

# Climate Smart Agriculture

Pilot project assessment





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# Summary

Climate change is an imminent threat to the prosperity of societies and pose cascading risks to global food security. Not only because rapid climate change is in itself problematic, but also because climate change makes other issues worse.

In Uganda, like in many other countries, the prospects of resilient farming livelihoods are, amongst several things, challenged by climate change hazards. On top of the various insecurities faced by people in disadvantaged communities, the ongoing COVID-19 emergency continues to aggregate current issues, devastating lives while exposing the vulnerability of current food systems.

Climate Smart Agriculture (CSA) reflects the ambition to increase productivity to enhance food security, adapt to climate change while building resilience and mitigate negative climate change impacts by reducing, or when possible removing, greenhouse gases (GHGs).

Since 2018, Wimat Development Foundation (WDF) have employed a Climate Smart Agriculture (CSA) approach as a means to empower and equip farmers with practical skills for ecologically sound and socio-economically viable agricultural food cultivation.

This report has been written to share the results from an evaluation of the WDF CSA pilot project. The evaluation has made use of the characterization of agroecological transition (CAET) to assess the dimension of sustainability transition between pre- and post-project implementation. The CAET framework is part of the Tool for Agroecology Performance Evaluation (TAPE) developed by the FAO [6]. To understand the synergies and outcomes from the introduced activities and promoted practices in the pilot project, the tree criteria for CSA (namely productivity, adaptation and mitigation) were used as an analytical framework.

The systems assessed were of same relative vicinity on the basis of representing the average agricultural household in the agro-ecological zones targeted by the pilot project. The results of the CAET and CSA assessment, coupled with situating the findings in the context of the SDGs, formed the basis for the interpretation of the results.

The evaluation found that the CSA pilot project contributed to significant improvements in livelihoods and sustainability of agroecosystem management by fostering site-specific knowledge to diversify systems with respect to locally available resources. The results also showed that the contextual and multifaceted approach of the pilot project contributes to the SDGs on a broad spectrum.

# Why is Climate Smart Agriculture relevant, and what is it?



Climate change hazards challenge the livelihood of many farming communities around the world. Rising temperatures, higher frequency of extreme weather events and unpredictable perception patterns can cause unexpected losses of agricultural production, contributing to decreased income and increased food insecurity [5;9]. Additionally, the negative effects caused by changes in climatic conditions are disproportionately distributed [34]. Exposure, vulnerability and adaptive capacity are neither equally experienced across the world, nor within societies [9]. Unfortunately, among the ones who are left the most at risk, are the ones who the world depends the greatest on for global food security, namely small-holder farmers [1;18].

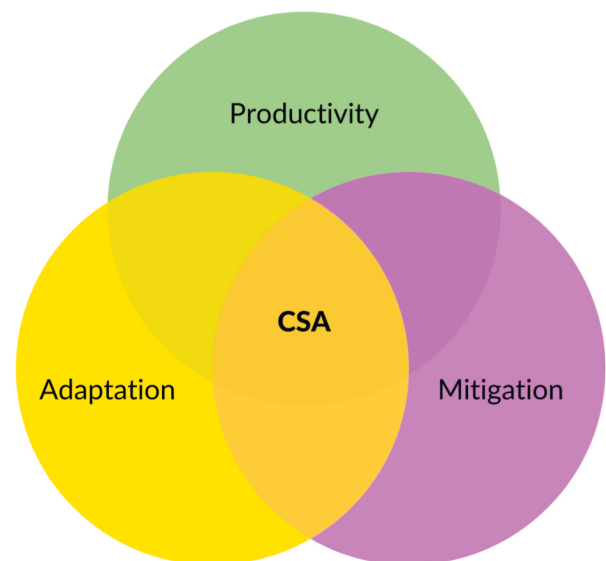
As of 2018, over 42.8 million people live in Uganda, and the country has the second highest population growth in the world at an annual increase of 3.7% [23]. The agricultural sector provides livelihood for the largest share of the working population and contributes to about one fourth of national Gross Domestic Product (GDP). Recent estimates suggest that approximately 7.4 million households in Uganda tend to agricultural land and/or rear livestock. Still many struggle daily to make ends meet, and opportunities to escape poverty are scarce [4;24].

According to the latest national development plan Uganda Vision 2040 (NDPIII), efforts to improve quality of life and actions to achieve the SDGs must be accelerated. The NDPIII also recognises that while Uganda's 0.099 percent share of global emissions is a negligible contribution to CC, the population remain highly vulnerable to CC impacts. While promoting inclusive growth through a green economy, the NDPIII has also put Climate Smart Agriculture (CSA) on the national agenda.[17].

