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Exploring Pathways for Promoting and Scaling Up Climate-Smart Agriculture in Myanmar

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ABSTRACT

This paper explores potential pathways for promoting and scaling up the uptake of climate-smart agriculture (CSA) in Myanmar, using qualitative methods. Key informant interviews with stakeholders from government, research institutes, international and local development agencies, and the private sector identified technology development as an important investment and action area. A desk review of policy documents revealed that considerations on climate change adaptation in agriculture are embedded in Myanmar's international commitments and national plans, including policies on making the agriculture sector resilient. Moreover, climate change resilience has been framed as a key component of the country's sustainable development plans. This means the basic framework for advocating and promoting CSA is already in place. However, policies on land, water, environment, seed, and fertilizer and pesticide management are poorly enforced. In addition, the extension system has an inadequate coverage and reach of the remote communities. In the current political context of Myanmar, the process of policymaking has changed. Thus, the impetus for shaping an enabling environment for scaling up CSA will likely shift toward more active citizen engagement via local nongovernment organizations (NGOs), the private sector, and independent academic institutions. There are opportunities for policy integration to effectively scale up CSA, but much remains to be done. Donors of Myanmar have a special opportunity to support the integration of CSA into their respective country program strategies. Likewise, local and international NGOs may take this opportunity to mainstream CSA into various conventional development programs, such as livelihood development, women's empowerment, and food security and nutrition. On the other hand, academic institutions can pursue research opportunities to support the development of CSA technologies and approaches and to generate evidence for input to capacity development, advocacy, and policymaking.

Keywords: Myanmar, climate smart agriculture, climate resilience, scaling up, climate change adaptation, agriculture development policy

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INTRODUCTION: WHY CLIMATE SMART AGRICULTURE

Myanmar is a disaster-prone country. Part of its borders is located along the coasts of the Bay of Bengal and the Andaman Sea, where cyclones invariably develop during the monsoons. Its coastal and river deltas are home to a large portion of the country's population and infrastructure, which are thus vulnerable to the impact of natural disasters and climate change. With global warming, the frequency and severity of natural disasters have become hard to predict.

Myanmar's agriculture sector, especially smallholder agriculture, faces unprecedented risks and vulnerabilities due to increasing climate variability and climate shocks, such as floods, droughts, and extreme temperatures. To keep pace with the growing population's food demand and the export demand for agricultural commodities, agricultural areas have been expanding. However, this direction of agricultural development, largely driven by monocrop production systems dominated by rice, is unsustainable and detrimental to land resources in the long term.

Disaster management is an important consideration for Myanmar, especially for its agriculture sector. While total precipitation levels have changed little from the 1990s, the rainy season has shortened due to late onset and early withdrawal of the southwest monsoon, invariably causing intense rainfall and flooding (NAPA 2012). Current projections for Myanmar suggest longer dry spells and heavy rains by 2050 (Horton et al. 2017). The delta region will be exposed to flooding and intense rains, and the low-lying rice fields will be inundated with salty water as a result of sea level rise (RIMES 2011).

Fortunately, the Myanmar government has embraced climate smart agriculture as a key approach to developing technical, policy, and investment conditions to achieve sustainable agricultural development for food security (Hom et al. 2015). Climate-smart agriculture (CSA) generally seeks to bring together three important

economic, social, and environmental elements of sustainable development in addressing food security and climate challenges in communities. These are: (1) sustainably increasing agricultural productivity and incomes, (2) adapting and building resilience to climate change, and (3) reducing and/or removing greenhouse gas emissions (FAO 2013).

Launched in 2015, the Myanmar Climate Smart Agricultural Strategy (MCSAS) was commissioned by the CGIAR Research Program on Climate Change, Agriculture and Food Security in Southeast Asia (CCAFS SEA) and the International Rice Research Institute (IRRI). With the Ministry of Agriculture, Livestock, and Irrigation (MOALI) as lead implementing agency, MCSAS is a collaborative endeavor with other government agencies, local and international partners within Myanmar, and some countries in Southeast Asia. Currently, the Department of Agriculture (DOA), Department of Agricultural Research (DAR), and Yezin Agricultural University (YAU) are implementing CSA activities in line with the MCSAS, which include the establishment of a CSA center in YAU (Htwe et al. 2019).

