Study Brief 54: Policy

Climate Responsive Extension and Advisory Services (EAS)

Strengthening extension and smallholder farmer capacities in support of the Paris Agreement

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Summary

Primarily through secondary literature and desk reviews, this study explored the need for and the importance of empowering current extension and advisory services (EAS) to be climate responsive. This is now more crucial than ever to ensure a *just and inclusive transition* for smallholder men and women farmers to adapt their farming practices to shift to a resilient and sustainable agrifood system. Key to these systemic structural reforms is the establishment of strong enabling conditions that enhance the capacities and climate knowledge of extension actors and rural stakeholders. These enablers further include digitalization of information delivery for improving the timeliness of advisories, while ensuring equitable access for both men and women in rural communities, and the need for coherent EAS policies aligning with the national climate and development priorities under the Paris Agreement. Furthermore, there is a need to foster bottom-up, consultative planning processes and community-led development initiatives that reflect local realities. Finally, financial sustainability is a crucial factor, requiring the establishment of self-sustaining

financial systems, robust budgeting, and effective monitoring plans to ensure continuity of climate-responsive services. The study underscores that with the right structural reforms, knowledge and capacity building initiatives, and supportive governance frameworks, development programmes such as PlantwisePlus, can empower national EAS to be powerful channels for achieving national climate commitments. This will also empower rural agrarian communities to sustain their livelihoods under the new realities of climate change.

Highlights

- Strengthening agriculture extension and advisory services is pivotal for translating global and national climate goals into actionable support for smallholder men and women (including youth) farmers for *inclusive and just transition* to low emission and resilient agriculture systems.
- Most EAS currently need an increased investment in technical and human capacities to enhance knowledge on climate change, and institutional re-orientation. This will enable targeted and inclusive modalities to reach smallholder farmers, through a mix of both digitalized and traditional means of information dissemination.
- Development programmes such as PlantwisePlus are addressing a critical gap in updating current EAS and plant health systems with the latest knowledge and technologies, integrating advisory on climate smart agricultural practices, where relevant.
- The Plant Doctor networks, established through Plantwise and further sustained through PlantwisePlus, provide effective avenues to drive some of the country specific Nationally Determined Contribution (NDC) and National Adaptation Plan (NAP) priorities in the different target countries.
- The processes of co-creating locally led, and community-based adaptation and mitigation actions to tackle climate risks to the agricultural rural communities need to be embedded into EAS actions plans. This is important to ensure the sustainability of actions and that solutions are context-specific, inclusive, and effectively address the real needs and priorities of those most vulnerable to climate change.
- However, sustainability of any actions is underpinned by the crucial need for regular capacity strengthening and training of the extension networks on updated climate change adaptation and mitigation information, commitments for increased budget, robust monitoring systems and a self-sustaining financial mechanism.

Background

The Intergovernmental Panel on Climate Change (IPCC) states with *high confidence* that across the world, a changing climate is negatively affecting agriculture productivity and production systems, with spillover effects on food and nutrition security, poverty, environmental wellbeing and overall socio-economic development. This is more prominently becoming a structural impediment to achieving sustainability across global and national food systems (IPCC, 2022). Impacts such as rising temperature, erratic precipitation, increasing incidences and frequencies of extreme weather events, crop losses from pests and diseases, loss of biodiversity and acute water scarcity will intensify overtime, affecting food security and livelihoods of over 500 million smallholder farming households, with significant regional variations.

Countries have set ambitious goals for reforming their agriculture sectors. Current agrifood systems are responsible for about 34% of global greenhouse gas emissions (GHGs) (mainly land based emissions, with large regional variations but about 75% of agrifood emissions are from developing countries) (Crippa et al., 2021). Despite being a key emitter, the agriculture sector is uniquely placed to deliver not only on adaptation but also mitigation and build the pathway to resilience and carbon neutrality. Transforming this sector is, therefore, essential to not only achieve the individual goals of countries as set out in their NDCs and NAPs but to also ensure the collective success of the Paris Agreement.