Since 2018, Wilmat Development Foundation (WDF) have employed a CSA approach as a means to empower and equip farmers with practical skills for ecologically sound and socio-economically viable agricultural food cultivation. WDF's CSA project strives to empower local communities by integrating gender equality, climate action and natural resource conservation for community resilience through farming.

## What is Climate Smart Agriculture?

Climate Smart Agriculture (CSA) reflects the ambition to increase productivity to enhance food security, adapt to climate change while building resilience and mitigate negative climate change impacts by reducing, or when possible removing, greenhouse gases (GHGs). [5;18;22].



A visual representation of Climate Smart Agriculture.

## Uganda, agriculture and climate change.

Uganda is endowed with richness of natural resources. Still, in Uganda, like in many other countries, the prospects of resilient farming livelihoods are, amongst several things, challenged by climate change hazards. Contributing to the adverse social implications of climate change, is the disproportionate degree to which exposure, vulnerability and adaptive capacity affect women and other marginalised people. On top of the various insecurities faced by people in disadvantaged communities, the ongoing COVID-19 emergency continues to aggregate current issues, devastating lives while exposing the vulnerability of current food systems. [28]

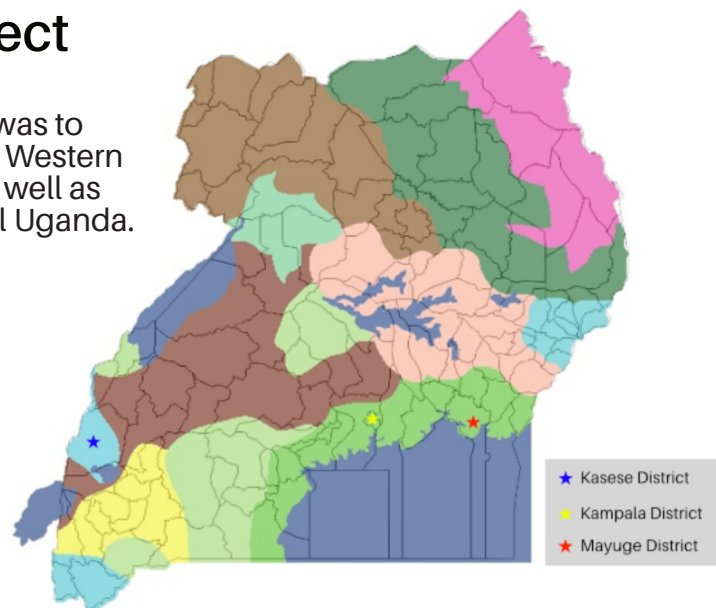
In Uganda, agricultural production is highly reliant on rain-fed agriculture and characterised by smallholder subsistence farming [4;23]. Land holding size per agricultural household averages at 1.35 Ha, with about 38.6% of adults (18+) having land ownership, or are rights holders, of the land they cultivate. Still, discrepancies between those that cultivate smaller share of land areas and those that cultivate larger shares of land areas, as well as gender distribution of land tenure rights, are evident. About 66.2% of all those engaged in farming do so on less than 1 Ha, and women while cultivating more frequently and for longer hours than men, are less likely to have legal recognition of the land they tend to. [24].

Expansion of agricultural land has steadily increased at a rate of 1% per annum in the past decade, contributing to the country's land degradation. It is estimated that about 41% of the total land area in Uganda is experiencing degradation, with the most common form being soil erosion [4]. One major implication of soil erosion in Uganda is loss of soil nutrients, with the country having one of the highest soil nutrient losses of the African continent. In 2018 a nation-wide agricultural survey reported that 24% of Ag HHs apply fertilisers to some degree. Amongst those who did, most respondents indicated using organic fertilisers, while 32% responded using inorganic fertilisers. (UBOS 2020). Furthermore, 21% of Ag HHs reported using some agro-chemicals in order to control pests, vectors and diseases. [24].

Coupled with continuous population growth and land degradation, climate change will further cause negative impacts to agricultural productivity and amplify an already high degree of food and nutrition insecurity. In 2017 it was estimated that about one of every four people in Uganda was undernourished [4] and in the Agricultural Survey report published in 2020, the Ugandan Bureau of Statistics pointed to that about 47% of Ag HHs had experienced food shortages in 2018 [24]. With a greater share and degree of poverty among smallholder subsistence farmers in Uganda, rural farmers generally have less resources to face shocks and therefore represent one of the most vulnerable groups in relation to climate change impacts. [23].

