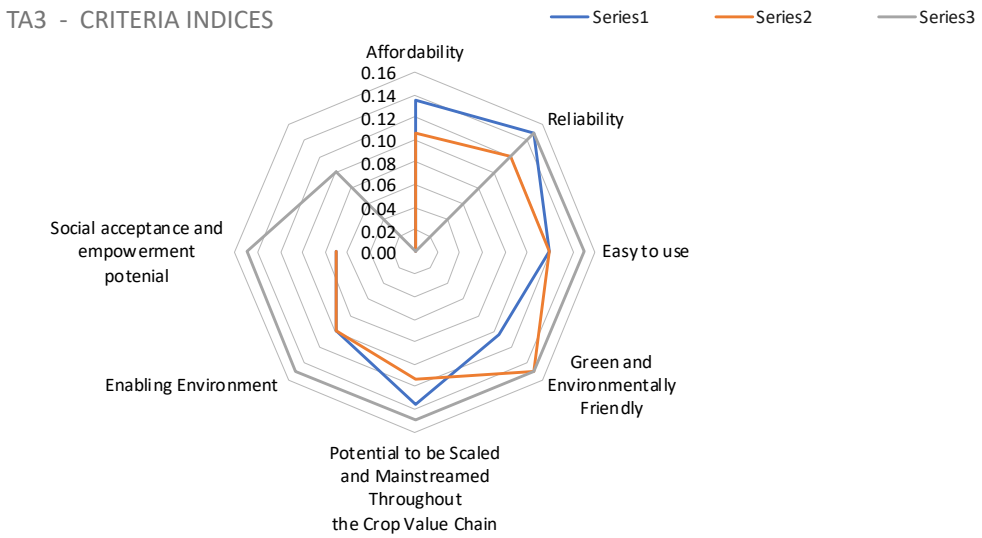


Türkiye

TA3: Sustainable pest control and crop management

Technology one	
Name	Farmolog
Type	Digital
Description	A digital agriculture platform utilizing sensors, satellites, drones and machine learning to provide data analysis and transmission for informed decision-making in farming.
Innovation	Features centralized management for contract farming, activity records, income and expense tracking, and advanced reporting capabilities.
Benefits for smallholder farmers	Increases efficiency and productivity, supports resource management, offers early warnings for natural risks and promotes sustainable practices.
Acquisition cost	None
Maturity	Intermediate (3–7 years)
Additional information	Address: Gülbahçe Mah. Gülbahçe Cad. Teknopark İzmir A8 Binası No:1/45 İç Kapı No. 21, Urla İzmir, Türkiye Phone: (+90) 23 25206438 Email: info@farmolog.com

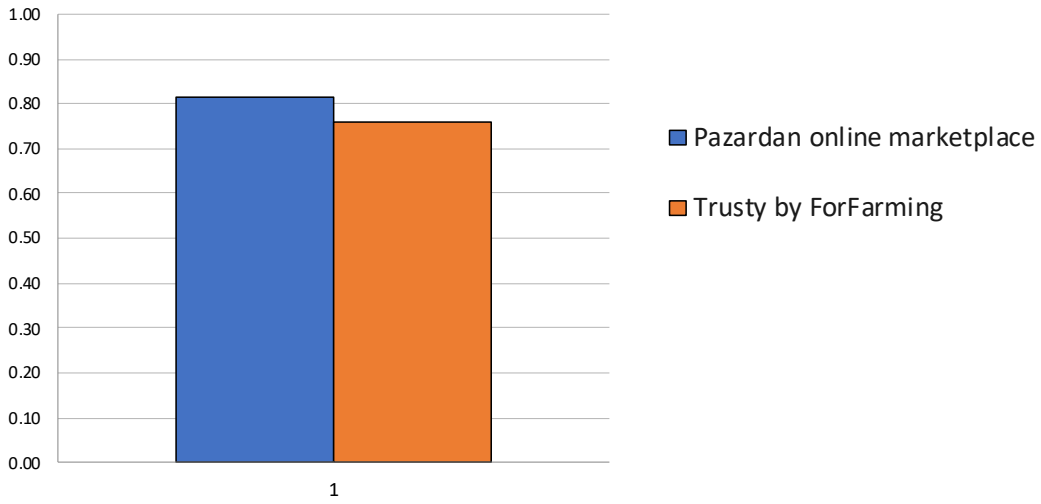
Technology two	
Name	PestTrap
Type	Digital
Description	An IoT-based pest-tracking station using pheromone traps and machine learning for real-time pest identification and counting, suitable for various agricultural settings.
Innovation	Integrates a sticky paper and camera for daily pest tracking, a 5MP camera for high-resolution imaging, and solar panel energy generation.
Benefits for smallholder farmers	Enables early pest detection, reducing crop damage and economic losses, and allows for remote monitoring and timely interventions.
Acquisition cost	Total hardware cost: USD 850–1 700 (split between PestTrap unit: USD 500–1 000, Pheromone trap: USD 250–500, Solar panel: USD 100–200); Total software cost: USD 250–500/year; Pheromone trap replacement: USD 250–500 every 12–18 months.
Maturity	Nascent (1–3 years)
Additional information	Provided by Doktar Technologies; Address: Teknokent, İTÜ Maslak Kampüsü - Reşitpaşa Mah. Katar Cad, Arı Çk. No. 3 Binası B3, 34467 Sarıyer/İstanbul, Türkiye Phone: (+90) 85 0433 6477 Email: info@doktar.com