National reforms that intend to make agriculture more productive and resilient to higher variations in temperature and/or rainfall, and with lower carbon footprint must involve smallholder farmers for a *just and inclusive transition*. A crucial and often overlooked element of rural empowerment is the EAS, whose impact is often unnoticed due to weak institutions, lack of funding and thereby, inability to provide adequate support to rural communities. They are a critical connection between agricultural innovation and implementation at scale and can foster wider adoption of climate smart agricultural practices among men, women (including youth farmers) and other local stakeholders. Empowering extension networks with the latest climate information and technologies, and stronger institutional arrangements can unlock possibilities to accelerate climate actions at local levels, making them climate responsive, and with ripple effects on tackling food insecurity and poverty.

Just Transition in the Agriculture Sector

Just Transition is integral to achieving the Paris Agreement. Emerging primarily from fair rights for industrial labourers and workers, the principle highlights the need to consider equitable and inclusive decarbonization pathways that address the needs of all involved. In the context of agrifood systems, FAO (2023) states that 'efficiency improvements and global rebalancing' or convergence' are fundamental objectives. What this entails is systemically acknowledging responsibilities, power hierarchies, inclusivity, and participatory actions to support smallholder farmers with capacity and technology to address cross-sectoral challenges such as boosting production, reducing hunger and malnutrition, and the overall environmental footprint of agriculture activities.

Just Transition can create new arenas to transform food systems that can respond effectively to climate change. It will also ensure food for all, addressing systemic injustice to farmers (particularly women and other marginalized communities) and ensuring access to skills, technologies, knowledge, social safety nets and other required support to make these shifts to a low emission and climate-resilient agrifood system (FAO, 2023; ActionAid, 2019).

What we did

Under this context, drawing primarily upon secondary literature and desk reviews, this policy brief aims to determine the enabling conditions to strengthen support to the EAS to advance climate actions, with the common understanding that agrifood system transformations cannot be achieved without involving smallholder farmers.

The technical brief uses the NDCs and NAPs of Bangladesh, Ghana, Kenya, Pakistan, Sri Lanka, Uganda and Zambia, and a global programme, PlantwisePlus being implemented by CAB International (CABI), to support evidence and opportunities. The programme is being

implemented in 27 countries globally, but the seven countries listed above are the focus countries. In addition, the study also used relevant findings from scoping studies conducted in Bangladesh, Pakistan and Sri Lanka to identify leverage points for PlantwisePlus to align its activities with the national climate and agriculture goals of these countries.

Findings

Smallholder farmers and, extension and advisory services – the agents of change

Smallholder farmers, particularly in the global south, are some of the most marginalized and vulnerable communities to climate risks with negative implications on their income and livelihood opportunities. Globally, smallholder farmers are spending about 20-40% of their total incomes (or about US$ 368 billion collectively) on implementing farm practices to adapt and build resilience to the changing climate (Hou-Jones & Sorsby, 2023), while only receiving about 0.3% of the total international climate finance (as of 2021) (Climate Focus, 2023). Managing environmental risks and climate variability under the unprecedented and prolonged impacts brought about by long-term climate change is currently exceeding the capacity of their traditional coping strategies to deal with these challenges.

The vulnerabilities of women and youth farmers in particular, are often amplified due to their limitations in accessing productive resources to respond to shocks. With climate change scenarios, it is estimated that under 1°C rise in temperature, a female headed household is likely to experience a 34 percent reduction in income in comparison to a male household (FAO, 2024).

As developing countries start to deliver on their national climate commitments, it is becoming imperative to include smallholders as part of the solutions. Failure to include farm level actors and interventions will mean *food system transformation* merely remains an ambitious vision (Mutyasira, 2023). For instance, Kenya has very ambitious targets of becoming carbon neutral by 2050 (Kenya Energy Transition and Investment Plan, 2023) but a big share of its total emissions is from the food system (approx. 70%, a much larger share than the global average of 31 percent usually) (Babiker et al. 2022.). Roughly 7.5 million Kenyan smallholder farmers are responsible for ensuring continuous output from this key economic sector. Without appropriate knowledge, skills and involvement of the smallholders in *driving agrifood system transformations,* it will remain a challenge for Kenya to achieve its emission reduction targets. Similarly, one of the goals of NAP Bangladesh is to develop 'climate-resilient agriculture for food, nutrition and livelihood security' through climate smart agricultural approaches. The country is expected to reach about 190 million people by 2030 and feeding this large population is a daunting challenge. Without smallholders' active participation in increasing efficiency along each node of the value and supply chain (together with other actors), the goal may remain unaccomplished.