# Regional focus of the pilot project

For the pilot project of WDF’s CSA initiative, the aim was to reach rural farming communities in Kasese district of Western Uganda, and Mayuge District of Western Uganda, as well as semi-urban households in Kampala district in Central Uganda.



The 10 agro-ecological zones (AEZs) in Uganda

Highland Ranges	North Western Savannah Grasslands
Kyoga Plains	ParaSavannah
Lake Victoria Crescent	Pastoral Rangelands
North Eastern Drylands	South Western Farmlands
North Eastern Savannah Grassland	Western Savannah Grasslands

Map 1. The map illustrates the agro-ecological zones (AEZs) and district borders in Uganda.

Source: Geospatial data from World Resources Institute (2009) & data on AEZs from MAAIF (2020)

## Kasese district cont.

In an official district report published in 2016 it was found that Kasese district is vulnerable to several hazards, some of which are; environmental degradation, extreme wether conditions, pest and diseases (crops and animals), invasive species and internal conflict. Weak soil structure, and poor practices (such as deforestation and agricultural intensification) are factors that contribute to many of the issues. Some of the consequences are crop failures in consecutive seasons and subsequent food insecurity. The most vulnerable in the district are the elderly, women and children, especially those relying on agriculture for their livelihood. [11]

The most recent National Population and Housing census for Uganda was conducted in 2014 and reported that 85.4% of all accounted for households in Kasese District were engaged in either crop growing or livestock farming for their livelihood. [25]. Cash crop production and processing is a large contributor to the economic activities in the district. Cotton is the single major cash crop, cultivated in most of the mid lowlands of the district, while arabica coffee, mainly cultivated in the mountain areas, is the second most important. Additionally, intensified agriculture, is a growing economic driver in the district. [11]

## District profiles

### Kasese District

Kasese district is located in the Western region of Uganda and is mainly part of the Highland Ranges agro-ecological zone, but also has it’s north and south tips in the western Savannah Grasslands agro-ecological zone. The district is characterised by highlands and the conditions of the agroecological zone, with a more pronounced bimodal climate cycle and drier conditions, contributes to the district’s suitability for growing a variety of crops (in particular matooke, Arabica coffee, maize and cotton). [28]

In Kasese District the majority of land is occupied by water bodies, areas of wildlife conservation, nature or forests reserves as well as set aside for government projects. As a result, 37% of total land area in the district available for human habitation and cultivation, and the population has become concentrated in a rather narrow corridor of land situated between the Rwenzori Mountains and the Western Rift Valley. With high pressure on available land to sustain the growing population, environmental degradation has widen. [11]



## Kampala District

Kampala district is located in the Central region of Uganda and is part of the Lake Victoria Crescent agro-ecological zone. The topography of the district is characterised by a diversity of habitats surrounded by hills and valleys with wetlands, swamps and slow rivers. The climatic conditions of the tropical rainforest climate provides the district with two annual rain seasons (August-December and February-June), which are separated by drier periods. [12].

The district is endowed with rich environmental assets, however these resources are continuously being degraded due to rapid urban population growth, industrialisation and infrastructure developments. Also due to climate change, urban flooding has become a recurring issue [28]. While about 23% of the district is urbanised, a significant share is not. About 60% is semi-urbanised and the remaining percentage is rural settlements. A survey in 2012 reported that an estimate of 40% of the Kampala city population, and a significant share of those who are newly migrated, live in informal settlements and/or slums. [12].

Decades of urban expansion and development has caused loss of soil, vegetation, habitat and biodiversity in the district. A central concern is the conservation of environmental assets, and even small-scale agriculture can be a threat to the overall health and function of the district's natural ecosystems. One reason is that conversion of already constrained wetlands to agricultural production systems uproots the natural vegetation and compromises the local nutrient cycle functions. [12] While the largest share of the population in the district is engaged in non-agricultural activities for income generation, food insecurity is a pressing issue that still leaves many people lacking enough safe and nutritious food to live a healthy life. [26].

**Climate change poses cascading risks to the agri-food systems locally and globally. With a large share of the population in Uganda dependent on agriculture for their livelihood, building resilience, ensuring food and nutritional security, as well as engaging in more sustainable practices, is essential.**



## Mayuge District

Mayuge district is located in the Eastern region of Uganda and is part of the Lake Victoria Crescent agro-ecological zone. Across the district, the soil is predominantly characterised by high fertility, a moderately stable structure and low erodibility. The climatic conditions with modest variation in temperature, humidity and winds across the seasons of the year, makes the district suitable for production of most crops grown in Uganda. Moreover, the agro-ecological zone of the district enables farmers to have at least two growing seasons since the bimodal climate conditions the area to two rainy seasons in a year (April-June and August-November) which are separated by one longer dry season (December-March) and one shorter (July-August). [16].

