Understanding the Design of Rural Agricultural Development Projects: The Case of Climate-Smart Villages in Kenya

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ABSTRACT

In the face of climate change-induced disasters that reduce crop yields and threaten farmer livelihoods, many development agencies started endorsing climate-smart agriculture (CSA) as the agricultural best practice in a warming world. The Climate-Smart Villages (CSV) in Nyando, Kenya are a participatory, outcome-focused agricultural research for development project that developed a series of tailored CSA interventions that have been shown to improve productivity, farmer adaptation, and greenhouse gas mitigation. Through systematic literature review and key informant interviews, this research paper first identified factors that enabled or constrained the project's effectiveness: community engagement; local and national partnerships; capacity building; providing agricultural resources; incorporating gender considerations; monitoring and evaluation; outreach targeted at marginalized members; prioritization of project outcomes; and an integrated articulation of a theory of change. Next, the research paper contextualized the project in, and compared it with, historical and contemporary rural agricultural development projects in Kenya. By learning from the design and implementation of projects such as the Nyando CSVs, policymakers and development practitioners can maximize project outcome across multiple dimensions in the context of climate change. This case study provides a critical examination of best practices which can be further tested and applied.

Keywords: climate-smart agriculture; rural development; climate change; Kenya

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1. INTRODUCTION

Rural development has been a key focus of international development discourse and operation, from the Green Revolution to the Sustainable Development Goals (Ashley & Maxwell, 2001; Mihai & Iatu, 2020). However, despite considerable aid and projects, rural poverty and food insecurity persist. The situation is especially urgent in Africa. In 2022, among all adults living in rural Africa, 25.9% experienced severe food insecurity and 38.5% moderate food insecurity (FAO et al., 2023). In 2023, the rate of extreme poverty in rural Africa was 46% (Statista, 2023).

Climate change has further compounded the challenge of rural development. In sub-Saharan Africa, increasingly frequent and severe droughts and floods threaten the livelihoods of smallholder farmers, many of whom rely on agriculture for subsistence and have fewer resources to adapt to the changing climatic conditions (IPCC, 2021). In Kenya, the focus of this research paper, the agricultural sector is vital to its society and economy, accounting for 33% of gross domestic product (GDP) and employing over 40% of the total population (USAID, 2022). However, 80% of the country's landmass is classified as arid and semi-arid, and 95% of crops are rain-fed, rendering the agricultural sector highly vulnerable to climate change (WB, 2021). Furthermore, 78% of all agricultural production is from smallholders, who own between 0.2 and 3 hectares of land (WB, 2015). Given smallholders' high reliance on agriculture and low access to resources, climate shocks and stresses will have more acute and negative impacts on them (FAO et al., 2023).

Meanwhile, climate change has also complicated the conceptualization of rural development. The agriculture sector, combined with land use changes, is a significant contributor to climate change, accounting for 23% of total global greenhouse gas (GHG) emissions in 2016 (IPCC, 2019). In Kenya, agriculture is the most significant sectoral contributor, releasing 51.07 MtCO2E in 2019, which represents 63.04% of total emissions (WRI, 2022). Thus, agriculture is both a victim and a driver of climate change, making it a potential site of adaptation as well as mitigation.

Climate-smart agriculture (CSA) was proposed as a "triple-win" solution to food insecurity, rural development, and climate change: increasing agricultural productivity, fostering farmers' resilience, and minimizing GHG emissions (Lipper et al., 2014). Around the world, many development agencies endorse CSA as the agricultural best practice in a warming world, and promising results have been reported, including higher crop yields, improved livelihoods, and lower emissions (Newell et al., 2018; Rosenstock et al., 2015). The Government of Kenya adopted in 2017 the Climate-Smart Agriculture Strategy, which sets out objectives to enable systematic coordination to promote CSA (GoK, 2017). However, scholars have identified several potential problems with CSA, including a trade-off between reducing carbon emissions and enhancing the ability of farmers to be resilient and food secure; a lack of emphasis on equity and power relations; and an overly broad definition which can encompass almost any kind of agricultural activity (Newell et al., 2018; Brisebois et al., 2022; Karlsson et al., 2018).

With over five decades of research, innovation, and policy advocacy experience on rural development and sustainable food systems, CGIAR is an international partnership of 15 non-profit research centres that contributed significantly to the development and dissemination of new agricultural technologies (Lele & Goswami, 2021). In 2011, the CGIAR initiated the Climate-Smart Villages (CSV) project in multiple sites across the Global South (Ogada et al., 2020; Aggarwal et al., 2013). Researchers worked alongside local stakeholders to test a set of CSA technologies and institutional arrangements tailored to complement each other and produce synergistic effects. Evidence gathered from the projects was used to generate lessons learned for up-scaling and out-scaling. The ten-year project ended in 2021, and many articles have shown positive outcomes in the CSV sites (Bonilla-Findji et al., 2018; CCAFS, 2015; Ogada et al., 2021b; Beal et al., 2021b; CCAFS, 2018). However, no article has analyzed how the CSV project in Nyando, Kenya was designed and implemented, the factors that enabled or limited its success, and how it compares with historical or contemporary rural agricultural development projects.

1.1 Research Objectives and Questions

By examining the often-cited success story of the CSVs in Nyando, Kenya, this research paper aims to explore the challenges associated with designing and implementing the project, as well as synthesizing lessons learned from this experience. More precisely, this research paper asks the following questions. First, what factors facilitated or constrained the effectiveness of the project? Second, how did interventions in the project address equity and gender issues? Third, how does its theoretical underpinnings diverge from or resemble past or current rural agricultural development approaches?

1.2 Outline of the Paper

In Section 2, the research paper surveys the literature on rural agricultural development projects in Kenya, covering distinct theoretical and practical approaches that emerged and were mainstreamed in different time periods. Based on the survey, factors that enabled or constrained project effectiveness are discussed. In Section 3, the paper describes the case study methodology employed to answer the three research questions. Section 4 provides the context of the Nyando CSV project. Section 5 analyzes nine factors that influenced the effectiveness of the project. Section 6 contextualizes the project in the wider literature, identifies key policy implications, and discusses study limitations. Section 7 concludes the research paper.

2. LITERATURE REVIEW

This section provides a critical overview of seven rural development approaches in Kenya since its independence. To limit the scope of the review, only the agricultural aspect of each approach is discussed. Finally, the section synthesizes key design and implementation factors that influence project outcomes.

2.1 Rural Agricultural Development Approaches in Kenya

Though precise definitions vary, rural development's objective is to enhance the well-being and living standard of those in rural areas, including increasing income, food security, and access to basic necessities such as education, healthcare, sanitation, information, and infrastructure (Zadawa & Omran, 2020; Baah-Dwomoh, 2016). Rural development projects can be implemented by governments, non-governmental organizations (NGOs), development banks, or local communities. Agriculture is often given the most attention, described as "the engine of growth," since it is the primary economic activity in most rural areas, strongly connected with the non-farm economy, and generates positive externalities on food security (WB, 2005). Many development actors also stress that rural development should target specifically the rural poor to help them alleviate poverty (WB, 1975; IFAD, 2020).

Rural development interventions are wide-ranging, including enhancing agricultural extension services, creating diverse livelihood opportunities, and improving access to credits and finance (Nwande & Olorunfemi, 2021). The growing awareness of resource depletion and climate impacts among development practitioners also gave rise to sustainability considerations in these interventions (Lipper & Zilberman, 2018). As a result, different approaches emerged in the past seven decades, summarized in Table 1 and elaborated in the rest of the section.

Table 1: Overview of rural agricultural development approaches in Kenya over time

#	Period	Rural Agricultural Development Approach
1	1950s-60s	Green Revolution: state-driven, donor-funded, technology-centred
2	1970s-80s	Integrated Rural Development: state-driven, donor-funded, multi-sectoral
3	1980s-90s	Structural Adjustment Programme: market liberalization, privatization, global value chain
4	1990s-Present	Community-Based Development: bottom-up, participation, empowerment, equity, gender
5	1990s-Present	Sustainable Agriculture: natural resource conservation
6	2000s-2010s	Millennium Villages Project: multi-sectoral, donor-funded, top-down
7	2010s-Present	Climate-Smart Agriculture: adaptation, mitigation, intensification

2.1.1 Green Revolution

During the 1950s and 60s, modernization theories dominated development discourse and practice (Tipps, 1973; Goorha, 2010; Baah-Dwomoh, 2016). They are characterized by an optimistic belief that the newly independent countries can follow a linear development pathway, based on European and North American experience, centred on technology, to industrialize, urbanize, and achieve economic growth (Rostow, 1960). Rural subsistence economies are portrayed as backward and traditional, in need of evolving into modern commercial agriculture systems that generate cash income. Against this backdrop, there was a concerted effort to transfer improved agronomical technologies like improved hybrid crop varieties, chemical fertilizers, and pesticides

to the Global South (Moseley, 2017). This process, known as the Green Revolution, is based on the premise that adopting technological innovations can produce significantly higher crop yields, so as to lift people out of poverty and transform the economy. Largely state-led and donor-funded, subsidies were directed to help farmers obtain these agricultural inputs at lower costs (Elhassnaoui et al., 2023).

In Kenya, hybrid maize was rapidly adopted by farmers across the country in favourable climatic zones, driving a rapid rise in cereal production (De Groote et al., 2005). This was accompanied by a simultaneous rise in the application of fertilizers, pesticides, and irrigation, especially by larger producers. By 1966, more than 50% of large farmers in the highlands in western Kenya were using hybrid maize (Jones, 1977). However, in the late 1970s, progress in maize yield and hybrid seed adoption stalled, which may be due to a number of factors (De Groote et al., 2005). First, although virtually all producers in regions with higher rainfall and altitude have adopted hybrids, they only represented 20% of the country's area (Wiggins, 1985). Farmers in lower-potential areas that are prone to drought were more circumspect (Jones, 1977). The food security and growth impact of the Revolution was thus limited to the high-potential areas. Second, the poorest farmers were unable to invest in agricultural inputs every year, thus failing to reap the benefits of improved technologies (Moseley, 2017). Third, it has been observed that pesticide and fertilizer overuse in some places has resulted in soil degradation.

In sum, Kenya was one of the few African countries that did benefit from the Green Revolution (Elhassnaoui et al., 2023). However, the outcome was far more modest than what the modernization theories predicted. Rural poverty and food insecurity persisted. The imported technologies were often inapplicable in drought-prone regions. Subsistence farming, by and large, did not transform into commercial industrial agriculture.

2.1.2 Integrated Rural Development

In the 1970s, the distributional implications of the Green Revolution became increasingly clear (Rondinelli, 1979; Ruttan, 1984). Rapidly industrializing urban centres around the world were draining capital from rural areas, and there was a widening gap between large-scale crop exporters and small subsistence farmers (Baah-Dwomoh, 2016). In 1971, the FAO convened a major symposium titled "Agricultural Institutions for Integrated Rural Development (IRD)," which prompted a shift in rural development discourse to focus on the poorest communities and the potentially synergistic effects of simultaneous investments in different sectors. IRD projects, largely state-driven, aimed to increase agricultural output, provide alternative livelihood opportunities, and enhance overall rural living standards (Nwande & Olorunfemi, 2021; USAID Armenia, n.d.). Agricultural interventions included extension services, training, credits, land reform, subsidized inputs, and better roads (Ruttan, 1984). Non-agricultural interventions included industry, public works, schools, and health facilities.