Historically, EAS were critical in disseminating technical knowledge and best practices to farmers. Their roles in connecting farmers to the development professionals, and in rural poverty alleviation programmes are well acknowledged (Maulu et.al., 2021; FAO, 2021a). Opportunities now exist in strengthening EAS to become the means that drive smallholders and agrifood systems towards carbon neutrality. However, the focus has largely been on helping farmers adapt without empirically understanding the resource needs and capacities of the extension departments (Agyei-Antwi & Stringer, 2021). Over the past two decades, national extension systems and services have undergone a shift influenced by '*innovation*

systems thinking'. This has given rise to the concept of the *New Extensionists*, who operate within an innovative platform and engage farmers through a non-linear and collaborative approach (Davis & Sulaiman, 2014). The evolving role now goes beyond simply transferring technology to farmers, and emphasises innovation, brokering relationships, and strengthening capacities across individual, organizational, and system levels. This expanded vision positions EAS as key enablers within Agricultural Innovation Systems (AIS), requiring new skills, partnerships, and institutional support (Davis & Sulaiman, 2014). They are key mediators of farmer groups, cooperatives and organizations that help address social challenges such as gender, market access and middlemen issues. They help negotiate fair prices through collective actions and employ various means of communication such as top-down training and capacity strengthening approaches, and farmer field schools to educate farmers and encourage the adoption of new technologies that are climate smart (FAO, 2021a). The new EAS now go far beyond simply pushing technology for higher yields. Their services encompass introducing improved crop and livestock varieties, promoting sustainable water and plant health management, and addressing plant pests and diseases (Fig 1). More importantly, they increasingly engage smallholders intellectually, acting as facilitators who help farmers develop their own technical, organizational, and management skills to drive innovation on the ground (Davis & Sulaiman, 2014), which is crucial in climate action.

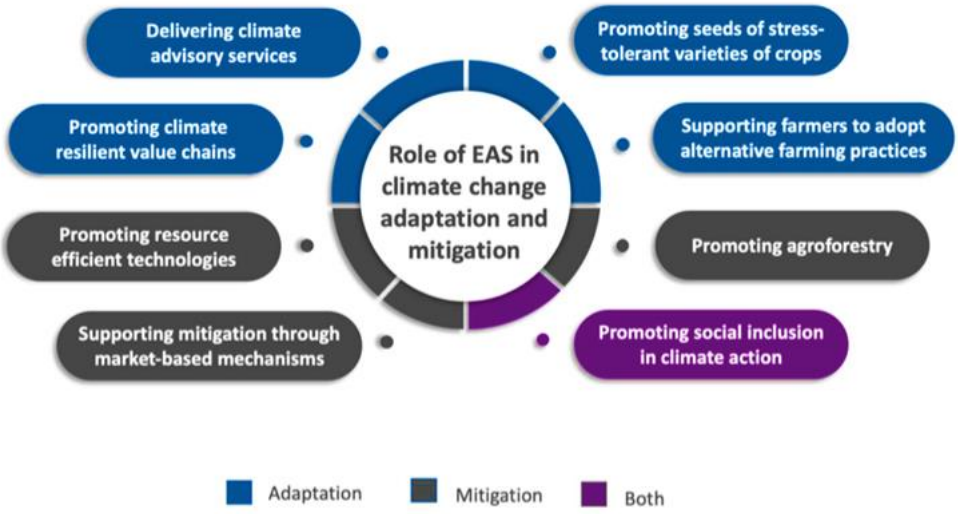

Figure 1: Role of EAS in climate change adaptation and mitigation (Sulaiman, 2024).