Türkiye

TA4: E-commerce and market access

Tematic Area		Technology Name	Level 2 Assessment							
			Final Score	Affordability	Reliability	Easy to use	Green and Environmentally Friendly	Potential to be Scaled and Mainstreamed Throughout the Crop Value Chain	Enabling Environment	Social acceptance and empowerment potenial
TA4	E- commerce and market access	Pazardan online marketplace	0.81	0.15	0.12	0.12	0.11	0.13	0.11	0.08
		Trusty by ForFarming	0.76	0.11	0.12	0.12	0.11	0.12	0.12	0.07
		Weights		15%	15%	15%	15%	15%	15%	10%

TA4 - TECHNOLOGY SCORES



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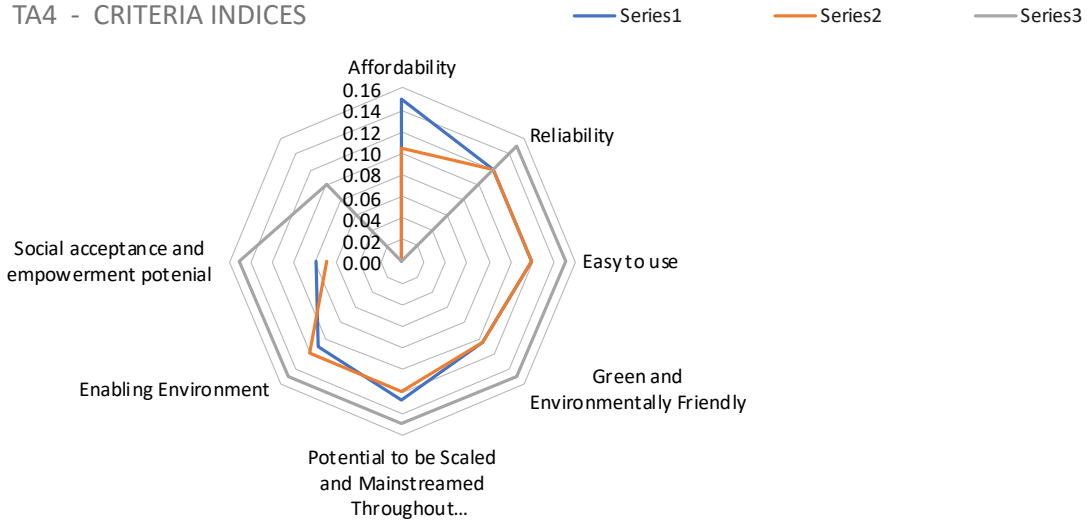


Türkiye

TA4: E-commerce and market access

Technology one	
Name	Pazardan
Type	Digital
Description	An online platform that connects consumers with fresh produce from local markets, offering direct access to a broader customer base for smallholder farmers.
Innovation	Integrates e-commerce and mobile technology to make the supply chain more efficient and accessible for both farmers and consumers.
Benefits for smallholder farmers	Provides direct access to urban consumers, expanding market reach beyond local selling points, potentially increasing profit margins.
Acquisition cost	None
Maturity	Intermediate (3–7 years)
Additional information	Address: Mimar Sinan Mahallesi Büyükdere Caddesi No. 235, Gayrettepe Şişli-İstanbul Türkiye Phone: (+90) 53 05047045 Email: info@pazardanış.com