In Kenya, the Special Rural Development Programme (SRDP) was administered from 1971 to 1977 in six sub-districts, each with a population size of between 20,000 and 75,000 (Ergas, 1982;

Wiggins, 1985). Each was funded by a foreign donor, and all were implemented by the Government of Kenya. The programme was area-based and multi-sectoral, targeting the country's arid and semi-arid lands (ASAL). However, in 1977, the programme was abandoned as foreign donors stopped their funding and the Government of Kenya decided not to support it. The process was widely regarded as a failure for several reasons. First, the planning process of SRDP did not extensively involve the community, and decisions were made by officials and implementers with scarce knowledge of the local context (Wiggins, 1985). Second, a lot of foreign expatriates, who possessed technical and managerial expertise, were involved in the project design and implementation, but after funding had gone out, no capacity at the local level was built up, and the project could not be sustained or replicated. Third, at both local and national levels, a sense of ownership failed to emerge, and the programme did not gain buy-in and support from the Kenya administration, giving rise to tensions during implementation, ultimately resulting in programme termination.

Nonetheless, in the following years, the Government of Kenya moved forward with its own ASAL programme using the same integrated rural development approach, through District Planning Units at 14 sites (Adams, 1990). Scholars noted several areas of weakness, including a lack of planning, monitoring, and reporting, the absence of baseline data, and the uncoordinated incorporation of existing programmes like farm credit and training. For these reasons, in addition to the absence of effective technologies to increase ASAL productivity, the programme did not generate much improvement in agricultural output or income.

In sum, these large-scale, integrated social planning interventions aspired to lift the poorest farmers in more disadvantaged geographies out of poverty by exploiting the theoretical complementarity of a multi-pronged approach, but outcomes fell short of expectations due to organizational complexity, coordination difficulties, low community participation and ownership, and a lack of local capacity building.

2.1.3 Structural Adjustment Programmes

In the 1980s, as economic development stagnated, the international debt crisis grew, and state-led development projects became widely viewed as ineffective, Bretton Woods institutions introduced the Washington Consensus and Structural Adjustment Programmes (SAP) (De Groote et al., 2005; Baah-Dwomoh, 2016). They diagnosed the problem of underdevelopment as heavy state intervention, which limited the efficient operation of the free market (Heidhues & Obare, 2011). Policies such as import substitution, controlling exchange rates, subsidizing inefficient producers, and rent extraction were considered to be undermining agricultural productivity. Instead, the adoption of neoliberal policies became the precondition to access loans, including budget deficit control, privatizing state entities, withdrawing subsidies, currency devaluation, and trade liberalization (Gibbon, 1992; Rono, 2002). Measures specific to the agricultural sector included dissolving export crop parastatals, privatizing agricultural input supply and market, abolishing the producer price floor, and cutting public agricultural extension services.

In Kenya, SAPs started in 1980 and continued until the early 1990s (Rono, 2002). The proportion of government expenditure on agriculture continuously decreased from 4.6%/yr in 1964-1973 to 0.4%/yr in 1980-1985. The objective of liberalizing the maize seed sector through state withdrawal from the market was fraught with challenges as it was difficult for firms to become competitive in their early stages (De Groote et al., 2005). Furthermore, without public work and maintenance, transportation infrastructure started to deteriorate (Moseley, 2017). Parastatals, which were the groups conducting agricultural extension services and research, were abandoned. Formal credits that farmers used to access disappeared (De Groote et al., 2005). As a result, in the most marginalized communities with the least agricultural potential, liberalization measures did not attract new firms or capital to the regions. There were actually increases in rural underemployment and declines in smallholder land size, due to the policy of land individualization and export crop producers' accumulation of land (Rono, 2002; Gibbon, 1992). Moreover, the policy of land individualization combined with the restructuring of the smallholder coffee payment system to solidify male control over land undermined women coffee cultivators' access to payment (Brownhill et al., 1997; Gibbon, 1992).

In sum, research has shown that the impact of neoliberal policies on economic growth in most African countries, including Kenya, was negligible (Heidhues & Obare, 2011). The withdrawal of public support in all sectors caused deterioration in living conditions in rural areas with the least production potential and highest poverty.

2.1.4 Community-Based Development

During the 1980s and 90s, as the state retreated from the development realm, NGOs started to fill the void (Baah-Dwomoh, 2016; Ahmad & Abu Talib, 2015). This was accompanied by the rise of prominent academics critiquing the old paradigm and proposing new frameworks. Arturo Escobar argued that top-down interventions disempower communities and impose a one-size-fits-all Western notion of "development" (Escobar, 1994). Amartya Sen proposed the capability-based approach that emphasizes expanding human freedom rather than merely meeting material needs (Sen, 1988). Research in political ecology reveals that relying solely on Western "scientific" expertise could mischaracterize problems and generate solutions that exacerbate the situation or increase the precarity of marginalized groups (Bryant, 1998; Schubert, 2005). Similarly, feminist scholars problematized the common practice of treating households as a homogenous unit, pointing to unequal intra-household dynamics, where wives and daughters often have less access to natural resources, capital, land, income, and project support (Sundberg, 2016; Tavenner & Crane, 2019; Okali, 2012). Interventions designed without awareness and accommodation for different social groups' circumstances and needs risk perpetuating inequality.

As a result, community-based development (CBD) grew in popularity (Ahmad & Abu Talib, 2015; Mansuri & Rao, 2003). CBD is an umbrella term describing any project that actively engages with its beneficiaries in the design and implementation processes. Participation, empowerment, capacity building, and access to information are central to its theory of change, leading to improved local governance and human development. The "community" in CBD refers

to the beneficiaries of a project, often bounded by geography, profession, or other common features. Project implementers ensure participation by consulting with or otherwise involving local people to understand their perspectives, priorities, and knowledge. To take a step further, projects that seek to empower local people offer them some degree of control over key project decisions. Common CBD methodologies include focus groups, community meetings, interviews, surveys, ethnography, and gender analysis. The proportion of projects funded by the World Bank that utilized a component of CBD increased from 2% in 1989 to 25% in 2003 (WB, 2005).

One example of CBD project was studied by Gugerty and Kremer (2000). It was implemented by a Dutch NGO called "International Child Support" in two densely populated and economically poor districts in Western Kenya. The project aimed to strengthen women's associations and boost agricultural production. Interventions included 1) training community groups on organizational and leadership skills and 2) providing agricultural inputs such as fertilizers, pesticides, and improved seeds. Results show that the treatment group both planted and harvested more than the comparison group. However, the authors also found that the implementation of the program was correlated with higher turnover among group members, with more men and more educated women entering into membership and leadership. This outcome reflects a common critique of CBD projects, which is that a homogenous assumption and treatment of "community" can overlook internal power relations, and the voices of the most marginalized members are silenced (Mueller, 2006). A more severe potential drawback is elite capture, whereby the members with authority engage in corrupt practices to divert project resources for personal benefits, or for only a select group of members based on gender, ethnicity, religion, or social hierarchy.

In sum, community-based and women-focused projects seek to address where previous development projects proved deficient, devising innovative ways to engage with and empower the beneficiaries. However, if the implementers do not give careful consideration to local power dynamics and the impact on the most marginalized groups, there may be unintended consequences that undermine the equity and effectiveness of the outcome.

2.1.5 Sustainable Agriculture

The seminal report "Limits to Growth" was published by the Club of Rome in 1972, popularizing the Malthusian theory of population growth outstripping the Earth's carrying capacity, leading to resource depletion and environmental degradation (Meadows et al., 1972). In 1987, the concept of sustainable development was defined in the Brundtland Report as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland Commission, 1987). In 1992, sustainable agriculture and rural development (SARD) was proposed at the UN Conference on Environment and Development to ensure soil, water, and other natural resources are conserved while improving agricultural productivity (Baah-Dwomoh, 2016). This can be achieved with a variety of techniques like cover crops, crop rotation, intercropping, agroforestry, and water conservation (Warinda et al., 2020; Ndiritu et al., 2014; Adenle et al., 2018).

In Kenya, sustainable agriculture initiatives were widely promoted by the government and international organizations (Wanjira & Muriuki, 2020; K'Owino Isaac, 2010; FAO, 2002). Pilot projects were conducted in collaboration with the Ministry of Agriculture, the World Agroforestry Centre, and the Kenya Network for Dissemination of Agricultural Technologies (Wafula et al., 2016). For example, from 1998 to 2001, an initiative focusing on conservation agriculture with trees was implemented in Machakos, offering training to farmers and supporting tree seedling nurseries. In another example, in Siaya, from 1988 to 1998, the international NGO CARE implemented a agroforestry project in collaboration with women's groups and schools (Noordin et al., 2001). They provided technical resources and advice and set up local agroforestry committees. Furthermore, the Government of Kenya implemented the Catchment Approach to promote conservation agricultural techniques (FAO, 2002; Ekbom et al., 2001). This is a participatory approach concentrating resources on a defined area (200-500 ha) for a limited duration (one year), tailoring conservation measures to be site-specific to facilitate farmers' adoption. The number of farms adopting these measures increased from less than 60,000 in 1988 to more than 100,000 in the mid-1990s.

However, there have also been studies critiquing the sustainable agriculture approach. First, it is found that some farmers perceived the Catchment Approach as corrupt, lacking in support, and inactive after the withdrawal of resources (Ekbom et al., 2001). Second, given that the impact of productivity improvements from sustainable agriculture practices take more time to manifest, merely offering technical training is insufficient to incentivize adoption (Wafula et al., 2015). Other important complementary factors include market access, road infrastructure, and establishing test plots that demonstrate productivity enhancement. Third, male farmers were more likely to adopt certain techniques, such as animal manure for crop production, suggesting potential gender disparities in their access to resources (Ndiritu et al., 2014).

In sum, sustainable agriculture became increasingly dominant in rural agricultural development discourse in the 1990s, placing environmental considerations at the centre of interventions, which may be top-down state-initiated or bottom-up community-driven.

2.1.6 Millennium Villages Project

In 2001, the United Nations adopted the Millennium Development Goals (MDG), serving as the global development agenda for the decade (Fehling et al., 2013). The MDGs included eight goals to be achieved by 2015, covering poverty, hunger, education, gender equality, health, and environmental sustainability. The Millennium Villages Project (MVP) was proposed to address the market failures preventing rural communities from achieving development, such as high infectious disease incidence, low levels of education, and poor infrastructure (Wilson, 2017; Mitchell et al., 2018; Sanchez et al., 2007). Similar to the Integrated Rural Development approach, the MVP envisions multi-sectoral interventions concentrated in a limited region for a sustained duration of time (Masset, 2018). According to its theory of change, targeted, concerted, and substantial investment would correct market failures, enhance living standards above a threshold to break the "poverty trap," and create a "big push" for the market economy to "take

off," so that the community shifts to a path of self-sustained economic growth (Carr, 2008; Masset et al., 2020; Jupp & Barnett, 2018). The project was headed by Jeffrey Sachs, who argued in "The End of Poverty" (2005) that carefully planned aid can eliminate extreme poverty. Launched in 2005, the MVP operated for 10 years at 10 different sites, which would serve as "living laboratories" to provide "rigorous proof of concept" for "national-level scaling up" (Mitchell et al., 2018; Sanchez et al., 2007; UN, n.d.). The "proven [and] integrated package of interventions" included subsidized agricultural technologies, agronomical training, schools and health facilities, road and power grid expansion, and business development services.