In 2015, an official report published by the Mayuge District local government, it was stated that 97% of the total population in the district depended on agriculture as the main source of economic income [27]. In addition, agricultural household outputs in the district were found to be highly characterised by a sugar cane cultivation dependency where the cultivated output of sugar cane is sold primarily to Kakira Sugar Works and Mayuge Sugar Industries Ltd. [16]

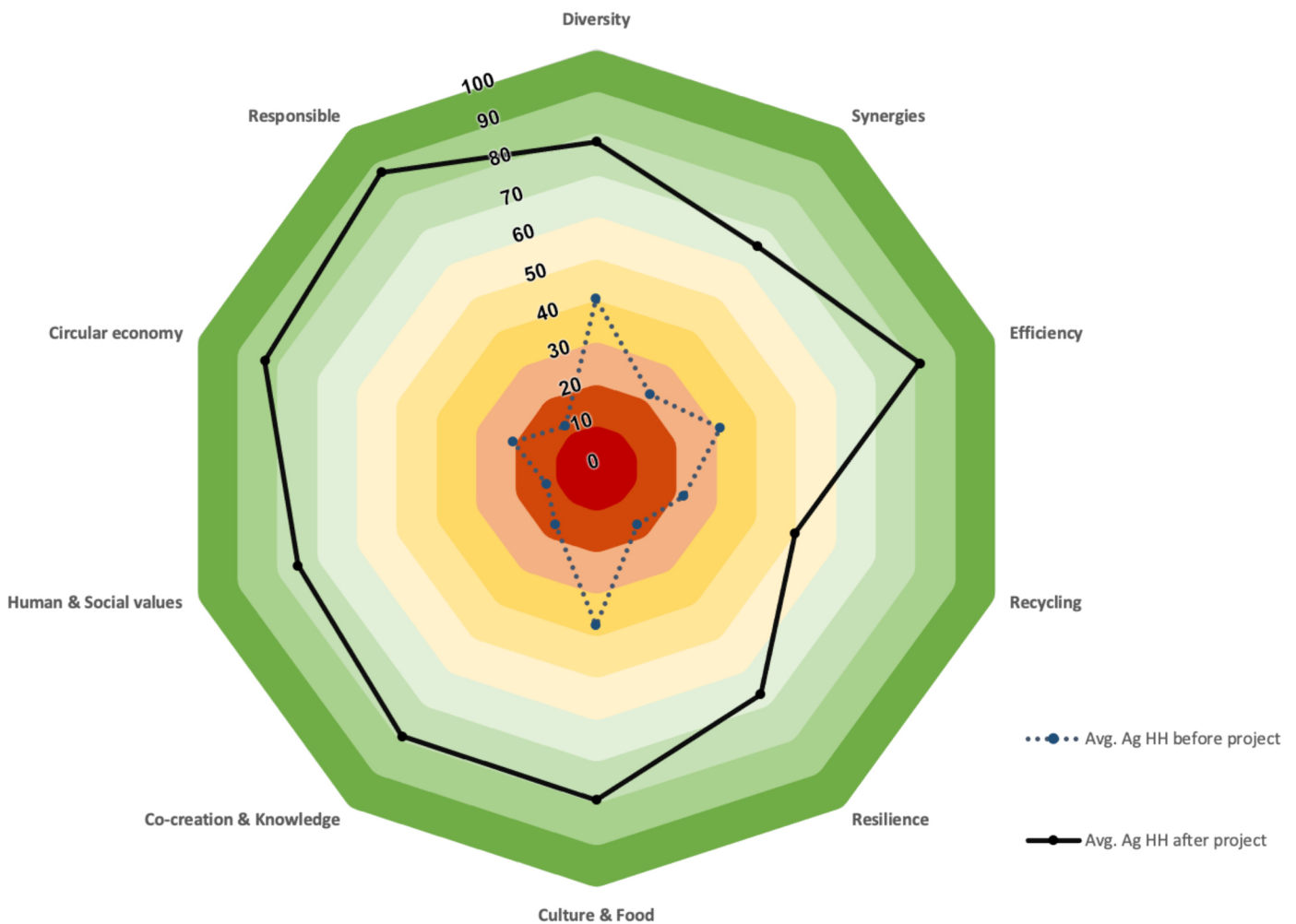
## Mayuge district cont.