Extension networks as catalysts of agricultural transformations under climate change

In attempts to build the adaptive capacities and resilience of smallholder farmers, the role of EAS, networks and agriculture extension officers can often be overlooked. Many countries in their NDCs and NAPs have outlined actions on integrated pest management (IPM) (e.g. Sri Lanka), dissemination of climate smart agricultural practices and technologies (e.g. Bangladesh, Pakistan, Sri Lanka), weather climate information systems (e.g. Ghana), better social protection and insurance mechanisms for women and youth (e.g. Kenya) and several others. These services are often facilitated by extension networks, though their roles have received limited to no acknowledgement in these policy documents. Under the current context, EAS (particularly extension staff) remain crucial pluralist systems that link farmers,

development partners, research organizations, the private sector and even policy makers, helping deliver the latest knowledge, climate smart technologies, and resources at field levels (FAO, 2013; Sulaiman, 2024; FAO, 2021a). For effective climate change adaptation at scale, interventions should consider the dynamics between both men and women smallholders, and EAS in tandem as they are interconnected. EAS has played vital roles in not only promoting best practices and local adaptation options to farmers, but in also preventing maladaptation (Agyei-Antwi, et.al., 2018). Farmers still tend to use the EAS to feedback challenges or problems who can then relay them back to researchers or development partners (Dwarakinath, 2006). Data and evidence from Plantwise suggest that targeted and inclusive advisories through plant clinics substantially empowered smallholder farmers in Pakistan to improve yield and income and to sustainably manage crop health problems (Lamontagne-Godwin et.al., 2018). Despite this, many extension systems remain constrained by limited staff capacity, financial and technical resources and accountability to reliably and effectively reach farmers (J-PAL, 2023; Sulaiman, 2024).

Development projects aimed at empowering smallholder men and women farmers to drive transformative change in agriculture must also recognize the critical role of investments in strengthening EAS. This will not only enhance farmers' access to knowledge, technology, and markets to act on risks and shocks, but can also play a pivotal role in ensuring the long-term sustainability and impact of development interventions at the grassroots.

Enabling Conditions for Climate Responsive EAS

PlantwisePlus aims to reach 75 million smallholder farmers in low- and lower-middle-income countries, providing them with access to the knowledge and skills to improve their production practices and resilience to climate change. Through three impact pathways, that focus on predicting, preventing and preparing to address plant health threats in the face of a changing climate, farmers are being empowered to reduce their crop losses and produce more food using safer practices that safeguard human health and environment.

Working closely with the national governments and local authorities such as extension departments, the programme has rapidly created a huge network of trained extension officers globally mainly through its plant clinics[1]. These plant doctor networks, with their extensive reach and trusted presence in rural communities, can now be strategically leveraged to advance country-specific NDC and NAP priorities. By providing practical, localized advice on sustainable crop management, climate-smart practices, and IPM, these plant doctors help farmers adopt low-emission and resilient agricultural methods, making them a vital tool for delivering knowledge to the agrarian communities.

1. Strengthening EAS with up-to date knowledge and information on climate change and climate smart agricultural practices

Under the rapidly changing climate, EAS also need to evolve quickly to keep up with the pace of change. The National Climate Change Adaptation Strategy for Ghana, for instance, identifies the need to strengthen capacities of extension officers in new farming technologies

[1] In collaboration with national agricultural advisory services, CABI has developed a global network of plant clinics designed to support farmers with expert plant health guidance. These clinics operate much like human health clinics where farmers bring in samples of their affected crops, and trained plant doctors carefully examine them to diagnose pests, diseases, or other issues. Based on this diagnosis, plant doctors provide practical, science-backed solutions tailored to local conditions, empowering farmers to protect their crops and improve agricultural productivity (CABI website).

to further support their farmers. This is already happening through the plant doctor network under PlantwisePlus in countries such as Pakistan, Zambia and Kenya. Climate-smart agriculture (CSA) advisories such as intercropping, drought-resistant varieties, soil and water conservation practices, composting, crop rotation and other climate smart pest management such as biocontrol, are now routinely delivered by plant doctors, ensuring that farmers receive resilient, context-specific recommendations alongside plant health diagnostics (CABI, 2022). However, for an efficient (public) EAS, continuous internal capacity strengthening should be prioritized through policy reforms, focusing on staff incentives for higher education in climate change and resilient agricultural practices, better knowledge on climate change adaptation and mitigation strategies, and developing diverse skillsets to tackle emerging climate risks and challenges within rural agrarian communities. This will ensure a resourceful EAS that has sufficient coverage within their target areas (accessibility), responds quickly to farmers' needs (adaptiveness) and perform efficiently (efficiency) (FAO, 2021b). Currently, most EAS are reliant on standardized training and outdated and conflicting messages that under current circumstances may not be sufficient for farmers and can even create confusion (Agwu, et.al., 2023). Other challenges include information loss when messages are delivered by extension staff to farmers due to perceptions and interpretation of the information. Similarly, studies have shown that uptake of advisories at farmer level can be low if advisories are not delivered in language and manners relevant to the local contexts (Ragasa & Mazunda, 2018; Ragasa et.al., 2015).