The DOA undertook three investment projects between 2015 and 2018. One of these was the Climate Friendly Agriculture Program, a national pilot project. Through these CSA programs, local farmers had obtained information on climate change adaptation technologies and the participatory guarantee system for the seed sector. Relying on a farmer-to-farmer learning approach, information on green water management technologies was disseminated to selected farmers.

To support the MCSAS priority programs on strengthening research and extension, the DOA has worked on an impressive range of research on climate resilience, focused mainly on developing stress-resilient plant varieties. In particular, it has conducted studies on rice varietal development for flood-prone areas, salinity-prone areas, drought-prone areas, and high night temperature effect. Moreover, it has implemented studies to develop and assess climate-resilient crop varieties, as well as develop short duration and drought- and heat-tolerant pulse varieties, high-yielding varieties

tolerant to abiotic stress, drought-tolerant varieties using in vitro nuclear technique, and high-yielding varieties with biotic and abiotic stress tolerance and good quality using molecular technology.

DOA's experience revealed various challenges, which include (1) limited budget for the extension activities (farmers' field school approach) and (2) the need for suitable climate change adaptation models for different agroecological zones.

This paper explores the potential pathways for scaling up CSA in Myanmar, as embodied in the MCSAS 2015. It examines the policy environment for CSA, maps the key stakeholders and their initiatives, and investigates opportunities, challenges, and future priority actions needed to scale up the adoption of CSA technologies and practices in the country.

LITERATURE REVIEW

There are two approaches to scaling up: the push approach and the pull approach (Wigboldus and Brouwers 2016). The push approach assumes that the technology or the solution to a problem is effective and valuable and that, through awareness building, people will adopt it, thus achieving scale as it moves from pilot and demonstration to the community. The process then of scaling up via the push approach is to develop technologies and solutions, generate evidence of its effectiveness and value, and conduct education programs, such as agricultural extension. On the other hand, the pull approach centers on having an enabling environment to support the target sector's adoption of a new technology or practice. Scaling up activities following the pull approach include improving policies to make them conducive to technology providers and improving farmers' access to financial support or even providing market-based incentives to farmers so they will shift from conventional farming to climate-resilient farming (e.g., better trading prices for climate-resilient crops) (Totin et al. 2018).

Halbherr (2019) proposes three approaches to adaptation/scaling up: (1) hierarchical (top-down)

centralized approach, which focuses on delivering technological solutions, but fails to consider all key stakeholders and non-farm factors that affect vulnerability levels; (2) individualistic (bottom-up) decentralized approach, which addresses socioeconomic factors within a community, but its local focus tends to overlook wider institutional issues; and (3) relational (holistic) approach, which combines technologies with community engagement, involves multiple stakeholders, and can often address non-farm vulnerability factors.

A few studies have been undertaken thus far to assess the extent of adoption and factors influencing CSA adoption by farmers in Myanmar. In [FAO and YAU \(2020\)](#), more than 80 percent of the respondents indicated being aware of CSA and its importance. However, only 45 percent of them undertook crop management changes in response to the effects of climate change. Meanwhile, more than 68 percent of the respondents expressed interest in adopting CSA approaches. The study underscores the need for training and capacity building, knowledge sharing events and campaigns, and demonstration activities to support the implementation of CSA.

The adoption of organic farming practices as a form of CSA is highlighted by [FAO \(2020\)](#), which presents the results of a sustainable land management study undertaken in Mindat (hilly region), Nyaung U and Kyaukpadaung (central dry zone), and Labutta (delta region) townships. The vast majority (95%) of the farmer respondents used fish amino acid; the others used organic pesticides (74%) and organic compost (65%). However, only 18 percent reported applying these practices consistently.