The first MVP pilot took place in Sauri, Kenya, consisting of 11 densely populated small villages with high agricultural potential (Kimanthi & Hebinck, 2018; Kimanthi & Hebinck, 2016; Wanjala & Muradian, 2013; Jivetti, 2012; Kalsi, 2016). In phase one, free and low-cost agricultural inputs were provided to increase farmers' capital. This would, theoretically, prepare the way for phase two, where farmers would be trained to become entrepreneurs, selling surplus yields in the market and investing in agricultural inputs on their own through formal farmer groups and cooperatives. However, when the "free gifts" were withdrawn after phase one, the poorest farmers dissociated from the MVP and resumed their traditional means of production, as they feared losing their assets in the event that they fail to repay the loans in experimenting with new technologies. Furthermore, there was a widespread perception of corruption and nepotism, with elite capture of inputs and resource abuse by the local administration. By the end of the project, there was no evidence that farmers had escaped the "poverty trap." Instead, many were unaware of its termination, and there was little collective effort to sustain the interventions.

Official analyses by the MVP planning team show that aggregating across the different sites, 30 of 40 outcome measures yielded significant and positive results favouring MVP sites relative to comparison villages, especially for health and agriculture (Mitchell et al., 2018). However, the study was not a randomized controlled trial, and baseline data was scarce for comparison villages. Many scholars have criticized its study design rigour, arguing that the actual impact of the interventions was much lower (Kimanthi & Hebinck, 2018; Clemens & Demombynes, 2013). Furthermore, there was significant concern regarding data transparency, as independent researchers were unable to access project data for objective investigation. Much of the claims in project documents could not be corroborated. Site-specific results were not disclosed, except on an occasional basis where there were significant positive gains. Only the Northern Ghana site had an independent impact evaluation at the request of the UK government (Barnett et al., 2018). Fewer outcome measures were significant, and the effect sizes were much smaller.

There were also other criticisms regarding the design and implementation of the MVP (Carr, 2008; Kimanthi & Hebinck, 2018; Wilson, 2017). First, despite rhetorically publicizing a "participatory" approach, the MVP contradicts itself by committing to a set of scientifically proven interventions at all sites, without truly understanding the particular local context, needs, and culture. Second, the villagers were treated as a homogenous group, neglecting differences in resource access, power, and networks, failing to account for gendered and class relations. This resulted in the elite capture of resources and perceived corruption, exacerbating inequality and

injuring social relations. Third, despite claiming that simultaneous interventions across multiple sectors can create synergies in Sanchez et al. (2007), the final report by Mitchell et al. (2018) did not discuss how sectoral interventions affected each other or the cost effectiveness of integration. In fact, according to the independent Northern Ghana impact evaluation, the cost of integration in the MVP was higher than what could have been achieved through non-integrated interventions (Barnett et al., 2018; Masset et al., 2020; Barnett, 2018).

In sum, the donor-driven MVP was a conceptual fusion of modernization theory, integrated rural development, and community-based development. Contradictory outcomes were reported, but the true impact could not be determined due to study design flaws and data opacity.

2.1.7 Climate-Smart Agriculture

According to the Intergovernmental Panel on Climate Change, anthropogenic activities have unequivocally increased atmospheric GHG concentration, resulting in an estimated average global temperature rise of 1.07°C compared to 1850, changing temperature and rainfall patterns, and increasing the frequency and intensity of extreme weather events (IPCC, 2021). With growing global awareness of climate change, considerations of reducing GHGs and supporting adaptation were gradually mainstreamed into development planning (Beg et al., 2002).

The agricultural sector is both vulnerable to and complicit in climate change, as disasters jeopardize food production and farmers' livelihoods, while the use of inorganic fertilizers and certain soil water practices contribute to GHG emissions. As a result, the concept of CSA emerged in 2009, formally launched by the FAO (Lipper & Zilberman, 2018; Lipper et al., 2014; Chandra et al., 2018; Sova et al., 2018; Khatri-Chhetri et al., 2017). CSA is an umbrella term that includes any agricultural practice, technology, and institution that supports at least one of the following pillars: 1) increasing agricultural productivity, food security, and income; 2) reducing exposure and sensitivity and increasing adaptive capacity to climate shocks and stresses; and 3) mitigating GHG emissions relative to the baseline or business-as-usual scenario. There is no one CSA package that can be universally applied, but they must be tailored to and embedded in local contexts to minimize trade-offs and maximize synergies among the three pillars (FAO, 2022). Typical CSA practices include soil water conservation, agroforestry, intercropping, crop rotation, animal manure, feed conservation, and improved seed varieties and animal breeds.

Kenya enacted the Climate Change Act in 2016 to mainstream climate considerations in all sectors and levels of government (Kibugi, 2021). In addition, the Climate-Smart Agriculture Strategy adopted in 2017 sets out objectives to enable systematic coordination to promote CSA (GoK, 2017; Faling, 2020). CSA projects were often implemented in partnership with international organizations and donors such as the World Bank, Vi Agroforestry, International Livestock Research Institute, and the German Agency for International Development (Cavanagh et al., 2017; Mogaka et al., 2022; Vi Agroforestry, n.d.; CCAFS, 2015). For example, the Kenya Agricultural Carbon Project operated from 2011 to 2017 with a total cost of $1 million, promoting to smallholders sustainable agricultural land management techniques that store carbon

in the soil (Nyberg et al., 2020). The amount of GHGs sequestered was exchanged into carbon offset credits sold to provide direct finance for the farmers.

However, scholars have pointed to a number of challenges in CSA. First, given the broadness of what constitutes a CSA practice and the vagueness of which pillar should be prioritized, technologies that support a narrow interpretation of productivity without ensuring resource sustainability often overshadow other practices (Lipper & Zilberman, 2018; Taylor, 2018; Karlsson et al., 2018). Meanwhile, on the other side of the spectrum, projects could promote mitigation technologies that do not produce tangible food security and income benefits, leading to an exacerbation of precarity for farmers or to low adoption rates and disengagement. The "triple-win" rhetoric of simultaneously advancing intensification, mitigation, and adaptation is often unfeasible, leaving an unclear rubric on how to balance trade-offs. Second, CSA projects, when implemented in a top-down manner, could be too focused on delivering a pre-determined package of technical interventions, neglecting to adapt to local contexts and community needs (Hellin et al., 2023). Third, CSA has no mandate for equity or power relations. When differential capabilities are not taken into account, CSA interventions can exacerbate inequality between farmers with more resources to invest in CSA technologies and those who lack the requisite financial and physical capital (Brisebois et al., 2022; Collins, 2018; Bernier et al., 2015; Huyer, 2021). Finally, a more fundamental criticism is that the promotion of CSA in international development discursively places the burden of mitigation on the agricultural sector of the Global South, yet Kenya's total emissions make up less than 1% of the global sum (Kibugi, 2021).

In sum, CSA is currently viewed by many development practitioners as the silver bullet to achieve climate resilience and food security. Positive outcomes in GHG emissions, food security, and production were reported from adopting CSA technologies, but some conceptual and operational challenges remain.

2.2 Project Enabling Factors

Having surveyed the main rural agricultural development approaches in Kenya over time, this section abstracts five project-specific enabling factors for an effective outcome: access to capital; community engagement; equity and intersectionality considerations; monitoring and evaluation; and capacity building.

2.2.1 Capital

All the rural agricultural development approaches, with the exception of Structural Adjustment Programs, provided some combination of five types of capital to farmers (Scoones, 2009; Crane et al., 2017). First, interventions targeting natural capital help farmers better access and use natural resources. For example, sustainable agriculture promotes soil and water conservation techniques, and the Green Revolution provided improved hybrid seeds (FAO, 2002). Second, interventions can provide or improve physical capital like roads, transport systems, housing, energy grids, and fertilizers at a subsidized price, such as in IRD programs and the MVP

(Masset, 2018). Third, financial capital can be provided in the form of credits, loans, unconditional cash transfers, liquid assets, or access to financial services. Fourth, interventions that improve human capital focus on health facilities, education, and agricultural training. Multiple research has shown that better education and access to training improve the likelihood of adopting CSA (Nyang'au et al., 2021; Musafiri et al., 2022). Finally, social capital refers to the local institutions and human relations. CBD projects often support the establishment or strengthening of women's groups, youth groups, and rotating savings and credit associations (Gugerty & Kremer, 2000).

2.2.2 Community Engagement

Since CBD approaches were mainstreamed in the 1990s, many rural agricultural development projects, at least rhetorically, have incorporated some aspects of community engagement, whether in the form of consultation, participation, empowerment, or ownership (WB, 2005). This is important for understanding the local context, needs, and culture, so that the "problem" a development actor is trying to address is accurately articulated, responding to an actual priority (Ahmad & Abu Talib, 2015; Mansuri & Rao, 2003). This is also important for getting local people's buy-in and recognition, as "interventions" could be co-created with the farmers, who can contribute local knowledge key to the project design and implementation. A common pitfall of many development projects is the lack of community involvement, resulting in implementation tensions, disengagement, and the lack of long-term sustainability (Rondinelli, 1979; Wiggins, 1985; Carr, 2008; Taylor, 2018). However, participation does not inevitably lead to empowerment, but can be manipulative to reinforce pre-existing conceptions and decisions, or be susceptible to elite capture (Cooke & Kothari, 2001). Measures to ensure accountability, to provide space for all community members to express their ideas, and to genuinely take community input and feedback into account are essential to overcome these challenges.

2.2.3 Equity

Equity, gender, and intersectionality considerations are important in development planning to ensure that interventions uplift the most marginalized members of the community and do not exacerbate their precarity (Bryant, 1998; Schubert, 2005). In terms of gender, the practice of sex disaggregation and not assuming households as a homogenous unit has become the standard analytical practice (Sundberg, 2017; Okali, 2012). In the community engagement process, paying particular attention to the locally specific roles and circumstances of women fosters intervention designs that are more sensitive to women's needs, that do not exacerbate pre-existing inequities in resource access and control, and that empower women to expand their decision-making power (Brisebois et al., 2022; Tavenner & Crane, 2019; Bernier et al., 2015; Huyer et al., 2021). In terms of other dimensions of equity, such as based on land sizes, income, or social status, some development projects have fallen prey to elite capture when the local power dynamics are not appropriately understood and accounted (Wilson, 2017; Kimanthi & Hebinck, 2018; Kimanthi & Hebinck, 2016; Hellin et al., 2023). Project implementors could pay particular attention to the most marginalized farmers, studying how they are engaging with or impacted by the project.

2.2.4 Monitoring and Evaluation

A robust system of monitoring and evaluation (M&E) is critical to ensuring the effectiveness, equity, accountability, and iterative improvement of development interventions (Lamhauge et al., 2012). A common weakness of IRD and MVP is that their M&E system lacked transparency and rigour, making it difficult to assess the true impact of the interventions and to modify the interventions while the project is still ongoing (Adams, 1990; Jupp & Barnett, 2018; Masset et al., 2020). Best practices of M&E include randomized controlled experimental design, baseline data collection, collection of both qualitative and quantitative data, independent analysis, open data, results-based management, and the logical framework approach (Lamhauge et al., 2011; Jupp et al., 2018; Clemens & Demombynes, 2013). Intermediate and final results from the M&E processes help identify the most and least effective interventions, drawing lessons learned, and facilitating future scaling-up.