Climate change and agriculture challenges vary regionally, nationally and even locally. The first crucial step is therefore to ensure that extension staff have access to up to date, targeted and context-specific information, enabling them to deliver relevant guidance to farmers. This entails collating large datasets, knowledge of climate adaptation and mitigation actions on the ground, and evidence bases for making training guidelines and messages suited to the needs of a geographic location. This can be done in two main ways:

- **Enhancing skills** – More men and women extension officers need to be trained in knowledge on up-to-date climate smart agricultural and sustainable land management practices in the context of emerging challenges to climate change. This entails equipping extension workers with pertinent skills to understand climate information, including early warning systems, to advise farmers and local communities. They need to be upgraded to have a more holistic understanding of climate risk management, disaster responses, insurance mechanisms, low emission and resilient practices, and other related topics. At the same time, senior extension officers also need training to address the structural barriers around low promotion and uptake of climate smart agriculture in many countries, that hinders their scalability. Access to online training (such as the CABI Academy) and chat groups could facilitate information sourcing and dissemination.
- **Developing resource materials** – More men and women extension officers need updated resource materials that are framed from climate adaptation, mitigation and risk management perspectives. The training materials need to be localized and aligned to the climate priorities highlighted not only in the NDCs and NAPs, but also other broader national climate and agriculture development frameworks.

To achieve this, there is a need to reorient current extension systems to expand their pluralism through collaboration with local authorities and national research institutions working on climate change and agriculture related issues and bring together different skillsets and expertise. The need for these multidisciplinary agriculture stakeholder consultations to rethink functional extension systems was found to be of high priority in countries such as India, Nepal and Indonesia (Babu et.al., 2024).

PlantwisePlus through its large national and local networks has been convening stakeholder consultations across multiple disciplines in support of strengthening plant health management systems and more recently, on promoting uptake of climate smart and resilient practices. In 2025, the programme will launch comprehensive training programs on climate change and agriculture, complementing the *Plant Doctor* training modules. The aim is to strengthen the capacities of local stakeholders across several Asian and African countries to drive climate-resilient and sustainable agricultural practices. This intervention is expected to positively help upgrade EAS in the implementing countries to understand the climate risks and effectively disseminate guidance to smallholders in different contexts.

2. Empowering EAS through easy-access and human-centric digital innovations

The process of strengthening EAS to respond more actively to the needs of the men, women and youth farmers under climate change conditions can be further sustained through digital delivery of services. In current times of uncertainty, farmers prefer to receive high quality and precise information for quick decision making. A study in Nepal reported that a higher number of farmers adopted practices (in this case relating to the use of fertilizers) through digital services (such as smartphones and apps) than traditional extension trainings. Digital extension is also more cost-effective in enhancing farmers' uptake of technical knowledge than the traditional approaches (Giulivi, et.al. 2022).

The Bangladesh NAP recognizes that under likely future increased temperature scenarios, emergence and infestations of crop and livestock pests are likely to become more challenging. To help EAS and farmers, together with the Department of Agriculture, PlantwisePlus aims to review and develop existing and new Pest Management Decision Guidelines (PMDGs) for priority crop pests with context specific CSA practices. These PMDGs are easily accessible by farmers and extension workers through the Factsheet App and PlantwisePlus Knowledge Bank.

Provision of training and designing digital tools to improve knowledge of crop health management advisories was a key strategy underpinning the success of Plantwise, and it is continuing under its successor, PlantwisePlus. The programme actively encourages extension networks and local stakeholders to access e-learning certification courses on topics such plant and pest management, gender responsive extension services, sustainable soil health and water management, and others at no cost to the users (through the CABI Academy). The conceptualization, design and delivery of the tools and the training are regularly updated to be more human-centric, user-friendly, participatory and digitalized for real time data delivery, monitoring and for maximizing uptake at grassroot levels, where applicable.