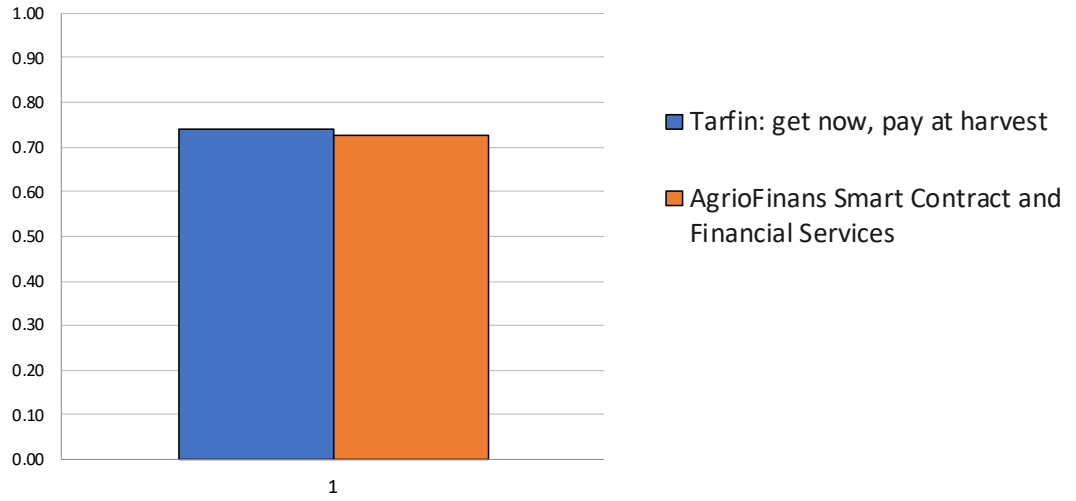
Technology two	
Name	**Trusty** by ForFarming
Type	Digital
Description	A customer communication platform that enhances brand transparency, food safety and sustainability by displaying production processes, reports and certifications to consumers via QR codes.
Innovation	Uses blockchain for secure data recording, third-party integrations for system compatibility and interactive elements for consumer engagement.
Benefits for smallholder farmers	Improves consumer trust, enhances marketability of products by demonstrating their safety and sustainability, and potentially increases sales and customer loyalty.
Acquisition cost	Platform setup: USD 1 000–2 500; Monthly data storage: USD 50–100; Training and onboarding: USD 250–500; Total: USD 1 300–3 350.
Maturity	Intermediate (3–7 years)
Additional information	Address: Maslak Mahallesi, 9.Sokak, No. 310/A, Daire:11-3, Sarıyer, İstanbul, Türkiye

Türkiye

TA5: Fintech

Tematic Area		Technology Name	Level 2 Assessment							
			Final Score	Affordability	Reliability	Easy to use	Green and Environmentally Friendly	Potential to be Scaled and Mainstreamed Throughout the Crop Value Chain	Enabling Environment	Social acceptance and empowerment potenial
TA5	Fintech	Tarfin: get now, pay at harvest	0.74	0.14	0.12	0.12	0.06	0.13	0.11	0.07
		AgrioFinans Smart Contract and Financial Services	0.73	0.11	0.12	0.12	0.09	0.11	0.12	0.06
		Weights	15%	15%	15%	15%	15%	15%	15%	10%