The average size of land cultivated per household is about 1.5 Ha and the land is owned under a customary freehold system. This landownership structure means that pieces of land are owned permanently, and that the right to a piece of land is free to be sold, or passed on, by the owner at wish. In effect, land in the district is today highly fragmented which has put a constraint on productivity. Adding to the productivity distress is the many decades of continuous cropping by farmers and poor agronomic practices that have contributed to land degradation. This has caused some of the district's fertile soils to lose natural fertility and become less productive than in the past. [16].



# Baseline study and post-project assessment

For the CSA pilot project that was rolled out in 2018/2019, the initial context analysis and baseline study for the region was carried out in 2018. The results showed that rudimentary sedentary cultivation and focus on perennial cash crops was the most common type of subsistence farming practiced among the rural agricultural households surveyed. (Annex 2). Moreover, the baseline study showed that only about two out of five agricultural households had meaningful outputs from their harvests, while the other share experience low yields or even losses in their harvest (Annex 4). Lastly, health concerns related to application of chemicals and prevalent malnutrition was highlighted by the survey participants. (Annex 2). In 2019, data was collected to evaluate the progress of the pilot project and responses from 121 participants formed the base for the assessment. Based on the data gathered, coupled with recent project monitoring data, the results indicate that the CSA project had reached 1100 people (consisting of 450 women, 150 teenage mothers and 500 young people), and contributed to diversified production and increased farming income for some. (Annex 5).



The radar chart illustrates the assessment of the baseline situation among agricultural households pre-project implementation compared to the average situation among agricultural households after participation in WDF's CSA project activities. The average scores for agricultural households pre-project range between 12.50 to 40.63 percent, while the average scores for agricultural households post-project range between 50 to 87.50 percent.

The assessment shows that the CSA pilot project embodies a high degree of sustainable transition of agroecological systems by fostering site-specific knowledge to diversify systems with respect to locally available resources and knowledges.

## Project activities and outcomes

In order to respond to the identified issues and current challenges of agricultural households in the communities where WDF works, horticulture, and primarily cultivation of a variety of vegetables, was chosen as the primary focus of the CSA pilot project. The aim was to shift the focus of agricultural households from dependence on perennial cash crops to locally adapted short cycle food crops. (Annex 2). The project activities were designed to provide knowledge and skill building through interactive training sessions for establishment and management of organic production of vegetables. Training took place on a demonstration plot that the organisation set up in close proximity to the local communities, as well as through on-farm advisories visits to agricultural households.

### Organic vegetable cultivation

Organic vegetable cultivation and management was taught on the basis of site-specific knowledge and covered aspects such as land and soil preparation, growing and caring for crops, as well as post-harvesting activities. The project evaluation results showed that many agricultural households had been able to generate continual revenue stream and diversify their diets.



WDF distributed locally adapted cultivar seedling that had germinated on the demonstration plot to participating agricultural households, and also trained agricultural households on how to conserve seeds from their on-farm harvests and manage nursery beds. Simple drip irrigation methods, primarily through the use of plastic bottles, as well as proper spacing and combinations for intercropping were part of the training activities.

The benefits can be denoted to agricultural diversification as increased cultivation diversity, in addition to provision of quality organic inputs, help increase productivity and contribute to health benefits associated to nutritional diversity. Several agricultural households have also shared testimonies about experiencing improved farm output and making money from their harvest. Additionally, with everything being organically grown, the output has added value and contributes to increased bargaining power for agricultural households. [19; 31]

The beneficial synergies generated through the introduction of intercropping different food crops, including legumes, and drip irrigation contributes to improve soil quality, increase efficiency of water and land use, contribute to more consistent yields and reduce crop failure risks.

## Cycling of biomass and nutrients

Cycling of biomass and nutrients was encouraged through simple techniques and utilisation of already available elements of the agroecosystem managed. In particular, activities focused on vermiculture; sorting of, and composting, organic household waste (e.g. usage of peelings from vegetables for compost and/or feed for animals); utilisation of compost and animal manure to produce organic fertilisers and biogas; and usage of burnt biomass waste for crop production.

Through the focus on cycling of biomass and nutrients, economic stress, that commercial market dependence for inputs can cause agricultural households, was diminished by production of organic fertiliser from farm residue, application of animal urine to avoid certain pest and disease, and for one agricultural households energy production from biogas. The benefits derived from integrated production systems by introducing organic fertilisation, recycling and waste management can be associated with increased soil biological activity, enhanced mineralisation of organic carbon and nitrogen. [31].