2.2.5 Capacity Building

In order to create lasting impact, development projects, whether top-down or bottom-up, need to build up the capacity of local administrators and community members to continue the interventions on their own without external funding and expertise (Merino & de los Ríos Carmenado, 2012). Capacity building is more than just delivering training on agricultural techniques, but also improving organizational efficiency, financial management, and institutional effectiveness. In the cases of IRD and MVP, parallel project management units were set up, largely funded by donors and staffed by expatriates, so when the project came to an end, the impact could not be sustained (USAID Armenia, n.d.; Masset et al., 2020). Meanwhile, some CBD, sustainable agriculture, and CSA projects emphasized building local capacity by working with community groups, so that farmers could continue to obtain improved agricultural inputs and disseminate to more farmers (Gugerty & Kremer, 2000; FAO, 2002; CCAFS, 2015).

3. METHODOLOGY

To better understand the factors that enable effective rural agricultural development projects, this research paper adopts a case study methodology focusing on the CSV project in Nyando, Kenya, implemented from 2011 to 2021. Qualitative data was collected from peer-reviewed journal articles, CCAFS publications, and key informant interviews, and analyzed with thematic analysis. Because the methodology involves human participants, an ethics certificate was obtained from the University of Ottawa's Research Ethics Board prior to conducting interviews.

First, to identify peer-reviewed academic literature, a query of keywords was developed and used to search in Scopus — TITLE-ABS-KEY(("Kenya" OR "Nyando") AND ("climate-smart agriculture" OR "climate-smart village")) — to find all relevant articles on the Nyando CSVs. Following the PRISMA protocol, the article titles and abstracts were first reviewed to remove

ineligible ones. Full articles were reviewed to further remove irrelevant documents. The inclusion criterion is that the article must be specifically about CSV interventions and outcomes in Nyando. From the 87 sources identified from the search, 13 articles met the criteria and were kept for analysis. Second, grey literature was identified using the CCAFS database, using the same keywords and inclusion criteria as the academic literature search. 27 reports, info notes, and policy briefs were kept for analysis. Nine other articles were further included upon recommendation by key informants.

Interviews were conducted with seven key informants to gain a deeper understanding of the project. The key informants must satisfy two criteria. First, they must be formerly or currently affiliated with or employed by CGIAR. Second, they must have good knowledge of the CSVs in Nyando, which can be acquired either through conducting research on the Nyando CSVs or being a part of the project planning or implementation team. Ten people were identified using purposive sampling by searching on the Internet. Invitations to participate in the interview were sent via email. Following the initial interviews, snowball sampling was used, whereby the key informants who have been interviewed introduced the principal investigator to other key informants. The interviews were semi-structured, with an interview guide that consisted of seven main questions, and the principal investigator asked additional probing questions. The interview guide template can be found in Appendix A. Each interview lasted around 30 minutes and was held via Microsoft Teams, audio-recorded and auto-transcribed.

After collecting the data, an inductive approach was used to analyze the publications and interview transcripts. While all articles and reports included for review were useful in providing background information, 17 sources were coded because of their high relevance to the research questions. All interview transcripts were coded. The coding process was iterative. A preliminary coding scheme was developed following a first review of the texts. The texts were coded during the second review. Following a third review, the codes were modified, merged, and reorganized. The description and summary of the final list of codes can be found in Appendix B. The frequency of each thematic code, the context of the coded passages, and the overlap between different themes were examined to draw inferences on the factors that influenced the project outcomes, mechanisms to advance equity, and the theoretical continuities with other rural agricultural development approaches.

There are three potential limitations to this study. First, this research paper adopts a case study approach focusing on the Nyando CSVs to draw insights on the factors that enable or constrain the effectiveness of rural agricultural development, and especially CSA, projects. Given scope and time constraints, this strategy allowed an in-depth and contextualized examination of a specific project and why available data suggests that it was relatively successful. However, the drawback of a case study is its external validity (Priya, 2021). It may be hard to establish whether the findings could be generalized to other CSA and rural agricultural development projects. Similarly, it may be difficult to generalize the findings to other communities in Kenya, Africa, and Global South countries. Nonetheless, the purpose of this research paper was not to propose a grand theory identifying every enabling factor, but to situate the CSVs in the plethora

of rural agricultural development approaches and identify good practices in project design and implementation. Second, the data collection methodology combined a systematic literature review with seven key informant interviews. The key informants all helped design or implement the CSVs in Nyando and worked on different aspects of the project, ranging from designing the overarching conceptual framework of CSVs to carrying out a specific intervention in Nyando. However, they may not have provided the full spectrum of views on the enabling and constraining factors, especially on the ones where there was a divergence in opinion, such as prioritization. The point of saturation was reached on most factors, but not on some. Therefore, there may be other factors and insights that have not been accounted in this paper. Last, this research paper focused exclusively on qualitative data and adopted a content analysis approach. No quantitative data was collected or analyzed to establish statistical correlation or causality between the enabling and constraining factors and the different dimensions of project outcome. A mixed approach combining documentary and key informant insights with statistical analyses could have increased the robustness of the study findings. Nonetheless, a number of articles analyzed in this paper are based on quantitative data and are peer-reviewed.

4. CASE STUDY CONTEXT

Climate-Smart Villages (CSV) is an initiative of the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS), launched in 2012 in climate change hotspots around the Global South (Aggarwal et al., 2013; Aggarwal et al., 2018; CCAFS, 2018; Recha et al., 2017a; Kinyangi et al., 2015). All CSV sites are characterized by high population density, poverty rate, climatic stress, and low agricultural productivity. The goal of the CSVs is to generate evidence on a portfolio of CSA interventions tailored to each site through transdisciplinary collaboration with researchers, farmers, government officials, and other organizations. The outcomes of the CSVs contribute to the overall CCAFS theory of change to promote large-scale adoption of CSA (CCAFS, 2016). It is highlighted that there is no one-size-fits-all package of solutions. Rather, the CSVs adopt participatory action research and community-based design by responding to locally specific needs.

Seven CSVs are situated in western Kenya's Nyando basin, a floodplain with high agricultural potential (CCAFS, 2015). However, the region's high climate variability, exacerbated by climate change, constrained agricultural production, with unpredictable seasonal rainfall, steadily increasing average temperature, and more prolonged droughts and floods (Musyimi, 2020; Macoloo et al., 2013). Furthermore, the region had a high population density (over 400 persons/ km2), poverty rate (more than 50% of the population below poverty rate), and HIV prevalence (adult infection rate of 7.5%) (Mango et al., 2011; Recha et al., 2017a; Wesenbeeck et al., 2019). Agriculture is the primary livelihood for most inhabitants, mainly cultivating food crops like maize, sorghum, and beans as well as raising local breeds of livestock. The baseline study found that only 1% of households in Nyando were food-secure for the entire year (Mango et al., 2011). Only 5% of households had access to improved seeds and fertilizers (CCAFS, 2015).

A suite of CSA interventions was implemented in collaboration with local stakeholders (CCAFS, 2015; Ogada et al., 2021b; Recha et al., 2017a; Ogada et al., 2020; Radney et al., 2018; McKune et al., 2018; Kinyangi et al., 2015; Macoloo et al., 2013). First, crop-smart interventions included introducing at a subsidized cost stress-tolerant maize varieties, encouraging crop diversification, and demonstrating the potential of cultivating new drought-tolerant crops such as sweet potatoes and improved beans. Second, carbon-smart practices were promoted, such as agroforestry, which brings co-benefits as the trees can be used for fodder, forage, fuelwood, fruit, and manure in addition to sequestering carbon. Over 40 tree nurseries were set up, increasing on-farm trees by 500,000 trees in just five years (Recha et al., 2017a). Third, rainwater harvesting and terracing to control soil erosion were supported in the CSVs. Fourth, weather-smart interventions consisted of partnering with five organizations to provide seasonal weather forecasts through mobile phones to 700 farmers, as well as agro-advisory services. Fifth, Galla goats and Red Maasai sheep were introduced to be crossbred with local goat and sheep breeds (Ojango et al., 2016; Ojango et al., 2018b; Recha & Radeny, 2017; Sila, 2020; Sila et al., 2021; Ojango et al., 2015). Galla goats are known to be docile, well adapted to live in dry conditions, mature quickly, and have good milking capacity. Red Maasai sheep grow rapidly, resist well against parasites, and tolerate heat and drought stresses. 2,500 crossbred sheep and 15,000 goats were born every year, and the price sold for crossbred animals doubled compared to local breeds.

A number of institutional CSA interventions are also notable. First, CCAFS partnered with three self-organized community-based organizations (CBOs) (Birir, 2020; Ogada et al., 2021b). Together, they consisted of 50 groups with representation from 106 villages and 2,500 households (Recha et al., 2017a; Macoloo et al., 2013). The majority were women and youth, who made up 80% of the membership (Huyer et al., 2023). Through the organizations, CCAFS provided technical and financial support to facilitate table banking and rotating savings and credit associations. Furthermore, the organizations also helped organize field days, exchange visits, and trade fairs to enable knowledge learning. From 2011 to 2015, resources pooled from the organizations increased from $14,000 to $95,000 (Recha et al., 2017a). More than 90% of farmers borrowed from this fund to obtain agricultural inputs, pay for living expenses, and start local trade. An input supply shop was also set up close to the community, increasing the proportion of farmers using inorganic fertilizers from 8% in 2011 to 94% in 2017 (Radney et al., 2018). Second, smart farms were established as community demonstration plots to showcase the productivity potential of new technologies (CCAFS, 2015; Huyer et al., 2023). Managed by youth groups, the smart farms served to train young farmers, enhance adaptation and facilitate farmer-to-farmer learning. Last, CCAFS leveraged the CSVs to scale up CSA interventions by working with the local governments, embedding climate-smart practices in the County Integrated Development Plans and Local Adaptation Plans of Action (Recha et al., 2017a).

A dozen articles have been published analyzing the outcomes of the various interventions in Nyando, with generally positive results. Compared to non-CSVs, households located in the CSVs were more likely to adopt climate-smart crop practices and improved small animals breeds (Oostendorp et al., 2021). It was found that crop-smart interventions increased household income by 83%, dietary diversity by 40%, and food sufficiency by 75% (Ogada et al., 2020; Radeny et

al., 2022). Meanwhile, livestock-smart interventions reduced household income by 76% (due to investment in assets), increased dietary diversity by 38%, and food sufficiency by 90%. From 2011 to 2016, the number of households reporting more than five months of food insufficiency reduced from 65% to 2% (Radeny et al., 2022; Recha et al., 2017b). Those reporting zero months of hunger or 1-2 months increased significantly. Furthermore, compared to non-CSVs, both men and women in the CSVs exhibited greater empowerment in political, social, economic, and agricultural domains (Tesfaye et al., 2022). Last, in terms of climate change mitigation and conservation, it was found that CSVs contributed to 87-420 MgCO2E/ha reduction in emissions, as well as a significant increase in soil macro- and micro-nutrients compared to non-CSVs (Ambaw et al., 2020; Recha et al., 2021; Recha et al., 2022a; Recha et al., 2022b). Forest cover increased significantly, and some wetlands were rehabilitated (Ogada et al., 2021b).