TA5 - TECHNOLOGY SCORES



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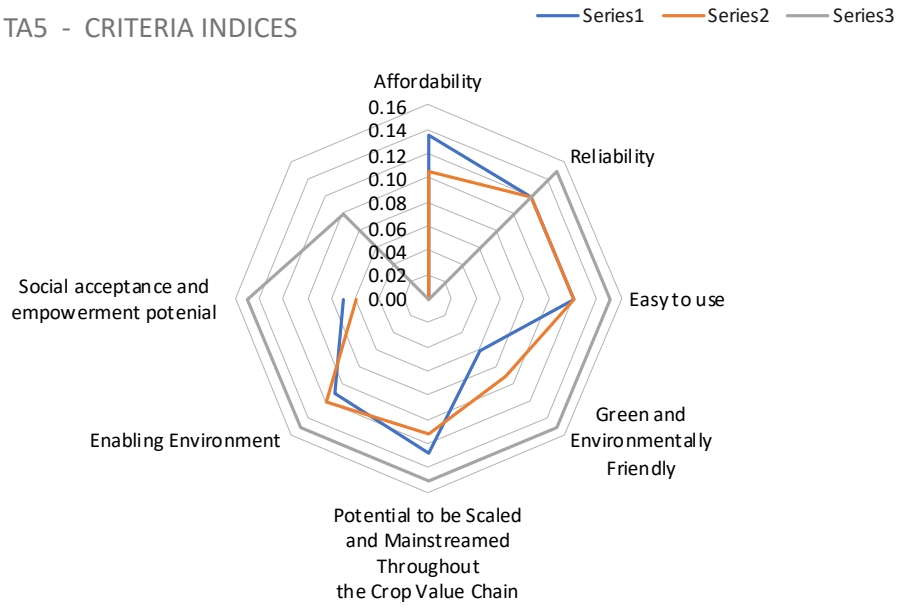


Türkiye
TA5: Fintech

Technology one	
Name	Tarfin
Type	Digital
Description	A digital platform offering agricultural inputs with a pay-after-harvest model, allowing farmers to compare prices from numerous retailers across Türkiye.
Innovation	Employs a mobile app for convenient transactions, price comparisons and instant approvals, enhancing cash flow management for farmers.
Benefits for smallholder farmers	Provides easy access to inputs without immediate cash requirements, competitive pricing and financial flexibility.
Acquisition cost	None
Maturity	Intermediate (3–7 years)
Additional information	Address: Nispetiye Cd 4, Beşiktaş, İstanbul, Türkiye

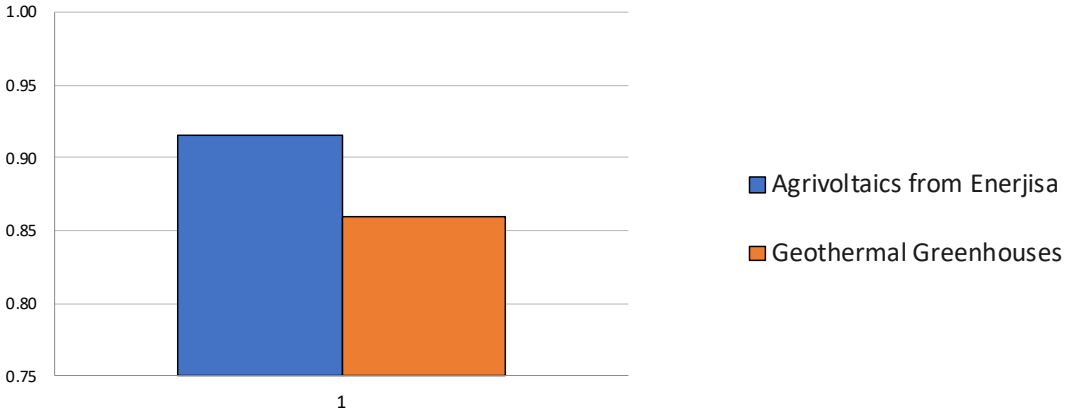
Technology two	
Name	AgrioFinans
Type	Digital
Description	Manages cash, inventory and data flow in agriculture, offering digital POS systems, e-wallets and a payment network, leveraging smart contract technology.
Innovation	Utilizes smart contracts for transparent financial transactions and efficient resource management in the agricultural sector.
Benefits for smallholder farmers	Streamlines financial transactions, improves access to credit, and aids in efficient resource management and risk mitigation.
Acquisition cost	None
Maturity	Nascent (1–3 years)
Additional information	Address: Akasya AVM - No:426/B, Acıbadem 34660 Üsküdar, İstanbul, Türkiye Phone: (+90) 850 840 2391; (+90) 850 308 2301 Email: info@agriofinans.com