In 2017, the International Institute of Rural Reconstruction (IIRR) established four climate-smart villages (CSVs) in four distinct agroecological and sociocultural settings in Myanmar ([Htwe et al. 2019](#)). This initiative, supported by the International Development Research Centre (IDRC) of Canada, aimed to demonstrate CSA options and to identify ways on how CSVs can be scaled up by NGOs and government agencies in Myanmar. The following key insights were shared by the participants in the CSV study: (1) minimize

primary crop losses due to climate risk by testing new varieties with farmers, (2) increase diversity of sources of income and food, (3) achieve security in access to food, and (4) increase the contribution of women to livelihoods and community development initiatives.

IIRR's work supported the findings of other studies on the location specificity of community-based adaptation; that is, CSA adaptation depends on the unique social and agroecological context of the community. The initial findings show the importance of using a mix of socio-technical methodologies to facilitate active participation of farmers, including women, in the adaptation process.

Scaling up CSA from plot level to landscape level requires the consideration of interactions and trade-offs between agricultural production and the external conditions affecting the production system. [Schaafsma and Bell \(2018\)](#) indicate the following as among the factors that determine the widespread adoption of CSA by farmers:

- The upfront costs of adopting CSA practices may be too high for farmers. Incentives are often necessary to enable and sustain adoption.
- The provision of secure tenure and access to resources (e.g., land, trees, and water) is crucial, especially to the more disadvantaged households.
- Improved agricultural extension services that are accessible to the poorest and information on the suitability of CSA practices across different agroecological and climatic conditions are critical.
- An inclusive CSA strategy requires the development of off-farm opportunities in the value chain that can be adopted by marginalized farming community members.

Furthermore, [Schaafsma and Bell \(2018\)](#) point out that CSA upscaling must be embedded in and managed at the landscape level to protect the remaining natural resources, on which poor households in particular rely for food, nutrition, and resilience. This requires coherence of national

policies to address national-level pressures so that landscape-level trade-offs can be avoided. Moreover, metrics are needed to assess the progress of CSA upscaling and especially its outcomes within and beyond the agriculture sector. These are important as CSA initiatives are expected to contribute to poverty reduction across multiple dimensions, such as food security, education, health, and living standards.

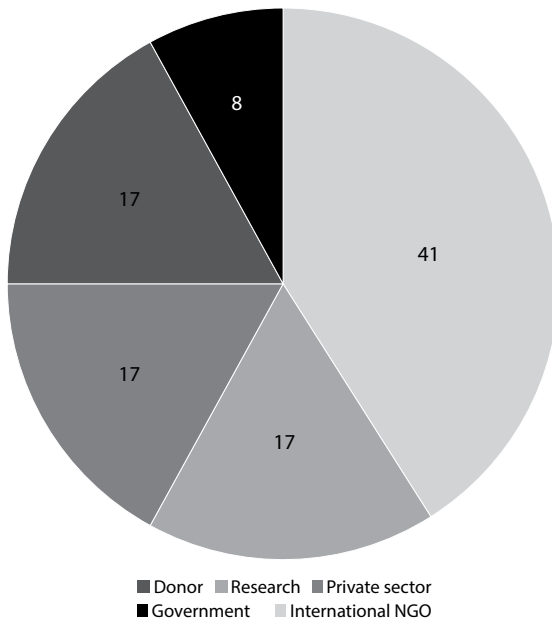
METHODOLOGY

This study examined the existing policies and programs of the government (beyond MCSAS), NGOs, and donors as it explored pathways to promote and scale up CSA adoption in Myanmar. It applied qualitative methods, particularly desk review of documents, key informant interviews, and follow-up consultations with various stakeholders from government departments, research institutes, international and local organizations, and the private sector.

For the desk review, relevant documents were compiled and examined to better understand the existing plans and CSA strategies of different organizations in Myanmar. The main objective of the review was to identify existing policy provisions pertinent to CSA, opportunities provided by these provisions, gaps and challenges in existing policies, and the state of CSA implementation and scaling up in Myanmar. The review was validated using secondary sources of information on CSA policies and practices.

After the desk review of current agricultural projects with a focus on climate change in Myanmar, key informants were identified and contacted for interview. The interviews were conducted through email in June 2021. Follow-up consultations were done via telephone in July 2021. The key informants were from 12 agencies engaged in research and development (R&D), donors, the private sector, government, and international NGOs (Figure 1).