From the evaluation of the pilot project, greater integration of animals into the production system is part of the planned expansion of the CSA activities, since a majority of the agricultural households surveyed responded that they engage in both crop growing and livestock raising.



## Supportive incentives



Supportive incentives were made to encourage sustainable transformation of agricultural livelihoods, in both rural and semi-urban communities, and sustain progress made. The focus of these incentives are dual, in terms of proactively improving resilience e.g. incorporation of trees into the agroecosystems, growing mushrooms in enclosed spaces, as well as value adding dimensions by facilitating processes to create networks of meaningful participation between local agricultural households.

With incorporation of trees into the agroecosystems, contributes to reduced risk of wind / water erosion, preserved soil moisture and provides shades for crops, while maintaining and / or improving soil carbon stocks. [19;31]

The initiative to introduce indoor mushroom growing has showed great success, also during the COVID-19 pandemic, as it provides high yields and high nutritional value that can be sold at profitable rates.

The CSA pilot project initiates market access through the local community itself, as they are the primary consumers of their produce. This is done by mobilizing the participants into self-help groups. Currently, approximately 30 groups, consisting of about 15-20 members each, meet on a weekly basis to sell and exchange produce.. Following evaluation, the members of the groups that show improved and sustained yields, are supported through market connections to expand their operations.

Table 1. Synergies from introduced activities and promoted practices

Activities		Productivity	Adoptation	Mitigation
Organic vegetable cultivation	Organic vegetable cultivation and management	Site-specific knowledge	Improved technical skills (human capital)	Greater understanding of climate change risks / better practices
	Provision of organic vegetable seedlings	Diversified production and income	Added value and bargaining power	Reduced dependence on external chemical inputs
	Drip irrigation	More consistent yields	Reduced crop failure risks	Better water use
	Intercropping	Diversified production, increased yields and incom.	Improved soil quality, increased efficiency of water and land use	Nitrogen fixation (e.g. through legumes such as cowpea)

\* Examples of vegetables: cabbage, capsicum (peppers), sukuma (collard greens), matoke, eggplants, cowpea, beans, carrots, beets, etc.

Cycling of biomass and nutrients	Vermiculture	Cost saving and income from worm sales	Reduced reliance on external inputs and improved soil moisture-holding capacity	Reduced raw manure application to fields and thereby reduction in associated GHG emissions
	Recycling and waste management	Improved on-farm resource recycling	Improved soil structure and soil water storage	Contributes to organic carbon sequestration
	Organic fertilisers	Improved yields	Enhanced soil fertility	Reduced external input use

\* Examples of practices: compost, mulching, biogas production, use of biochar.

Table 1. Cont.

		Productivity	Adoptation	Mitigation
Supportive incentives	Tree shelter belts	Biomass production and reduced risk of wind/water erosion	Roots preserves soil moisture (i.e. Water retention) and canopies provides shade for crops	Maintains/improves soil carbon stocks
	Mushroom growing	High yield, nutritional value and profitable sales	Verical indoor growing requires little space	Use of locally adapted cultivars
	Self-help groups	Greater market inclusion	Facilitates cooperation and networking	Localised food supply chains

\* Examples of focus: proactively enhancing resilience, and value adding dimensions.



# Testimonials\*



"I am seeing future in WDF because of the sustainable agriculture practices they demonstrate."

- Survey participant.

"We learn modern organic farming and ways of protecting our environment"