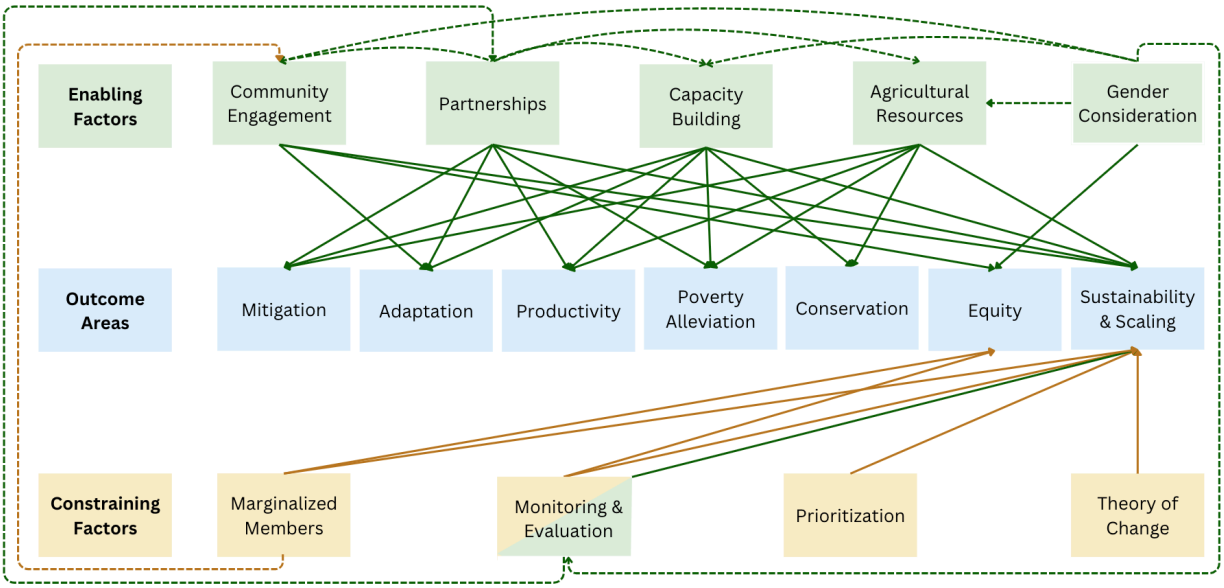
However, some negative results were also reported. First, by 2020, only 11% of farmers adopted improved sheep and 25% improved goats in CSVs, revealing that there was still a long way to go to achieve universal adoption (Oostendorp et al., 2021). Second, the difference between CSVs and comparison villages in land management and food insecurity was not statistically significant. Third, livestock ownership was unevenly distributed, especially for improved breeds, favouring those who have higher incomes, indicating inequalities (Radeny et al., 2022; Oostendorp et al., 2021). The disadoption rate of improved animals was also high, which may be because farmers sold all the improved animals to generate immediate cash income, leaving them with only less productive local breeds. Fourth, interventions to improve climate information services had an insignificant impact on food security (McKune et al., 2018). Fifth, in the endline report, food security deteriorated, which is estimated to be confounded by the COVID-19 pandemic and a long dry period in 2021 (Ogada et al., 2021b). Finally, open-access resources such as rivers and springs were observed to have degraded due to soil erosion and siltation from livestock.

5. RESULTS AND ANALYSIS

The results in this section answer the first two research questions, identifying nine enabling and restraining factors of the Nyando CSVs' success, which include mechanisms that addressed equity and gender issues. This section discusses these factors in detail and how they influenced the different outcome areas of the project, summarized in Figure 1. The factors are not discussed in any particular order. The literature and key informants explicitly or implicitly used seven outcome areas to evaluate the Nyando CSVs' effectiveness:

1. Mitigation: reducing GHG emissions or sequestering carbon;
2. Adaptation: increasing farmers' ability to cope with climate change impacts;
3. Productivity: increasing agricultural yields;
4. Poverty Alleviation: increasing farmers' income, assets, and food security;
5. Conservation: ensuring the sustainability of natural resources;
6. Equity: empowering marginalized community members; and
7. Sustainability and Scaling: sustaining or extending the impact of the interventions after project termination.

Figure 1: Illustrative diagram of how the enabling and restraining factors influenced the Nyando CSVs' outcome (Source: author's own analysis based on literature review and interviews)



5.1 Community Engagement

"Community engagement" is coded 28 times in 11 files, and is identified as a critical factor in contributing to the success of the CSV project by 6 key informants. This factor is defined as activities undertaken to talk with, consult, learn from, or empower the project beneficiaries in the design, planning, or implementation of the project.

Awareness. One key informant highlighted the importance of communicating with the Nyando community administrators and members to help them understand the challenge of climate change and how it was negatively impacting the agricultural productivity and livelihood of the community, using accessible language paired with concrete examples. After the farmers understood the concept of climate change, they agreed that the phenomenon is aligned with their own observations. After they learned about the potential of innovative practices to improve their adaptation and production, they became willing and open to work with CCAFS and to experiment with the various CSA practices. Therefore, awareness helped farmers to actively cooperate in project interventions, laying the foundation for success and sustaining the interventions after the funding terminated.

Participation. CCAFS adopted the participatory action research approach, so starting from the planning stage, specific interventions were designed in consultation with the community to understand their exact needs and priorities on what could help them adapt. Methods employed included household surveys, semi structured interviews, expert groups, focus group discussions,

and one to one interviews. Key Informant 001 described the participatory process as first coming up with a "basket of options on what can be done, a long list" which is generated based on ideas brainstormed by staff and community members. Next, after more consultations, a short priority list emerged containing feasible options for which CCAFS could provide technical support, training, and resources. Similarly, Key Informant 005 emphasized that they "were responding to a need within an area," and that the interventions implemented were identified jointly with the community members. Furthermore, during implementation, the community was actively involved in the process of iterative learning and improvement. In the livestock intervention, some community members were insistent upon introducing Dorper sheep, which they heard to be productive, so CCAFS researchers introduced cross-bred Dorper as a pilot, but it did not perform well in the humid Nyando climate. Seeing the results, farmers provided the feedback that they would not want this breed, so CCAFS introduced Galla goats and Red Maasai sheep instead, which were well-adapted and much more productive.

Ownership. Key informants highlighted that, because of the strong participatory elements, the project was aligned with the community's interests, and there was a sense of ownership, the feeling that "this project was part of their own." This resulted in farmers' positive perception of the interventions and eagerness to participate. For example, farmers experienced significant increases in productivity from cross-breeding with the improved Galla goats and Red Maasai sheep. They appreciated this intervention so much that they told their relatives living abroad in Global North countries, who reached out to CCAFS expressing that they would like to take over purchasing the improved animals to keep the intervention going, since CCAFS funding would end in 2021.

Local Knowledge. Local traditional knowledge was consulted and taken into consideration in CCAFS interventions. For example, in designing the improved livestock intervention, scientists and experts selected Galla goats and Red Maasai sheep, which are known to grow and mature very quickly, as well as resisting parasites and diseases. However, local farmers explained to the researchers that the indigenous breeds, which have historically been raised in Nyando, are good at tolerating climate stresses and shocks such as droughts and floods. Thus, CCAFS scientists cross-bred the improved and indigenous small ruminants, and a superior flock emerged, with high productivity as well as resilience. In another example, Key Informant 001 recounted how local weather forecast was done in collaboration with traditional knowledge holders who observe natural indicators like animal behaviours to predict droughts and rainfalls.

To conclude, community engagement directly influenced three outcome areas. First, participation allowed the interventions to be tailored to meet the needs of the community in the face of climate impacts, supporting increased adaptation. Second, it supported equity because through open consultation, all members of the community are given the opportunity to provide feedback and participate in the decision-making process. Third, ownership engendered from the participatory process ownership clearly increased the sustainability of the project impact and the potential to be scaled out in the region. There was no evidence showing that the factor influenced other outcome areas directly.

5.2 Partnerships

“Partnerships" is coded 37 times in 14 files, and is highlighted by 4 key informants as an important reason for the Nyando CSVs’ effectiveness. This factor is defined as activities undertaken to connect, communicate, or collaborate with different stakeholders, who are not direct project beneficiaries.

Local Partnerships. Key informants described CCAFS as a “partnership-led approach,” whereby collaboration with local organizations were “absolutely key.” In fact, Key Informant 002 explained that a central criteria in choosing the location of the CSV sites was whether CCAFS had good connections with local organizations to support implementation, and that “without those partnerships, it would have been pretty much impossible to make any headway.” Local partners included CBOs, market actors, financial institutions, government officials, and other development organizations. One of the goals of the CSVs was to bring together these stakeholders to complement each other’s work and maximize the synergies in CSA-related interventions. In particular, three CBOs — Friends of Katuk Odeyo, North-East Community Development Programme, and Kapsokale — were identified by multiple key informants and the literature as vital in disseminating CSA practices, organizing community initiatives, and mobilizing collective action to negotiate better deals with market actors. Additionally, CCAFS partnered with the various development and government organizations operating in Nyando to leverage their unique expertise, such as Vi Agroforestry, World Neighbours, and the Kenya Agricultural and Livestock Research Organization. Some of these organizations have worked with the community for a long time, and Key Informant 006 identified this as an important factor in better understanding the communities’ needs and gaining their trust. Therefore, local partnerships facilitated community engagement and increased the potential for project impact to sustain when the CSV project is concluded, as other actors would still be operating in the region.

National Partnerships. While much of the Nyando CSV project was focused on gathering evidence on local CSA interventions, forming national partnerships was a key strategy to support scaling up and scaling out project results. CCAFS collaborated with government officials to advance CSA on the national policy agenda. In particular, “learnings, knowledge, and capacities achieved in CSVs” were communicated with the government and major international organizations to support policy and investment decisions (Beal et al., 2021b). Key Informant 002 mentioned that they had good relations with many ministries, and supported the integration of CSA into the county development plans as well as contributing to the CSA national plan. In 2017, Kenya adopted the Climate Smart Agriculture Strategy, a landmark policy document institutionalizing the promotion of CSA practices. Key Informant 004 described the Nyando CSVs as a “stepping stone” that may have contributed to this milestone of CSA up-scaling.

To conclude, local partnerships directly influenced the outcome areas of mitigation, adaptation, productivity, and sustainability, because partner organizations brought different resources to support a diverse range of projects that bring benefits to the community, potentially outlasting

the CSV project. It also indirectly influenced the outcome areas by helping to build capacity for farmers, providing agricultural resources, and strengthening community trust and engagement. National partnerships directly influenced CSA scaling, as the results of this project could be used to inform wider level adoption of CSA.

5.3 Capacity Building

“Capacity building" is coded 69 times in 16 files, and 4 key informants identified it as important in the Nyando CSVs’ positive outcomes. This factor is defined as activities undertaken to enhance the skills of project beneficiaries or to foster local social connections and institutional effectiveness.

Human Capital. Multiple key informants identified that CCAFS had a greater focus on capacity development and training compared to resource allocation, and that the project provided relatively little direct or indirect financial support. Training featured prominently in all interventions, including improved livestock management, conservation practices, agroforestry, and other innovative CSA practices. Training sessions were organized in collaboration with the CBOs. Key Informant 006 mentioned that the model of champion farmers was sometimes adopted. Champion farmers selected by the CBOs were trained in CSA practices, and they in turn trained other farmers, propagating the practices. Demonstration plots were also used as sites of learning to show community members the potential of improved agricultural techniques. By learning these improved practices, farmers were able to become more resilient and productive, and they could continue using them after project termination.