Though the list of key informants was relatively limited, it nevertheless provided a rich range and overview of stakeholders. The follow-

Figure 1. Categories of stakeholders interviewed (%)

up consultations with experts from government offices, especially MOALI, provided information on the extent of policy implementation and associated challenges, as well as the contributions of CSA.

RESULTS

Existing Government Policies for Potential Scaling Up of CSA

Myanmar, through MOALI, has set policies, objectives, and strategies for the development of the agriculture sector, putting priority on food security and rural poverty reduction. Currently, only a few agricultural policies are *directly* related to climate change and CSA. However, there are a number of policies and strategies *indirectly* covering climate change adaptation and mitigation strategies for the agriculture sector. Some notable policies are the MCSAS, the Agriculture Development Strategy, and the Farmland Law.

The MCSAS seeks to optimize the opportunities in a changing climate while minimizing the negative trade-offs across food security, agricultural development, and climate

change adaptation and mitigation. It promotes climate change investments in agriculture. It also provides the context and analysis for Myanmar in terms of international climate negotiations. It encompasses other active climate change adaptation and mitigation projects in agriculture implemented by nongovernment entities. The MCSAS complements the Climate Change Policy, Strategy and Action Plan adopted also in 2016/17.

In 2018, MOALI released the Agriculture Development Strategy (ADS) to serve as an integrated and strategic document to guide and support the implementation of the Agriculture Policy. ADS contains the priorities for agricultural development in the short, medium, and long term. It assigns MOALI the key role of ensuring food and nutrition security, enhancing foreign exchange earnings, and contributing to rural development. It also provides the strategies, action priorities, and an investment plan for agricultural development from 2018 to 2023.

Further, a protocol on securing tenure for areas under agroforestry (revision of the new Farmland Law in 2016) was developed, which indirectly supports the implementation of CSA practices.

Table 1 presents Myanmar's existing policies that provide entry points for integrating CSA, as identified during the desk review. These policies directly and indirectly recognize the importance of addressing climate change as a key component of the Myanmar Sustainable Development Plan for 2018–2030. The Plan identifies agriculture as an important contributor to the realization of Myanmar's global commitments to the United Nations Framework Convention on Climate Change (UNFCCC) process, as indicated in the Myanmar National Action Plan for Adaptation (NAPA) and the Intended Nationally Determined Contributions (INDC). NAPA identifies agriculture as one of the four priority sectors for investments in climate change adaptation. The INDC, on the other hand, prescribes the CSV approach to increase the uptake of climate-resilient agricultural technologies that reduce agriculture's greenhouse gas (GHG) footprint (e.g., solar-powered drip irrigation and rainwater harvesting).

Table 1. Existing policies with potential for promoting climate smart agriculture (CSA) in Myanmar

	Title of Law or Regulation	Specific Element Relevant to Scaling Up CSA	Year Adopted	Responsible Agency
1	National Comprehensive Development Plan (NCDP) 2011–2012 to 2030–2031	Strategic Thrust (ST) 7, Element (E) 4, of Chapter 6: Conserve and Protect the Resource and the Environment mentions “resilience to climate change” (reference: ASEAN Blueprint 2009–15) to implement the Myanmar Action Plan on Disaster Risk Reduction.	2014	Ministry of National Planning and Economic Development
2	Myanmar’s National Adaptation Programme of Actions (NAPA) to Climate Change, 2012	NAPA, p.56, identifies 32 priority activities for effective climate change adaptation in eight main sectors/themes where agriculture is included for all four priority sector levels with four objectives to implement in specific project areas, with budget allocation of USD 1.5 million. Some implemented activities are mentioned in “Documenting the Application of the Myanmar Climate-Smart Agriculture Strategy, Working Paper No. 292” developed by the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS), but deeper analysis is needed to monitor and evaluate the level of implementation.	2012	NECC, MONREC,
3	Myanmar’s Intended Nationally Determined Contribution (INDC) (July 2021)	According to priority and outcomes for adaptation session 4.2.1, “A Technology Needs Assessment (TNA) has prioritized the assessment of two sectors, namely: agriculture and water resources management. Under these two sectors, Myanmar will support the development and uptake of Climate-Smart Villages (CSV), organic farming technologies, solar-powered drip irrigation systems and rainwater harvesting, etc.” Annex VII (a) of the same document indicates an ongoing adaptation action, CSA capacity building, and dissemination implemented by DOA, MOALI.	2021	MONREC
4	Myanmar Climate-Smart Agriculture Strategy	The implementation of CSA strategies involves short-term, medium-term, and long-term steps. Several projects done by an NGO and a government department followed the CSA adoption strategy. Some of these interventions are reflected in “Documenting the Application of the Myanmar Climate-Smart Agriculture Strategy, Working Paper No. 292” developed by CGIAR Research Program on CCAFS.	2015	MOALI
5	Myanmar Rice Sector Development Strategy	Climate change is mentioned under the challenges in p. 34. Objective 2 (p. 52) stresses the need to improve adaptation to climate change and mitigate its effects on rice farming by enhancing farmers’ capacity to cope with risks from climate change, minimizing the environmental impacts of rice farming, and conserving the diversity and richness of the rice ecosystems.	2015	MOALI