Türkiye

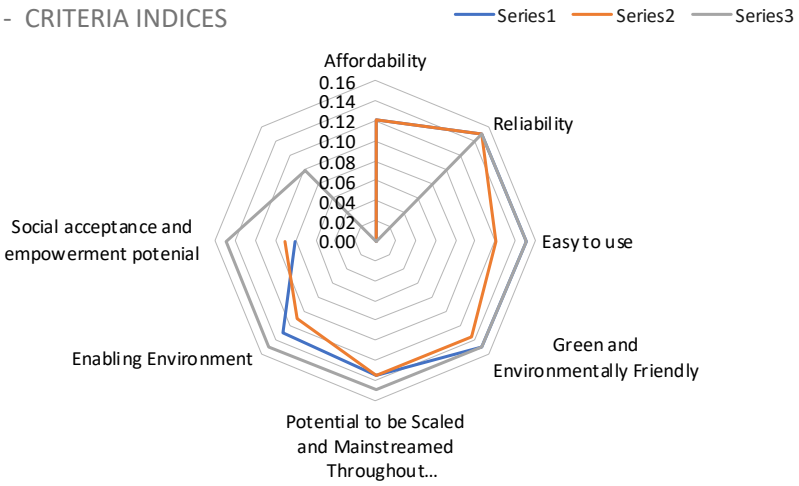
TA6: Green energy solutions for farmers

Tematic Area		Technology Name	Level 2 Assessment							
			Final Score	Affordability	Reliability	Easy to use	Green and Environmentally Friendly	Potential to be Scaled and Mainstreamed Throughout the Crop Value Chain	Enabling Environment	Social acceptance and empowerment potenial
TA6	Green energy for farmers	Agrivoltaics from Enerjisa	0.92	0.12	0.15	0.15	0.15	0.14	0.13	0.08
		Geothermal Greenhouses	0.86	0.12	0.15	0.12	0.14	0.14	0.11	0.09
			Weights	15%	15%	15%	15%	15%	15%	10%

TA6 - TECHNOLOGY SCORES



TA6 - CRITERIA INDICES



Türkiye

TA6: Green energy solutions for farmers

Technology one	
Name	Agrivoltaics
Type	Innovation
Description	The dual use of land for solar energy production and agriculture. It combines agriculture and solar energy production using solar panels installed over farming fields, offering both crop protection and energy generation.
Innovation	Provides a synergistic solution for agriculture and renewable energy, with elevated, diluted solar panels that protect crops and generate electricity.
Benefits for smallholder farmers	Protects from extreme weather, enables efficient crop growth and generates renewable energy, enhancing farm sustainability.
Acquisition cost	Estimated cost: USD 20 000–40 000/hectare.
Maturity	Mature (7+ years)
Additional information	Provided by Enerjisa; Enerjisa launches first agrivoltaic pilot project in Turkey in Balkan Green Energy News

Technology two	
Name	Geothermal greenhouses
Type	Innovation
Description	Uses geothermal energy for heating, enabling year-round cultivation of crops in a sustainable and cost-effective manner.
Innovation	Utilizes geothermal energy for greenhouse heating, supporting soilless agriculture and cultivation irrespective of external climatic conditions.
Benefits for smallholder farmers	Reduces energy costs, allows growth of produce throughout the year and increases agricultural productivity.
Acquisition cost	Rough estimate of equipping the greenhouse with a geothermal heat system where the service is provided: USD 20 000–40 000.
Maturity	Mature (7+ years)
Additional information	Sera-Bir (Greenhouse Investors and Producers Association); Geothermal greenhouse in Sandikli, Turkey exports produce to Europe in ThinkGeoEnergy; Geothermal greenhouses offer alternative solution to food crisis, Turkey in ThinkGeoEnergy.

OVERALL REFLECTIONS AND RECOMMENDATIONS FOR NEXT STEPS

This report, transcending the scope of the ten analysed countries, represents a pioneering effort in methodological technology assessment for smallholder farmers. It delineates the development and application of a new methodology, its translation into a practical decision support tool—an Excel-based application—and the subsequent validation across ten countries. This approach served not only to refine the methodology and tool, but also to underscore the broader applicability and relevance of this work beyond the countries analysed.