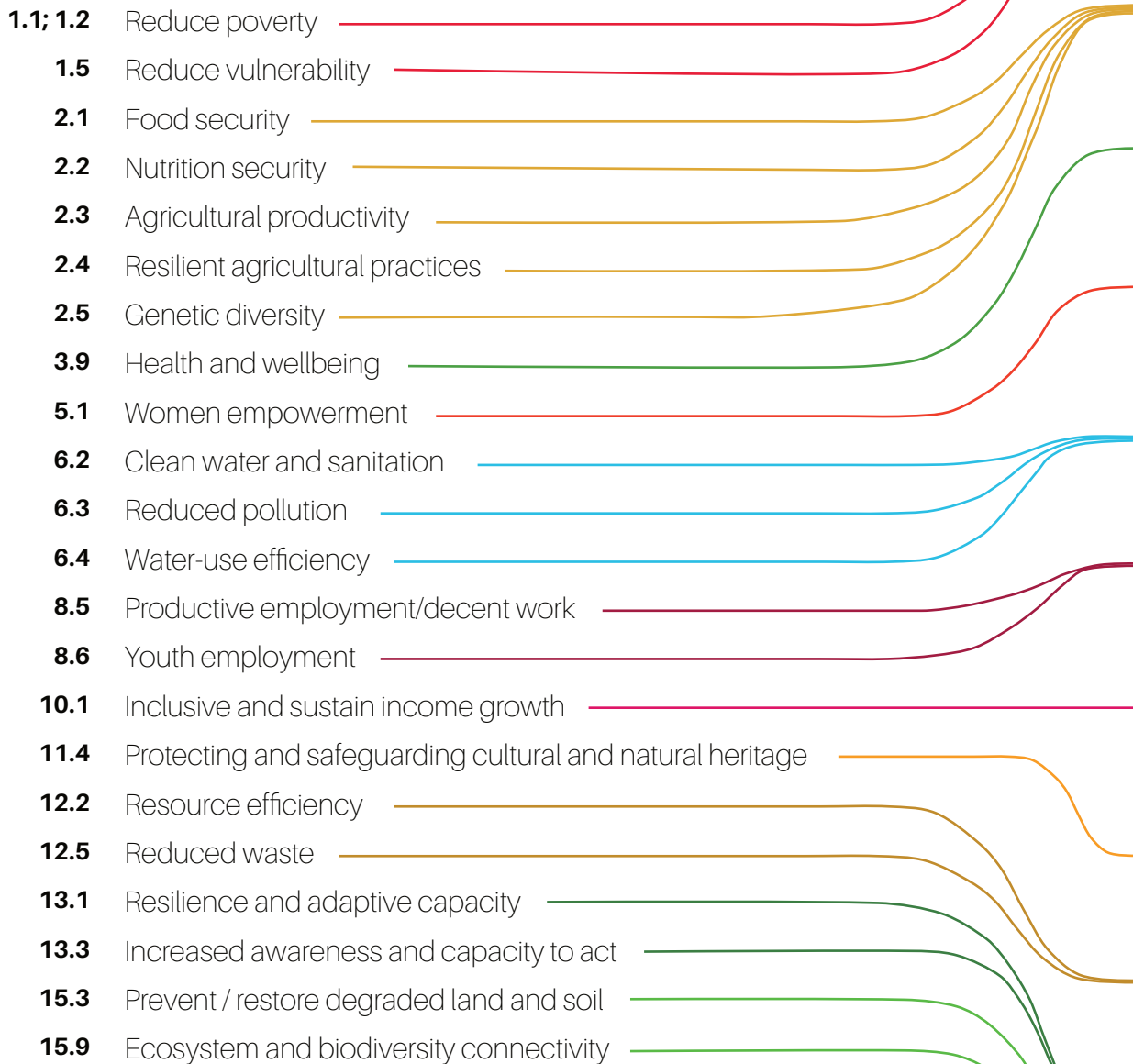
- Survey participant.

\* The testimonials and individuals on the photos are not correlated.

# The Sustainable Development Goals (SDGs)

Taking the SDGs as a framework to assess the CSA project's contribution to sustainable development, it is possible to show how the various activities and practices promoted have contributed to sustainable development.

Indicators



**Out of the 17 SDGs, the different activities and consequential outcomes of WDF's CSA pilot project stimulates synergies that can be position along 22 indicators across 11 different SDGs.**

# Long-term sustainability constraints

## The ecological

Agriculture is managed by human activity for social purposes, and embedded in the biological and physical properties of the surrounding natural environment [7]. The initial context analysis and baseline survey that WDF carried out was conducted in collaboration with partners consisting of technical and/or sector experts as well as survey responses from local agricultural households (Annex 2). The engagement of partners contributed to an understanding of the local terrestrial context, for example by collecting soil samples to understand the nutritional need of the soil, while involvement of local agricultural households through surveys helped to create an understanding of the actual needs at the ground. This process contributed to creating context specific activities within the larger frame of the CSA project. In effect, activities were designed to utilise the local ecosystems in a sustainable manner without endangering the already existing social and natural life there. (Annex 2). Because of this process, the promotion of diversification and incorporation of existing socio-cultural practices enhanced both below and above ground ecological dynamics which contributed to the sustainability of the introduced farming system

Part of the benefits of such synergies can be explained by the advantages of highly complex agroecosystems in which opportunities for coexistence and beneficial interactions between

components creates more paths for energy and material flow. This in turn supports stability and provides a buffer against unexpected changes, such as precipitation or temperature patterns. [19]. Because of this it can be argued that diversified agroecosystems that are adapted to the local context have greater resilience in the light of climate change, and can be considered more sustainable [10;19].