However, digital delivery of EAS can also come with its share of challenges especially in reaching vulnerable and marginalized communities such as women and youth. A study by IWMI found that only 12.7% of households in Bangladesh have steady internet connectivity with large district level variations (Perera, 2023). In the same study (now covering three

CABI has developed a Pest Risk Information Service (PRISE) to help farmers address the problems of plant pests driven by the rapidly changing climate, in Zambia, Ghana, Kenya and Malawi. Through collaboration with the Ministries of Agriculture and extension departments, the project integrated climate and pest datasets into the forecasting system to communicate efficiently and accurately any imminent pest risks to crops. The PRISE model outputs were integrated into Kenya's Ministry of Agriculture's SMS services based on which 59% of end users have reported to have changed their practices to address FAW problems, based on PRISE alerts.

divisions), gender disparity in access and ownership of digital information and devices was also evident. Only 7% of smallholder male farmers, and none of the female respondents, reported using digital devices to access agricultural inputs or advice-related information (Perera, 2023). This may not be the case everywhere as elsewhere evidence from several low- and middle-income countries indicate that mobile phone ownership is increasing among women who otherwise lack access to productive household assets. In such cases, studies have shown that mobile phones have enabled women to access information directly or indirectly through intermediaries such as extension workers or community knowledge workers, who disseminate information to women's groups and individuals who may not own phones themselves (GSMA, 2023; Slavchevska, Kaaria, & Taivalmaa, 2020; Campenhout, 2017).

For successful capacity strengthening interventions, these structural barriers and cultural nuances also need to be considered for optimal uptake and dissemination of knowledge, an aspect PlantwisePlus is continuously working on improving, particularly through its social and behavioural campaigns. Another aspect to consider is the need and capacity of the users to use digital tools because if neither of these two variables are at an optimal uptake level, the digital intervention will struggle to gain traction. For such instances, technology can be rather simple and the provision of advisory services through radios, and text messages through analogue or smart phones have been deemed as effective modes of communication in Ghana (and in other many countries where PlantwisePlus is active) (Nyamekye, 2024).

3. Designing coherent and aligned action plans and policies through multidisciplinary approaches

According to the Zambia NAP, implementation of their plan would require translating these national strategies into targeted measures that address the specific vulnerabilities, and adaptation needs at various levels within the country. This means aligning the adaptation actions outlined in the NAP with 'district-level Integrated Development Plans (IDPs) and provincial plans', which are further derived from the National Development Plan. Similarly, the Uganda NAP also recognizes the need to mainstream climate change knowledge and science into agriculture extension and at community levels.

At the moment, there is still a disconnect between national agriculture policies and climate and development goals. For sustainable agriculture and resilient rural development, it is essential to embed climate priorities into local planning and agricultural extension strategies, ensuring that all actions align with climate adaptation and mitigation strategies through appropriate governance mechanisms (Local Government Association, 2024; Babu & Selvaraju, 2023). Policy alignment and clear roles and responsibilities can also ensure adequate resource commitments from sectoral ministries.

Programmes such as PlantwisePlus, drawing upon multidisciplinary expertise and strong national and local networks, can support the development of cohesive extension action plans by fostering partnerships and convening consultations among plant health specialists, agronomists, social scientists, farmer groups and cooperatives and extension departments. For instance, in Bangladesh, Pakistan, Sri Lanka and Ghana, PlantwisePlus is working with the relevant departments of extension to promote awareness of low-risk biocontrol as a climate smart agricultural solution, and on gender and financing, highlighting the intersectionality of gender and climate. These interventions enhance vertical institutional coordination and capacity, facilitating an efficient delivery of advisories. Simultaneously, this process further strengthens extension networks through capacity strengthening to advocate for gender inclusive and climate smart agricultural practices. Lastly, this ensures that support extended to extension networks is relevant, impactful, and contributes to more resilient and sustainable agricultural development. In the same countries (and many others), the programme is also working with extension departments and national plant protection organizations to develop local level roadmaps to reduce and limit the use of harmful pesticides, a key environmental degradation and climate change driver. Successful action planning is essential to create a vision for EAS, making them fit for the future, and underscoring their roles in uplifting the mass rural agrarian population to transform agrifood systems. Sustainability of these different actions by development projects, however, is largely dependent on robust governance structures that help identify and support the right entry points where climate priorities can be embedded within existing and new actions plans.