The report can be appreciated from three distinct perspectives:

1. **Methodological:** The development of a novel detailed methodology for screening and assessing agricultural technologies for smallholder farmers, which consists of three levels of assessment including seven Level 1 criteria, and 29 Level 2 and Level 3 subcriteria. The screening criteria allowed for narrowing down the thousands of technologies available across different technology databases to a total of 349 technologies across the six thematic areas in the ten target counties. All identified criteria include specific quantifiable indicators where possible, and a rating scheme to facilitate the assessment process.
2. **Tool development:** Acknowledging the context-specific nature across different countries, and the potential varying priorities and goals for different stakeholders (farmers, investors, donors, etc.), the developed tool allows users to reflect those priorities through adjusting the scores and weights for different criteria. Recommendations for future improvements are grounded in an Agile development philosophy, advocating for continuous refinement based on assessments in diverse country contexts. Such an approach ensures that the methodology and tool remain adaptable and responsive to new insights, thereby enhancing their utility and effectiveness.

3. **Country-specific technology mapping and analysis:** This perspective focuses on the context-specific findings from each country analysis. It addresses the refinement understanding gained from individual country assessments, providing a rich source of insights and recommendations for future endeavours. Ten technology directories were created, which include detailed information for 349 technologies. A total of 228 technologies were screened and evaluated through a multilevel assessment, which included 3 276 criteria, resulting in the identification of a total of 120 highly viable technologies. Through assessing the suitability of agricultural technologies across different contexts, it becomes evident that numerous factors play a role: fragility conditions, market access opportunities, costs of technology production or import, infrastructure availability, enabling policy environment, and the technological capacity of farmers collectively shape the adoption and scale-up potential landscape.

Overall reflections and recommendations

Encourage stakeholder engagement

Stakeholder engagement emerged as a critical aspect, with the report highlighting the iterative nature of the assessment methodology and the value of continuous consultations. An iterative and continuous engagement process would enhance the relevance and effectiveness of the assessments furthering validation and contextualization of the results. Moving forward, it is critical to involve stakeholders in the assessment process, ensuring their representation for evaluating different criteria for different technologies. This could be done through organized in-person or online workshops during which the results of the initial mapping exercise can be shared. Structured sessions would allow for identification of new technologies that might have not been initially considered.

Incorporate stakeholder inputs throughout the entire process

Engaging stakeholders from the outset indeed promotes a sense of ownership and consensus, laying a stronger foundation for the adoption of the technologies. This engagement is crucial for ensuring the practical applicability of innovations and securing stakeholder buy-in, which can significantly influence the project's success. Skipping this participatory phase could instead undermine the potential benefits of the technologies, regardless of their inherent quality. The following include suggested actions to consider:

- **Peer-review:** Engage external experts to critically evaluate the assessment's methodology and findings to ensure academic rigor and contextual relevance.
- **Stakeholder feedback:** Share the report and insights to gather opinions from local partners, technology providers, farmers, and NGOs to refine and ground the assessment in local realities.
- **Comparative analysis:** Compare the assessment's findings with existing literature and studies to ensure alignment and accuracy.
- **Sensitivity analysis:** Examine how changes in the assessment's parameters could potentially affect the final outcomes and conclusions.
- **Field verification:** Conduct on-ground checks and observations of the implemented technologies to confirm the practical viability of the technologies assessed.

- **Local workshops:** Facilitate interactive sessions with local communities to discuss and understand the practical aspects of technology adoption.
- **Training programs:** Provide training and capacity-building initiatives for stakeholders involved in technology assessment and adoption; this would empower local communities to effectively utilize and adapt identified technologies to their specific contexts. Establish educational initiatives to equip end users (and other relevant stakeholders) with the necessary skills for using and maintaining new technologies.
- **Pilot projects:** Implement small-scale projects to test the scaling of the technologies in real-world settings, providing valuable insights into their effectiveness and helping to define KPIs and funding schemes.
- **Ranking review:** Re-evaluate and adjust the ranking of technologies based on feedback and additional data gathered post-initial assessment. In case of failure, switch to the next ranked technology and repeat the process with it.
- **KPIs definition:** Develop clear performance indicators to measure and track the success, impact and scaling of the implemented technologies.
- **Funding schemes:** Leverage the information gathered in the previous phases to define the right funding strategy to facilitate the broader adoption of validated technologies.
- **Users' champions programs:** Identify and empower key individuals within communities to advocate for and support the uptake of new technologies.
- **Monitoring & Evaluation:** Implement a robust monitoring and evaluation framework to track the impact of adopted technologies on food security outcomes. This would facilitate learning and adaptation over time, enabling the refinement of strategies and interventions.