Social Capital. Key Informant 001 highlighted that “all people in Kenya operate in groups… youth group… [and] women group.” Social connections are essential, as people living in rural areas often do not have reliable access to finance and capital, so people need to support each other. A study found that 90% of Nyando residents belonged to at least one social group, and they were able to lend and borrow money, engage in collective bargaining, and exchange climate information through these groups (Birir, 2020). CCAFS mainly worked with three CBOs, which represented more than 50 farmer groups in 106 villages in the region, the majority being women and youth groups. CCAFS provided seed money to the CBOs to start a revolving fund, offered training on climate-smart crop, livestock, water, and soil practices, and connected them with market aggregators. In just four years, membership increased significantly from 306 households in 2011 to 1,675 households in 2015 (CCAFS, 2005). Participation in savings and credit groups also rose from 33% of households in 2011 to 84% in 2021 (Ogada, 2021b). Therefore, the CCAFS interventions positively influenced people to join CBOs, increase social connections, and improve their ability to continue leading the interventions after project termination.

To conclude, capacity building directly influenced the outcome areas of mitigation, adaptation, productivity, poverty alleviation, and conservation because of the relevant training in CSA practices provided through the CSV project. This factor also contributed to the sustainability of project impact since capacity built could outlast project funding.

5.4 Agricultural Resources

“Agricultural resources" is coded 34 times in 8 files, and all key informants referred to them in explaining the project outcomes, as they formed the basis of many interventions in the Nyando CSVs. This factor is defined as providing farming inputs, tools, animals, and plants directly or indirectly to project beneficiaries.

Physical Capital. The CSV project offered a variety of farming inputs, including fertilizers, pesticides, irrigation, water pumps, greenhouses, and solar lamps. However, this factor was not emphasized by any key informant as instrumental to the effectiveness of the project, as the CSVs did not have much funding to offer them to farmers in large quantities for free or at a reduced price. These inputs played a more complementary role in CCAFS interventions, serving to attract farmers to learn about the technology and receive training on how to leverage them. CCAFS did support the establishment of an agricultural supply shop which increased farmers’ access to these resources at an affordable price. Nevertheless, the project introduced these technologies to encourage farmers’ adoption to generate higher productivity.

Natural Capital. CCAFS provided natural capital in three particular interventions in Nyando: improved crops, improved livestock, and agroforestry. First, through partnerships brought together by CCAFS, improved seed varieties were given to more than 200 farmers, including beans, maize, sweet potatoes, and cow peas (CCAFS, 2015; Ogada, 2021a). These improved crop varieties are better adapted to drought conditions, more resistant to pests and diseases, and have higher yields. Second, in 2015, 22 tree nurseries were also established, generating over 50,000 seedlings every year and planting 23,500 trees, which serve to sequester carbon, produce fruits, and be used as fuelwood (CCAFS, 2015). Finally, 70 breeding units of Galla goats and 30 breeding units of Red Maasai sheep were introduced to be cross-bred with indigenous breeds, yielding highly productive and resilient offspring (Kinyangi et al., 2015).

To conclude, providing physical capital supported Nyando farmers' productivity, and providing natural capital supported adaptation and mitigation. There is no evidence indicating that these agricultural resources continued to be subsidized after the project wrapped up, but the improved livestock, crops, tree seedlings, and the agricultural supply shop continued to be used, contributing to the project's sustainability of impact.

5.5 Gender Considerations

“Gender considerations" is coded 20 times in 11 files, and 5 key informants highlighted gender-sensitive designs or means of implementation in fostering equity and women’s empowerment. This factor is defined as activities undertaken to understand local gender dynamics and tailor measures to meet women’s needs.

Local Dynamics. First, Key Informant 005 explained that one measure to better enable women to voice their opinions is to separate community meetings and discussions into gender groups. CCAFS adopted the approach of conducting breakout meetings by gender, and then bringing everyone back to share what had been discussed in each group anonymously by the facilitators, so that the final summary or decision could fully capture both men's and women's ideas. Second, Key Informant 003 highlighted that simply paying attention to the crops grown by women actually improved their status and decision-making power in their households, since their livelihoods were emphasized and valued by the researchers. Third, CCAFS sought to understand gender dynamics in livestock keeping and production. They found that men generally had control over large ruminants like cows, whereas women were more involved in tending and selling small ruminants like sheep and goats. This understanding enabled the project designers to select projects that would help empower women rather than unintentionally exacerbate pre-existing inequities. Therefore, understanding local gender dynamics and providing a safe space for women to express their thoughts enabled women to benefit from the project.

Tailored Measures. The inclusion of women was identified as "fundamental to [the Nyando CSVs'] success," and there were intentional measures to ensure that both men and women participated and benefited from the project (Recha, 2017a). Two measures were highlighted by key informants. First, CCAFS chose small ruminant improvement as the main intervention to improve livestock adaptation and productivity because women had more control over sheep and goats. The provision of improved breeds and livestock management training enabled women to earn more income. Through this intervention, women also became leaders in rotational mating programs, monitoring livestock performance, and marketing the animals, thereby increasing their confidence and empowerment. Second, Key Informant 003 identified that a key strength of the Nyando CSVs was that they had women extension agents, which facilitated the interventions' reach to women farmers and make them feel more at ease.

To conclude, embedding gender considerations in all stages of the CSV project, including community engagement, capacity building, resource distribution, and monitoring and evaluation, facilitated the outcome area of equity, helping women become more productive, better adapted to climate impacts, and generate more income or assets, with lasting impacts on their empowerment.

5.6 Monitoring and Evaluation

"Monitoring and evaluation" (M&E) is coded 18 times in 7 files, mentioned by 3 key informants. This factor is defined as the systematic process of observing and analyzing the Nyando CSVs' different dimensions of outcomes. This factor had mixed impact on project outcomes, and the following paragraphs discuss first the positive elements and then the negative elements.

To begin, M&E and research activities in the Nyando CSVs generated a lot of open-access publications published on the CCAFS website, including the baseline and endline surveys as well as intermediate quantitative and qualitative results. Independent researchers were also welcomed

to study particular aspects of the project, such as a Masters thesis on improved small ruminants breeding and management (Sila, 2020). Such transparency is important not only for objective verification and scientific standards, but also for fostering credibility and inviting constructive feedback. Second, the results of the Nyando CSVs were communicated in diverse formats not just peer-reviewed journal articles — info notes, reports, news articles, videos, blog posts, and working papers (Pillot & Dugue, 2018; Beal et al., 2021a). These media help reach non-scientific audience such as development practitioners and policymakers. Furthermore, ongoing reporting while an intervention was still in the planning or early implementation stages supported partnerships building and scaling because local, national, and global partners are kept aware of project development, can provide feedback and input in real time, and see results immediately, instead of having to wait for a journal article to be reviewed, edited, and published.

However, there are two major weaknesses of the Nyando CSVs' M&E system. First, the project implementers did not randomly select a control group in advance and collect their baseline data (Pillot & Dugue, 2018). As a result, they could not adhere to the best practice of randomized controlled trials to draw confident conclusions that the successful outcomes could be attributed to the CSV interventions. Instead, in individual impact assessments for specific interventions, such as the adoption of resilient crop varieties, counterfactuals were selected after the fact, reducing the academic rigour. Furthermore, in 2021, when the endline survey was conducted, there was no inferential analysis to examine the impact of interventions on outcome variables (Ogada et al., 2021b). Instead, conclusions of project effectiveness were based on correlation between CSA practice adoption and an outcome variable, which does not imply causation. There was no systematic impact assessment undertaken after project completion. This impacts the rigour of evidence and thus the case for scaling. Second, with the notable exception of gender sensitivity and disaggregation, the Nyando CSVs did not disaggregate data by different socioeconomic variables such as ethnicity or wealth in their analysis, thereby potentially overlooking inequalities in the distribution of intervention benefits (Pillot & Dugue, 2018). Systematically accounting for the diversity of project beneficiaries beyond gender could further enhance the equity outcome of the project.

Therefore, the Nyando CSVs' M&E system positively contributed to partnerships and CSA scaling through transparency and accessibility, and negatively affected equity and CSA scaling due to the lack of analysis on different socioeconomic variables and of control group data collection. It did not have a direct impact on other outcome areas.

5.7 Marginalized Members

One factor that may have reduced the project's success, especially in terms of equity, was limited engagement with socially marginalized members in the Nyando CSVs. This factor has been coded 19 times in 10 files, highlighted by 4 key informants. Key Informant 007 explained that if one wants to understand the voice of the minorities and adequately accommodate for their needs, it is necessary to "actively search for them" and not "just assume that people who welcome you into a community are going to lead you to the minority groups." They will often not participate

or be present in group meetings, so targeted research and interventions are needed. Indeed, multiple papers that analyzed the outcomes of the Nyando CSVs revealed that the relatively wealthier households benefited more from the interventions than poorer ones (Radeny et al., 2018; Oostendorp et al., 2021). For example, adopters of improved small ruminants tended to have significantly more income than non-adopters.

In the design and implementation of the interventions, CCAFS relied heavily on the CBOs, working directly with their leaders and administrators to plan consultations, allocate resources, and train farmers. The champion farmer and the training of trainers models of disseminating CSA technologies and practices provided more resource access to select farmers deemed "smart" and "cooperative," as recommended by the CBOs. In fact, Key Informant 006 noted that some CBO leaders pulled off from the project because people were perceiving favouritism in such design, creating social pressure. Though there was engagement with women- and youth-specific groups, no key informant noted any targeted intervention for farmers who did not participate in the CBOs or systematic outreach to marginalized farmers within the groups.

Key Informant 001 explained that, since "all people in Kenya operate in groups," all those who did not participate are rich or work in schools, government, or the private sector with off-farm income. Those who have a desire to be a part of the project would join the community meetings and the CBOs, so the process was "voluntary." CCAFS "did not face that challenge [of engaging with marginalized communities] because all the people who came out, those who are willing and affected, they happen to be also people who are already in existing groups." The problem was thus characterized as non-existent or non-significant in the context of Nyando, and there was no evidence to suggest that it negatively influenced productivity, adaptation, mitigation, poverty alleviation, or conservation. Nonetheless, designing the project to make room for engagement with those who are marginalized in the community and in the CBOs could have enhanced the project's equity and generated relevant lessons for scaling up.

5.8 Prioritization

A common critique of CSA projects is that, despite rhetorical synergies among the three pillars of productivity, adaptation, and mitigation, a "triple-win" is often infeasible, so prioritizing some pillars and having a guiding rubric of how to balance trade-offs become important to achieve a project's envisioned theory of change. However, when asked whether they have encountered trade-offs and how the pillars were prioritized, key informants offered different assessments. The factor "Prioritization" has been coded 15 times in 5 files, discussed by 4 key informants.

Productivity. Key Informant 001 explained that food security and productivity were prioritized and that mitigation was not quite a priority. Working in a highly food insecure community, they needed to prioritize increasing food production, income, and then resilience. This was also what the local farmers would prioritize from participatory consultations. Mitigation was viewed as a co-benefit, whereby planting trees could provide fruits, fuelwood, and other useful resources in addition to sequestering carbon. Key Informant 002 also expressed that productivity tended to be

what most development actors would focus on because it is the most effectively and easily measured outcome among the three pillars.

Adaptation. Key Informant 002 emphasized the importance of increasing resilience and adaptation for Nyando communities, since any productivity or mitigation intervention that cannot adapt to the changing climate is unlikely to be sustained. Similarly, Key Informant 003 highlighted that the focus of the project was on improving resilience for the local people and community.