A challenge to manage ecological balance in diversified systems is that management needs to occur at contrasting spatial and temporal scales in order to promote constructive trade-offs [3]. Such management requires investment, often in terms of time and financial capital, in order to acquire knowledge to identify, establish and maintain good management practices [10], which ultimately depend on the economic costs and benefits. [3].



# Long-term sustainability constraints

## The social

One social aspect that poses a great barrier to sustainability is dependence on external inputs. In essence, market dependence creates vulnerability to livelihoods in the light of supply shortages, fluctuations and increased prices [7]. Dependence can also contribute to a vicious cycle of debt for agricultural households. For instance, cash crops, take longer time to mature, yet during that timespan landlords may be demanding rent to be paid, or parents need to pay for children's school fees, which forces the farmer to sell the harvest while it is still immature. (Annex 2). In effect, when the crops are ready for harvest, the output does not belong to the farmer. Cultivation of short-cycle food crops provides an opportunity to generate income with greater consistency and break away from a dependency on commercial cash crop production. (Annex 2). Nevertheless, while the CSA pilot project helps farmers to redirect their cultivation focus, it does not yet break the dependency on external inputs, as most still depend on organic seedling inputs for each new season. This sort of 'organic' treadmill impedes on long term social sustainability, as the dependence on input suppliers is extended from one provider to another [19].



A prospective pathway toward socially sustainable production is embodied by the notion of food sovereignty, and the right of farmers to have local control, context-based knowledge and direct connection to address problems and opportunities according to local priorities [7]. Food sovereignty through local collaboration, sharing of knowledge, machinery,

labor and risk, could be one way in which local networks can promote a more sustainable food system [21]. Achieving food sovereignty is however a process that will require a fundamental redesign of the current food systems, and while such radical change is desired, incremental changes tend to carry less risk and are therefore also often more feasible.

## The economic

The economic dimension remains a principal force in enabling or limiting any agricultural transition towards greater sustainability [10]. Economic factors such as labor, access to investments, conditions of credit, are important determinants to the success of farming systems [8; 10]. Additionally, inequality is a major constraint for economic sustainability [7], and economic conditions for subsistence farmers are often unfavourable [8]. For most subsistence farmers, labor availability and access to credit are essential for making decisions about how to allocate resources, illness or poor credit conditions can hamper adaptive management of farming systems and expose the livelihood of agricultural households for external stressors, which causes vulnerability [7].

In the context of the agricultural households involved in WDF's CSA pilot project only 25% of the survey respondents responded that they have access to credit, whereas the rest responded that they did not because it was too hard or too risky (Annex 3). Additionally, as mentioned by the project leader many of the agricultural households that the CSA pilot project has involved have limited educational background and literacy, and incentives to change therefore need to be provided in an accessible language that people understand. Which is not always the case with administrative paperwork that some economic opportunities require (Annex 2). The dimension of economic sustainability should therefore recognise the various structures that threatens the sustainability of managing agroecosystems, and consider what policies, incentives and opportunities that need to be enacted to support the needs of farmers and their biophysical environment [19].

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## Concluding remarks

Wilmot Development Foundation's CSA pilot project has shown the potential to be considered as a potential avenue to empower local communities by integrating gender equality, climate action and natural resource conservation in agricultural community development.

In addition to optimizing yields and production of quality goods, the CSA project also focuses on realizing greater well being through nutritionally rich and diverse diets, as well as conservation of natural resources, maintaining fertile soils, access to clean water and preservation of rich biodiversity.

To contribute to resilient and sustainable progress needed in the light of the many challenges we are faced with, both locally and globally, WDF intends to scale the CSA approach across the communities in which the organisation work. The goal is to boost local ability to adapt to climate change, build greater resilience to climate shock, increase food security, and where possible, reduce greenhouse gas emissions.

Still some challenges remain, and continuous monitoring and evaluation of project activities and promoted practices need to be an integrated part in the scaling of the initiative.

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# Annexes

- Annex 1. Empirical material (overview)
- Annex 2. Interview transcript
- Annex 3. Google Forms Survey responses
- Annex 4. Baseline study
- Annex 5. WDF project evaluation
- Annex 6. Description of systems and contexts
- Annex 7. CAET
- Annex 8. SDGs