Continued on next page

Table 1 continued

	Title of Law or Regulation	Specific Element Relevant to Scaling Up CSA	Year Adopted	Responsible Agency
6	Agricultural Development Strategy	The Agricultural Development Strategy stresses that it recognizes diversification of crops, livestock, etc. However, land and agriculture policy as well as climate and environmental policy and the law-making processes are influenced by diverse interests.	2018	MOALI
7	Agricultural Sector Policies and Thrusts for the Second Five-Year Short-Term Plan of MOALI	The Research, Development and Extension Policy (p. 8, paragraph 3) indicates the development of different crop varieties resistant to climate, pests and diseases; fish resource conservation; and development of good livestock breed and fish species resistant to climate and diseases. Climate change resilience is significantly stressed in the Environmental Conservation and Climate Change Resilience Policy.	2016	MOALI
8	Myanmar National Action Plan for Food and Nutrition Security (MNAPFNS)	This encourages crops diversification and acknowledges agroforestry and nutrition-sensitive interventions but does not mention climate-smart and nutrition-sensitive agriculture.	2018	Ministry of Health and Sports
9	Myanmar Climate Change Strategy & Action Plan (MCCSAP) 2017–2030	Myanmar will integrate climate change into policies, plans, and extension systems; strengthen the capacity of actors; implement strategies/actions on climate-smart farming systems; improve the adaptive capacity of smallholder, marginalized, and landless households; increase climate investment; strengthen the financing framework for climate-smart agriculture, livestock, and fisheries; focus on the vulnerable, landless, women, and marginalized groups in climate-sensitive geographic areas; access climate-resilient technologies and good practices, including low-emission farming practices; and encourage multi-stakeholder partnerships for technology transfer and implementation of efficient technologies. These are aligned with the 2016 Climate Smart Agriculture Strategy, NAPA priorities, and INDC development partners' interventions.	2018	MONREC
10	Myanmar Sustainable Development Plan (2018–2030)	No. 3.1.9 of MSDP calls for the formulation of an action plan to "lessen rural communities' exposure to extreme climate-related events, especially in disaster-prone areas, including supporting the development of climate-resilient rural infrastructure" for outcomes such as "Increased Productivity and Farmers' Income" (ADS Objective 2)	2018	GORUM
11	National Biodiversity Strategy Action Plan 2015–2020 (NBSAP)	NBSAP has 20 biodiversity targets (known as the Aichi targets). This action plan could serve well if it integrates formulating climate change impacts, biodiversity, and sustainable agriculture.	2015	GORUM MONREC

Sources: [GORUM \(2016, 79; 2018, 66; 2021, 83\)](#); [MOALI \(2018, 126\)](#); [MONREC \(2017, 64\)](#)

A number of these policies also provide the directions for agricultural R&D, such as varietal improvement of specific crops, development of livestock breeds, and conservation of fishery resources.