Mitigation. Key Informant 007 perceived that CCAFS was prioritizing mitigation and there was too much emphasis on understanding how carbon losses could be cut and where carbon could be kept in. For example, there has been a lot of research on agroforestry in the area, promoting the use of fruit trees. However, the same type of fruit tree all flower at the same time, so the unit price of a fruit decreases, reducing farmers' incentives to grow fruit trees, unless they can diversify into growing different fruits. Similarly, agroforestry for the purpose of fuelwood does not contribute to the mitigation objective in the long run, since the carbon stored in fuelwood are released when burned. Thus, alternative sources of energy supply and fruit tree diversification are necessary preconditions for agroforestry to be an effective mitigation activity. Mitigation interventions may have been promoted without accounting for these nuances that would impact their long-term potential in sequestering carbon.

Key Informant 004 observed that a tension between mitigation and adaptation effort was always present, but it was a "healthy tension" that facilitated an ongoing dialogue on how CCAFS's work could contribute the greatest value-add at the local, regional, and global levels. However, the lack of a systematic way of assessing which objective should be prioritized may constrain the project's effectiveness in terms of inefficient budget allocation, resource diversion, conflicting organizational priorities, and thus the potential to be scaled out and scaled up (Chandra et al., 2018). This factor will also have varying impact on the three CSA pillar outcome areas depending on how they are prioritized.

5.9 Theory of Change

"Theory of change" is coded 16 times in 6 files, and is raised by 2 key informants. Key Informant 004 reflected that one thing they would have changed, if they could redo the project, is to think through what they actually want to change and what would be feasible to change in a particular country before selecting the CSV site and designing the portfolio of interventions. A better approach would have started with an articulation of the desired outcomes and then identifying the necessary outputs and strategies to attain the outcomes. This would create a realistic impact pathway that both meets the needs of local communities and has greater leverage in influencing the wider promotion of CSA, increasing project impact.

The concept of CSV emerged in 2012 from CCAFS's existing work promoting and evaluating CSA, and was envisioned as "models of local actions" that generate best practices to achieve the

objectives of CSA (CCAFS, 2018). It was in 2015 that the CSVs were integrated into CCAFS's updated theory of change and regional impact pathways to support wider CSA scaling, in the local region as well as at the national and global levels. In particular, the approach became more "outcome focused," which refers to measuring effectiveness not simply by the publication of research, but the actual changes in investment and policy decisions because of the knowledge products (Kristjanson, 2020; Beal et al., 2021a). This resulted in changes such as the "three thirds principle," which means allocating resources evenly between participatory community engagement, evidence generation, and outreach and capacity building (Vermeulen & Campbell, 2015).

In the Nyando CSVs, various activities were undertaken to support the objective of scaling out and scaling up (Aggarwal et al., 2018). Horizontal scaling included organizing farmers' fairs, farmer-to-farmer learning, exchange field visits, wider-scale adoption of improved small ruminants, and access to weather forecast services. These measures helped interventions implemented in the CSVs to be scaled-out to cover the wider Nyando region. Meanwhile, vertical scaling included activities undertaken to establish national partnerships and generate evidence to promote CSA practices and processes to be set up in other parts of Kenya. However, Key Informant 004 commented that a lot of the significant national level developments in Kenya might have been "pure luck," as the World Bank became interested in CSA in Kenya and initiated the Kenya Climate Smart Agriculture Project in 2017. Therefore, dedicating more resources and effort to think through the outcomes, theory of change, and how activities can support scaling out and scaling up the CSA interventions and processes in Nyando could have increased its success.

6. DISCUSSION

Based on the analysis of the literature and key informant interviews, five factors that enabled the Nyando CSVs' effectiveness are identified: community engagement; local and national partnerships; capacity building; providing agricultural resources; and incorporating gender considerations in project planning and implementation. Three factors that may have constrained the project's effectiveness are: insufficient outreach targeted at marginalized members, ambiguity around project outcome prioritization, and delayed articulation of a theory of change. Monitoring and evaluation both positively and negatively contributed to the project outcomes. This section first considers the Nyando CSV project's conceptual framework and contextualizes it within the wider rural agricultural development literature to examine theoretical continuities and novelties. Next, three policy implications for designing and implementing CSA projects are discussed. Finally, some study limitations are identified.

6.1 Theoretical Continuities in Rural Agricultural Development

Compared with other rural agricultural development approaches, it is found that 1) the substantive focus of the Nyando CSVs is promoting CSA; 2) the project design is strongly

influenced by the CBD approach; and 3) the CSVs implemented agricultural interventions in an integrated manner, similar to IRD and the MVP. Meanwhile, the CSVs were distinguished in its approach by adopting an outcome-focused agricultural research for development (AR4D) approach and leveraging partnerships to sustain and scale its impact.

First, the overarching objective of the CCAFS programme, under which the CSVs were implemented, was to test, promote, and scale CSA (CCAFS, 2016). The CSVs were sites where different CSA technologies, institutions, and processes were integrated and evaluated (Aggarwal et al., 2018). This reflects the increasing awareness of climate change and the incorporation of adaptation and mitigation considerations into agricultural development interventions. Given the concept of CSA only emerged in 2009, the CCAFS programme and the CSVs were pioneers in generating evidence and popularizing this approach (Lipper & Zilberman, 2018). Now, CSA features prominently in international development discourse and rural development planning, including the World Bank Climate Change Action Plan (2021-2025), FAO Strategic Framework 2022-2031, and Kenya Climate Smart Agriculture Strategy 2017-2026 (WB, 2021; FAO, 2021; GoK, 2017). Despite sharing with other CSA projects the common challenge of balancing the three pillars and handling tradeoffs, the Nyando CSVs overcame many weaknesses identified in other projects. The articles and info briefs produced by CCAFS have been cautious to avoid the "triple-win" rhetoric, which has been heavily criticized as simplistic and unfeasible (Karlsson et al., 2018). Instead, the CSVs aimed to "understand the effectiveness of CSA options" and "demonstrate their synergies" (Aggarwal et al., 2018). Another general critique is that CSA projects are often implemented with a pre-determined set of interventions regardless of the local geographic, socioeconomic, and gender context (Hellin et al., 2023). The Nyando CSVs overall did a commendable job in understanding and responding to the actual needs of the community, co-developing solutions, tailoring interventions to benefit and empower women, and iteratively learning from experience and feedback to optimize interventions.

Second, the procedural design and delivery of the Nyando CSV interventions is evidently based on the CBD approach. The common feature of CBD projects is the active engagement with project beneficiaries (Ahmad & Abu Talib, 2015). It is important to note that this approach consists of a wide range of approaches that differ in the level of engagement, from awareness raising and consultation to local knowledge incorporation and community ownership over project decisions. The Nyando CSVs clearly exhibit this feature. Being participatory in design, there was a genuine effort to engage with local farmers to help them understand the impacts of climate change, learn from their traditional knowledge and experience, and create interventions based on their real needs and priorities. As well, in implementation, the project actively consulted with farmers and other stakeholders to iteratively learn and adapt their interventions to optimize outcomes. However, a common critique of CBD, and almost any development project, is treating the "community" as a homogenous entity without looking at social stratification and power relations, resulting in elite capture, corruption, and the exacerbation of pre-existing inequalities (Mueller, 2006; Cooke & Kothari, 2001). While there is no evidence to indicate that this was the case in the Nyando CSVs, the project primarily engaged with community members who were part of the CBOs and administered interventions through the CBO leaders. The most

marginalized community members therefore may have been silenced and disconnected from the interventions.

Third, the Nyando CSVs administered a variety of CSA interventions which were integrated to reinforce each other and amplify the positive outcome. This resembles the agricultural aspect of IRD and the MVP, which provided area-based concerted investment across different sectors (Ruttan, 1984; Mitchell et al., 2018). Both implemented multiple interventions in agriculture to create a "big push" in enhancing productivity. It is important to note that the CCAFS programme and the CSVs were only focused on the agricultural sector, and improving the overall rural living standard like education and healthcare was beyond their scope. In Nyando, these complementary technological and institutional interventions included agroforestry, improved crops, improved livestock, and access to market, credit, and loans (CCAFS, 2015). However, such complementarity was not quantified or systematically assessed and reported (Beal et al., 2021a).

Meanwhile, the CCAFS programme was groundbreaking in developing and following a theory of change based on the AR4D approach (Solomon et al., 2018; Thornton et al., 2017; Pillot & Dugue, 2018). AR4D lies at the intersection of pure research and development practice, aiming to use scientific methodology to produce outputs on agricultural innovation that directly lead to local and global changes. Indeed, CCAFS stated that it is outcome-oriented, focusing not on publications in and of themselves, but on promoting the use of these knowledge products by local farmers, national policymakers, and development practitioners who change their behaviours as a result, such as farming practices, investment decisions, and policy plans. After establishing the desired outcomes, an impact pathway is constructed by going backwards to identify the types of research outputs, how they can be used, and the activities needed to produce these outputs. Programme success is measured by indicators such as the number of new CSA investments that are based partially on CCAFS priorities and the number of policies that are based partially on CCAFS publications. Partnerships are fundamental to the process, as research partners enable evidence to be produced at different scales, operational partners build local institutional capacity to sustain interventions, and finance and policy partners ensure the evidence is taken into consideration in strategic decisions.

Therefore, the Nyando CSVs contributed to the wider CCAFS theory of change by leveraging its research findings to not only generate locally relevant CSA solutions that improve farmers' livelihoods, but also foster national and global dialogue and decisions on the promotion, design, and implementation of CSA. The ultimate goal of the Nyando CSVs, and all CSVs, was not to replicate the AR4D model around the world to achieve rural development, but rather to build evidence and collaborate with strategic partners to scale successful CSA interventions and processes. This approach can be contrasted with the MVP, which is also area-based and aimed to scale out and scale up, but which aimed to replicate the village-based multi-sectoral investment model around the world (Masset, 2018). Key Informant 004 pointed out that the goal of CSA and the CSVs is primarily, not to lift people out of poverty, but to help them adapt to the changing climate. There was very little provision of funding or financial resources compared to the MVP.

6.2 Policy Implications for Climate-Smart Agriculture

As CSA becomes increasingly embraced by the global agricultural development community, local and national policies and strategies have been developed and implemented in different countries, and more rural development funding and investment has been allocated to CSA projects. However, CSA adoption has remained low in Africa despite their demonstrated potential in different settings (Makate, 2019). According to existing literature, CSA projects can be often technology-oriented and focused on promoting specific agronomic practices at the local level, which constrain both project effectiveness and the project's leverage on facilitating wider-scale CSA adoption (Fusco et al., 2020; Totin et al., 2018). Furthermore, they are often implemented on a short-term timescale of three to five years (KCSAP, 2022; Kusamala, 2015; IDRC, 2024). Based on the Nyando CSVs case study, three key policy implications are identified to help increase the effectiveness of CSA interventions.

First, CSA is more than just promoting a set of technologies, but creating or strengthening the institutions that enable them to be tested, assessed, adopted, and sustained. Institutions are the rules, norms, and organizations that influence behaviours, and they can include local and national policies, governments, community groups, and investment mechanisms (Ghimire et al., 2022; Chandra et al., 2018). Even if the CSA technologies are tailored to the local agroecological zone, there are informational, social, political and economic barriers that prevent their adoption. Raising local farmers' awareness and understanding of CSA technologies, enhancing the capacity of farmer groups to disseminate CSA technologies, and building transdisciplinary partnerships to connect farmers, researchers, and policymakers to overcome these barriers are just as important, if not more, than the development of the technologies themselves. In the case of the Nyando CSVs, researchers and project implementers partnered with public and private sector, NGOs, and CBOs to increase farmers' human and social capital, strengthen existing organizational structures, and channel sources of investment, insurance, and credit. As such, an enabling environment conducive to developing and sustaining effective CSA technologies was created.