Identify weights collaboratively

Implement collaborative processes or polls for defining weights for assessment criteria. Different weight profiles can be considered for different users. These weight profiles could be automatically incorporated through a question in the tool that identifies the type of user (smallholder farmer, investor, development organization, etc.).

Develop an online user-friendly interface for GC-STAT

In an effort to improve accessibility to the tool and the potential for replicability of this exercise across new countries, a user-friendly interface is envisioned, where Country Profiles can be created, new technologies can be added, new criteria can be included, while following the same overall methodology for assessment

Enhance technology categorization in the technology directory

- Identify technologies as either innovative tools or innovative processes.
- Identify the source for different technologies: NGOs, research institutes, start-ups, established companies.
- Consider the origin of the technology (local vs. imported) with configurable weights in the assessment.

Develop and clarify assessment criteria

- Introduce and clarify criteria like affordability (differentiate setup costs vs. operational costs), and ease of use (differentiating between ease of setup and ease of use).
- Move some parameters requiring extensive research on broader aspects like policies, subsidies and social acceptance to Level 3 assessment.

Highlight the role of Multilateral Development Banks (MDBs) and donors

MDBs and donors have an important role to play in facilitating the deployment of technologies among smallholder farmers. They can provide financial resources, technical assistance and policy support to catalyse technology adoption and dissemination. Their involvement can help bridge the gap between technology providers and end users, facilitating access to financing, capacity-building initiatives and market linkages. Furthermore, MDBs and donors can facilitate partnerships and collaborations among various stakeholders, fostering an enabling environment for technology deployment and scaling.

Ensure scalability and replicability

In assessing the scalability and replicability of identified technologies, it is essential to recognize the diverse contexts and varying needs of smallholder farmers across different regions. While some technologies may demonstrate promising results in pilot projects, their scalability hinges on factors such as resource availability, infrastructure and local socioeconomic conditions. Additionally, the replicability of technologies relies on their adaptability to different agroecological settings and the capacity of farmers to integrate them into existing agricultural practices. Several barriers to adoption may impede the widespread dissemination of these technologies, including limited access to finance, inadequate infrastructure, insufficient technical capacity and sociocultural factors. To overcome these barriers, strategies such as targeted capacity-building initiatives, financial incentives, public-private partnerships and participatory approaches can be employed. By addressing these challenges and leveraging innovative strategies, smallholder farmers can enhance the scalability and replicability of identified technologies. This re-emphasizes the need for further engagement with farmers and broader stakeholder groups for further validation and contextualization of the results through Level 3 assessment.

CONCLUSION

This report represents a significant effort to identify and evaluate technologies for smallholder farmers. While acknowledging the constraints and limitations faced, it provides a substantial basis for further exploration and refinement in the field of agricultural technology.

The key highlights of this report lie in its comprehensive approach, which encompasses the tripartite cooperation agreement between the Islamic Development Bank (IsDB), FAO's Regional Office for the Near East North Africa region and the International Fund for Agricultural Development (IFAD). This collaboration facilitated a complex mapping exercise of affordable and transferrable food security-related technologies across ten countries, with a primary focus on enhancing food security among smallholder farmers.

The co-creation of a robust methodology for assessing and comparing technology performance is central to the report's significance. This methodology not only streamlines the evaluation process, but also ensures consistency and comparability across diverse technological interventions. The development of the technology directory template, populated with a comprehensive array of potential technologies, further enhances the accessibility and dissemination of valuable information to rural producers and stakeholders.

Moreover, the iterative nature of the assessment methodology, coupled with highlighting the need for further stakeholder engagements and consultations, underscores a commitment to adaptability and responsiveness to context-specific needs and priorities. The report provides a solid basis for further exploration and refinement in agricultural technology while recognizing the constraints and limitations inherent in technology assessment. It underscores the need for continuous dialogue and engagement to address emerging challenges and opportunities in the agriculture sector effectively.

In conclusion, this report not only serves as a benchmark in agricultural technology assessment but also catalyses a broader discourse on context-specific sustainable farming practices that benefit smallholder farmers. Its findings and methodologies pave the way for future initiatives and collaborations, emphasizing the importance of stakeholder engagement, adaptability and innovation in addressing the multifaceted challenges confronting smallholder farmers worldwide.

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