The desk review and key informant interviews show that Myanmar has many past and ongoing programs whose objectives include the promotion of climate resilience in agriculture (Table 2). Many of these programs have been in the form of technical assistance to various government agencies. Only a few programs delivered direct community support to facilitate the transition of farmers' production systems to climate resilient systems. It is noted that technical assistance

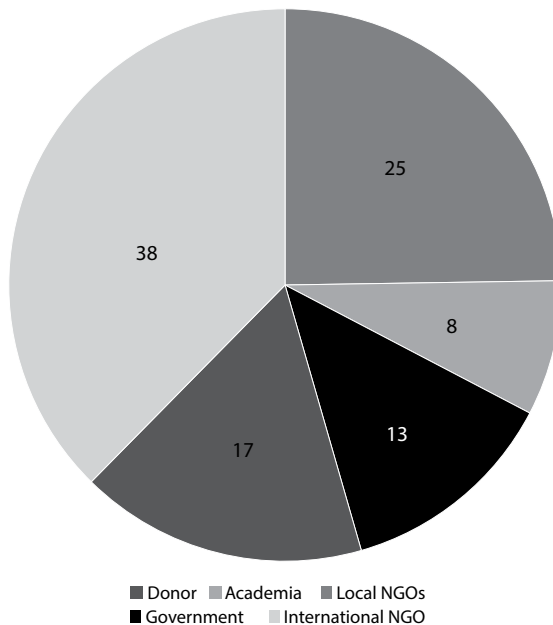
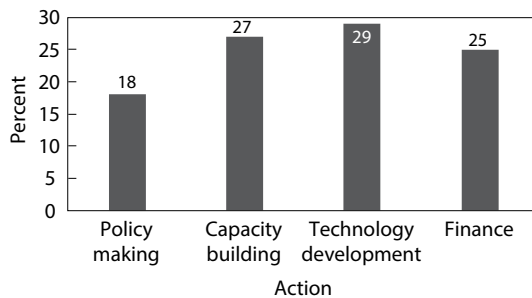
programs are important components in shaping an effective policy environment for climate change adaptation in agriculture.

Mapping of Agencies and Their Actions in CSA Promotion

Figure 2 presents the categories of key agencies involved in promoting climate change resilience in agriculture. A large percentage of this work has been undertaken by NGOs, both local and international. This is expected since there is still a huge gap in the delivery of government services to many parts of the country. NGOs serve as the de facto extension service arm in many agricultural communities in Myanmar.

Table 2. Technical assistance and programs on climate resilience in agriculture in Myanmar

Period	Initiative
Feb 2020–Mar 2021	National environment safeguard consultant, IAIDP (Irrigated Agriculture Inclusive Development project), MOALI – KRC, Nay Pyi Taw
Jan 2020–Dec 2020	National consultant (climate change adaptation), FAO led Global Environment Facility Least Developed Countries Fund (GEF LDCF) project, "RICE-Adapt: Promoting Climate-Resilient Livelihoods in Rice-Farming Communities in the Lower Ayeyarwady and Sittoung River Basins"
Feb 2019–Jul 2021	National consultant (climate change adaptation), Technology Needs Assessment (TNA) Project, Myanmar. UNEP in cooperation with UNEP DTU Partnership
7 May–Aug 2019	TCP/RAS/3602; national consultant (natural resources management/climate change), FAO, Myanmar, Regional TCP on Zero Hunger Challenge, Creating Enabling Environments for Nutrition-Sensitive Food and Agriculture to Address Malnutrition
Nov 2018–Mar 2019	Safeguard Consultant (EIA), World Bank Agriculture Development Support Project (WB ADSP KRC JV), Ministry of Agriculture, Livestock and Irrigation, Nay Pyi Taw
Jul 2017–Dec 2017	Safeguard Consultant (EIA), World Bank Agriculture Development Support Project (WB ADSP KRC JV), Nay Pyi Taw
Jan 2014–Nov 2014	National Team Leader, ATWGARD (ASEAN Technical Working Group on Agriculture and Research Development), ASEAN-German Programme on Response to Climate Change (GAP-CC) – German Development Cooperation (GIZ), in cooperation with the Southeast Asian Regional Center for Graduate Study and Research in Agriculture (SEARCA) on "the promotion of climate change resilience in rice and other crops – value chain analysis"
Jan 2016–Jun 2021	Sustainable cropland and forest management in priority agroecosystems of Myanmar (SLM-GEF) in three agroecological zones in Myanmar
Jan 2013–May 2013	Agriculture expert, mid-term review team of the LIFT Project (Multi-donor Livelihoods and Food Security Trust Fund)
Apr 2012–May 2012	UNDP, Myanmar, national consultant (climate change and environment) for climate resilience and climate proofing for formulation of new UNDP program
2010–2012	National consultant (agriculture and adaptation), National Adaptation and Programs of Action (NAPA) Project, UNEP, Myanmar
2009–2012	National expert in agriculture sector and team leader, National GHG Inventory and Mitigation Option Analysis Team, Initial National Communication (INC) Project, UNEP, Myanmar