Second, to ensure the interventions are benefiting farmers and can be sustained, community-based participatory approaches should be adopted in the design, implementation, and evaluation of CSA projects. Some scholars have criticized that CSA does not have a "firm participatory mandate," which could lead to the neglect of local knowledge, expertise, and priorities (Taylor, 2018). The Nyando CSV case demonstrates that co-developing solutions, dedicating effort to understanding community needs, and incorporating traditional knowledge can enhance the effectiveness, relevance, and local ownership of the interventions. Furthermore, when trade-offs among the three CSA pillars become unavoidable, prioritization should be based on community priorities, otherwise the interventions will not be able to sustain once project funding runs out. Each community has its own assessment of the relative importance of CSA interventions and pillars, and CSA projects need to understand and reflect such assessment in their project design. For example, in Nyando, key informants concurred that mitigation should be treated as a co-benefit, with greater emphasis and target on interventions that enhance productivity and adaptation. This is because mitigation interventions tend to be less profitable, more costly, and

knowledge-intensive. Without financial incentives such as carbon credits, community members prioritized the other two pillars over mitigation. Indeed, from the environmental ethics perspective, sub-Saharan African bears little historical responsibility for GHG emissions, and mitigation should not be the responsibility of rural households in these countries (Karlsson et al., 2017). Therefore, bottom-up participatory design can support CSA adoption and sustainability, as well as meeting local farmers' needs. However, iterative learning, continuous monitoring and evaluation, and detailed understanding of a local community's needs are often time- and resource-intensive, so the design and 10-year duration of the Nyando CSV project enabled researchers to establish a good relationship with community members, learn about their priorities, and adapt interventions to optimize outcomes.

Third, the consideration and emphasis on social equity is essential in ensuring that CSA projects advance human development and do not exacerbate inequalities. Critics point out that equity is not a part of the CSA conceptual framework and that many CSA projects fail to understand local power dynamics and the differential control over natural, physical, and financial resources (Karlsson et al., 2018; Brisebois et al., 2022; Huyer, 2021). It is therefore important to ensure that project benefits do not disproportionately accrue to elite groups, reinforcing vulnerabilities of marginalized community members and leading to maladaptation (Hellin et al., 2023). The Nyando CSVs provide particular insights on how gender considerations can be incorporated in CSA projects. During the planning phase, understanding gendered access to and decision-making authority over different resources helped inform the design of interventions. The project should tailor the interventions to ensure that women are benefiting from project resources, that they are included in decision-making processes, and that their particular needs are prioritized and met. In particular, in alignment with the literature, the Nyando CSVs partnered with women-specific farmer groups to enhance women's CSA uptake. However, in this case study, strengthening engagement with marginalized farmers based on income and wealth could be an area of improvement. More critical reflections on "what works, for whom, in what social… conditions, and according to whose criteria" could further enhance equity (Hellin et al., 2023). Nevertheless, achieving transformational social outcomes on the front of equity within a "climate-smart" project can be challenging, as the fundamental assumptions of this paradigm adhere to the status quo, aiming to improve farmers' livelihoods and reduce emissions while still operating within the dominant market-oriented economic system, which places the burden of mitigation on the production side of the food system rather than the consumption side, and sustains the existing trade dynamics between Global North and Global South countries.

7. CONCLUSION

CGIAR is one of the biggest and earliest pioneers in promoting CSA, generating robust evidence demonstrating its effectiveness in mitigation, adaptation, and intensification, and the CSVs were crucial sites where long-term CSA interventions were administered in a concentrated and integrated manner. These laboratories of innovation offer rich insights into how contemporary rural agricultural development projects are designed and implemented. By focusing on the case

study of the CSVs in Nyando, Kenya, the paper reviewed academic and grey literature and conducted key informant interviews, identifying best practices and lessons learned that can be applied to increase the effectiveness of other CSA and rural agricultural development projects in Kenya and the Global South.

This research paper first sought to analyze the enabling and limiting factors that influenced the project outcomes. It can be concluded that community engagement through awareness raising, consultation, and sharing decision-making power with project beneficiaries was conducive to designing interventions tailored to the specific needs of the communities, thereby ensuring that the outcomes are more effective and sustainable. Local and national partnerships were also an essential factor in leveraging the expertise of different stakeholders and scaling up the outcomes horizontally and vertically. Third, providing agricultural resources helped attract farmer participation to adopt CSA while capacity building through training farmers and strengthening CBOs ensured that the interventions can continue to be promoted after project termination. Fourth, transparency and accessibility in the M&E system enabled the project outcomes to be communicated with different stakeholders and contributed to up-scaling. On the other hand, there was ambiguity around which outcome areas were and should have been prioritized, potentially constraining the integration of the different interventions. Furthermore, the CSV sites were selected before a theory of change was articulated and aligned with the overall CCAFS programme, which may have otherwise changed the project design.

The second research objective was to examine the mechanisms by which the Nyando CSV project addressed equity and gender concerns. First, gender considerations were well incorporated into project planning and implementation, with sex-disaggregated data analysis, special attention to women's roles, needs, priorities, and circumstances, and tailored interventions to empower women. However, there was insufficient outreach targeted at marginalized members, with an exclusive reliance on the CBOs for consultation and collaboration. Similarly, the M&E system did not disaggregate analysis by non-gender social indicators such as ethnicity, income, or land sizes. These factors also influenced the project outcome by supporting women's adaptation and productivity on the one hand, and potentially constraining the outcome area of equity for other marginalized community members on the other hand.

Finally, the paper compared the CSV with historical and contemporary rural agricultural development approaches to explore its theoretical underpinning. The paper argued that, while CSV resembles other approaches in some theoretical or practical aspects, such as being participatory, integrated, and climate-smart, it is distinguished in being an AR4D project that leverages partnerships to sustain and scale its impact.

In the context of climate change and rural food insecurity, there is an urgent need to sustainably increase food production, reduce vulnerabilities to disasters, and reduce GHG emissions. By learning from the design and implementation of CSA projects such as the Nyando CSVs, policymakers and development practitioners can improve the project outcome across different dimensions. This case study generated best practices which can be further tested and applied.

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APPENDIX A: INTERVIEW GUIDE TEMPLATE

Introduction & Logistics

Hello [key informant], thank you once again for accepting the interview. I am Geneva, and as you have seen in my email and the consent form, these interviews are conducted as a part of my Masters research paper looking at the design of the Climate Smart Villages initiative in Nyando, Kenya. I would love to learn about your experience [planning / researching on / implementing a CSV intervention]. Before we go into the interview, I would like to assure you that your answers will be entirely anonymized, but this interview will be audio recorded. All data and working level document will be deleted after a retention period of five years. Do you have any questions or concerns before we start?

Central Questions and Potential Probing Questions

1. In your experience, what were the outcomes of the CSV interventions you worked on in Nyando? To what extent were they effective?
2. In your view, what facilitated the effectiveness of the project? (prompting questions below as needed)
    a. Did you prioritize specific CSA pillar(s)? If so, which?
    b. Were there mechanisms allowing bottom-up participation in decision-making?
    c. How did the researcher-community relationship play a role?
    d. How was local traditional knowledge used?
    e. How did you form partnerships with local groups and governments?
    f. Other factors?
3. Did you have any measure to ensure equity either to engage marginalized community members in the project design and implementation process or to allocate more resources to help more marginalized members achieve productivity? If so, what were they?
4. Did you have any measure to ensure gender-sensitivity in project implementation and increase women's participation? If so, what were they?
5. Were there any unexpected situations during the implementation / research process?
6. In your view what might have limited the effectiveness of the project?
7. Are you aware of the research that went into informing the design of the project? What were some of your assumptions and paradigms? What best practices from past rural development projects did you learn from?

Conclusion

Thank you once again for giving your valuable time to contribute to my research on your important initiative to help farmers in Nyando adapt to climate change. Please do not hesitate to reach out if you have any questions or concerns. Lastly, I was wondering if you know anyone else who is closely involved in designing and implementing the Nyando CSV project? Would it be possible for you to give me their contact information so that I could request an interview with them as well? Thank you very much.

APPENDIX B: SUMMARY OF CODES

Code Name	***References***	***Description***
Agricultural resources	34	The provision of farming inputs, tools, animals, and plants directly or indirectly to project beneficiaries.
Natural capital	24	The provision of animals and plants.
Physical capital	10	The provision of farming inputs and tools.
Capacity building	69	Activities to enhance the skills of project beneficiaries or to foster local social connections and institutional effectiveness.
Human capital	43	Provision of training to improve farmers' ability to use CSA techniques.
Social capital	26	Provision of training and resources to improve local social networks and organizational effectiveness.
Community	28	Activities to talk with, consult, learn from, or empower the project beneficiaries in the design, planning, or implementation of the project.
Awareness	2	Activities to help raise awareness on climate change and CSA practices.
Local knowledge	2	Activities to understand local traditional knowledge and incorporate them into project planning and implementation.
Ownership	4	Interventions that generated a sense of ownership among community members.
Participation	20	Activities to consult with the community to understand their needs and priorities and to co-design interventions with the community members.
Gender	20	Activities to understand local gender dynamics and tailor measures to meet women's needs.
Marginalized members	19	Activities (or the lack of which) undertaken to reach out to and tailor measures to meet the needs of marginalized community members, which are not gender-based.
Partnerships	30	Activities to connect, communicate, or collaborate with different stakeholders, who are not direct project beneficiaries.
Prioritization	12	Considerations of how the three pillars of CSA - mitigation, adaptations, and productivity - are sequenced and prioritized.
Monitoring and evaluation	18	Activities to monitor and evaluate the Nyando CSVs' different dimensions of outcomes.
Theory of change	16	Considerations of how project activities and outputs lead to wider impact.

* The same passage may have been coded multiple times under different codes as long as the content of the passage is relevant to each code.
** Codes in italics are child codes. The references of the parent codes include all references of their child codes.

APPENDIX C: RESPONSE TO SECOND READER'S COMMENTS

I have addressed all major comments made by the second reader, Dr. Joshua Ramisch, on my MRP proposal, discussed below:

1. My proposal was initially framed as an impact evaluation of the Nyando CSV project from a critical lens. However, Dr. Ramisch advised that the word "critical" is often misinterpreted simply as "criticism" and that the project evaluation approach could be too broad in scope. He suggested focusing on best practices and lessons learned from implementing the project. Therefore, this research paper is focused on identifying the enabling and limiting factors in the design and implementation of the project.
2. Dr. Ramisch's suggested that I change one of my research questions from "How did the design of the CSVs influence the overall, as well as disaggregated, sustainable livelihood outcomes" to "How effectively did CSA interventions in the CSV Nyando address equity and gender concerns?" I changed the research question accordingly.
3. Dr. Ramisch suggested that I compare the Nyando CSV project with the MVP, both of which adopted the "model village" approach. This research paper has done such a comparison, not just with the MVP, but also with other historical and contemporary rural development approaches to understand the theoretical continuities and divergence.