4. Co-creating inclusive, context specific and locally led adaptation climate actions

Integration of climate mandates into local action plans is a fundamental enabler to support EAS to drive climate action on ground with farmers. Under current circumstances, interventions need to be context specific and farmer-centric to ensure sustainable adaptation with potential co-benefits for increasing farming revenue and carbon assets (World Economic Forum, 2022). Extension staff often have the most proficient knowledge of rural contexts and farmer needs because of their close working relations (Giulivi et al., 2022). There is now a greater need than ever to involve them in the co-creation process of locally led and community-based adaptation actions that can help in designing effective and need-based interventions for greater resilience to climate and non-climatic risks. This will also ensure the sustainability of results. The extensive PlantwisePlus networks involving farmers and extension systems provide a suitable avenue to strengthen the processes of co-creation. This can support enhanced collaboration among rural networks to integrate equitable and inclusive local adaptation strategies into extension systems through participatory approaches. This process can also help build trust and establish a feedback loop with a two-way decision-making and information flow process from ground to extension levels and vice versa. Working together with extension departments and smallholder farmers, this co-creation process can help formulate high priority agricultural projects for countries with direct contribution towards national climate policies and frameworks. This is a key element of just and inclusive transition that ensures that rural stakeholders are contributing and included in the process of change.

Programmes such as PlantwisePlus, in this case, can facilitate the process as a knowledge broker and mediator. This is still an area being actively explored by the programme to build adaptive capacities from the ground up through strengthened local extension systems, integrating traditional and scientific knowledge, and creating pathways for farmer-led innovation and feedback.

5. Need for regular and sustainable finance and incentive mechanisms and monitoring systems

Underpinning the success of a reformed and capable EAS to alleviate climate change, poverty and food insecurity challenges is a fully functioning incentive and financing mechanism. This, in turn, is largely dependent on collating data and evidence of their work through regular assessments, monitoring systems, and registration mechanisms (FAO, 2021b). Further, helping extension networks to develop simple real time monitoring, evaluation and reporting systems and action plans to measure and track farmer activities can support sustainability of these systems through enhanced accountability, reporting and management of investments (Babu & Selvaraju, 2023). This also helps donors and partners to trust the process and make more informed and need-based investments.

These are highly resource dependent, and such endeavours are often beyond the scope of programmes such as PlantwisePlus. However, through collaboration and partnerships with private sector, donors and investors, EAS infrastructures can be reinforced to ensure a better return on investment of programme interventions on rural development and resilient growth.

The way forward and conclusion

Agriculture EAS and networks are crucial links to drive the much-needed low emission and climate resilient agricultural development through empowering smallholder men, women and youth farmers with timely knowledge and capacities. Transforming extension services at the grassroot level will be essential for national governments to align their agricultural strategies with global and national climate commitments, as highlighted in their NDCs and NAPs. Crucially, these efforts must also ensure that rural farming communities are not burdened but instead offered a just and inclusive transition to the new realities of agricultural practices in a warming world, with equitable and sustainable outcomes. This calls for the establishment of climate-responsive EAS and networks, primarily through systemic and structural transformation, supported by enabling conditions that enhance capacities and climate knowledge. It also involves digitalizing information delivery for timely access, while ensuring equitable reach and participation of both men and women among rural stakeholders. Furthermore, concerted efforts are needed for policy coherence and alignment with broader national climate and development priorities, bottom-up and consultative planning and community led development processes, and a sustainable financial mechanism through effective monitoring plans.

PlantwisePlus leverages its strong relationships with national and local partners, including extension networks across various countries, to drive efforts in addressing plant health related challenges within the scope of its interventions. These established networks, through further partnerships, collaborations and resources, offer a valuable foundation for disseminating gender-inclusive and climate-smart agricultural practices and technologies to rural communities. If successfully implemented, agriculture dependent countries can unlock huge potential to empower smallholder farmers and collectively drive agrifood system transformations in support of implementing the priorities of the NDCs and NAPs, contributing towards a global climate commitment.

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