Figure 2. Types of agencies involved in climate resilience in agriculture work in Myanmar (%)**Figure 3. Categories of actions to promote climate resilience in agriculture in Myanmar**

The actions undertaken by these agencies are categorized as policy, capacity building and training, technology development, and finance. Figure 3 shows that technology development (29%), including development and testing of climate-resilient crop varieties, is the most undertaken action. In the past 10 years, DAR has focused on varietal enhancement of rice, corn, oilseeds, and dryland crops like legumes, peanut, sesame and pigeonpea. Several centers of the Consultative Group on International Agriculture Research (CGIAR) based in Myanmar have been working also on technology enhancement. For

example, IRRI is working on improving rice varieties (IRRI 2020), the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) on dryland crop varieties (Kyu, Shwe, and Kumar 2016), and WorldFish on sustainable aquaculture in the delta region (Shikuku, Van Tran, and Khin 2019).

Next to technology development are farmers' capacity development and provision of finance. These direct community actions were mostly implemented by international NGOs and United Nations (UN) agencies, in collaboration with local NGOs. Their training programs were bundled with some form of financial and material support to incentivize early adopters of the new technologies and practices.

Policymaking and enhancement received less attention relative to technology development and capacity development. As indicated earlier, Myanmar's policies already have CSA and climate change considerations. What is lacking are the proper implementation of these policies and the right mix of financial and technical investments to support CSA implementation.

With regard to policy, the study identified some major areas needing reforms. Primary of these is the public agricultural extension system, which has to be more inclusive of farmers relative to other players in the crop value chain. Policies on providing market-based incentives (i.e., tax relief) must be reformed also to encourage traders and processors to support climate-smart and sustainable agriculture production. In addition, the stakeholders proposed the creation of a national CSA fund to be made available to local farmers groups that plan to start notable local CSA actions. Regarding land tenure policies, much more effort is needed to foster their widespread implementation, while at the same time working on areas that need reform. Policies on water access and use must be put in place also for a more sustainable system of irrigation and aquaculture.

On capacity development, different stakeholders require different sets of skills and knowledge to support their CSA adoption. Farmers need improved knowledge of crop management; soil, nutrient, and water conservation;

and conservation of agrobiodiversity through diversification, among others. They need to learn how to ensure crop productivity (improved yields) and to enhance farm productivity (total production output per area of land). Farm productivity is best achieved by diversifying crops and integrating trees and small animals into the farming system. This also ultimately confers resilience to smallholders while also contributing to climate change mitigation objectives.

In the area of extension services, both government and NGOs providing these services need to build their capacities in the use of participatory approaches so they can effectively facilitate the farmer field schools, farmer learning groups, and farmer field days. NGOs also need to improve their skills in community organizing and developing farmers' leadership. Technical agencies, on the other hand, should develop their capacity in risk assessment and analysis, including the use of tools such as GIS, mapping, and forecasting. Those involved in research for development need to build the capacities of local think tanks to generate more relevant research. Evidence from such research can inform policymaking affecting agriculture and climate change, such as economic assessments, social development impacts, and cultural dimensions of climate change adaptation, especially in a country with diverse agroecological and cultural contexts.

YAU, together with the FAO, established the National Climate Smart Agriculture Center (NCSAC) in 2018, with funding support from the Global Environment Facility (GEF). The NCSAC serves as the central repository of collected CSA knowledge. It is also a center for CSA training and other capacity building initiatives for government personnel and other CSA stakeholders in Myanmar. Moreover, it coordinates the technical advisory committee for CSA, monitoring and evaluation of CSA activities undertaken by concerned organizations, and knowledge sharing among stakeholders.

There is a huge opportunity for leveraging increased internet access and utilization of mobile technologies to support the scaling up of CSA promotion by making use of digital

platforms (e.g., Green Way and Htwet Toe mobile applications, which provide weather information). There is also a potential role for phone-based extension services, where farmers can call a local center or extension services are provided via radio transmission so these can reach the rural areas. Some NGOs are likewise involved in the development of drip-irrigation technologies (e.g., Netafim and Proximity Design), which support sustainable agriculture. The following are some ideas on CSA technologies relevant to Myanmar:

- development of digital platforms with mobile phone application (e.g., Green Way and Htwet Toe)
- establishment of CSVs for sustainable agricultural production
- integration of conservation agriculture (CA) technology for sustainable rainfed agriculture
- use of dry mulch and living mulch for sustainable upland crop production
- introduction of salinity-tolerant rice varieties in the delta region
- development of paddy dryers as a community-based adaptation technology
- introduction of weather index-based crop insurance system
- establishment/strengthening of local agro-meteorology stations
- introduction of alternate wet and dry (AWD) irrigation system in irrigated rice production
- promotion of system of rice intensification (SRI) in irrigated and rainfed rice production

Key informants of the study also indicated that the successful adoption of CSA technologies and practices in Myanmar depends on availability of funding mechanisms to support access to CSA technologies and broad support from various stakeholders, such as development donors, NGOs providing extension services, and government agencies. Increasing access to financial services and strengthening the financial system are crucial for implementing projects in the agriculture sector. It is estimated that less than 20 percent

of the population has access to formal financial services. Providing greater access to formal financing plays an important role in supporting Myanmar's continued development, including the advancement of an innovative and competitive private sector. Also, there is still a role for village-based credit and savings groups with small banks to develop credit specific to CSA-related practices and technologies. Farmers likewise need an insurance system to protect agricultural crop production against losses due to climate change effects.

Financial investments have been mobilized to build Myanmar's resilience in agriculture. These came from various donors and the private sector, which include the GEF, IDRC, One CGIAR, World Bank, Asian Development Bank (ADB), UN, International Fund for Agricultural Development, and Green Climate Fund. The ADB, which has a special interest in climate change and resilience, has provided loans to the government and grants to NGOs.

The current political situation in the country, however, makes it challenging to expect large international funding for CSA to come into Myanmar. Therefore, the private sector, businesses, and individual Myanmar citizens are critical to providing the domestic financial investments that will support CSA promotion. Some programs that can be targeted for financial investments are as follows: R&D, communication and public awareness, adaptation information and advisory service, farmer-to-farmer climate

extension service, establishment/strengthening of local agro-meteorology stations, delivery of local financing to farmers via microcredit, organization of community-based savings groups for capital buildup, and delivery of technical assistance for CSA technologies and practices.

Barriers and Opportunities for CSA Scaling Up

Table 3 summarizes the major barriers to scaling up CSA practices and technologies in Myanmar. For farmers, the barriers range from lack of knowledge and skills to lack of application of crop diversification and agroforestry. There is also the issue of land tenure insecurity, particular in the uplands and highlands where land tenure is still based on customary laws. Another barrier is inadequate CSA extension services and shortage of capital to implement CSA, resulting in farmers not getting adequate information, thus remaining unconvinced of CSA practices. On policy, the barriers are the archaic policies on land and water use, budgets and investments, and environmental management. The existing policies are also poorly enforced, such as those on seeds, fertilizers, and pesticide management. From the institutional side, a major barrier is the inadequate extension system, which is beset with human resource and logistical challenges as well as budgetary constraints, thus making it difficult to reach remote communities and effectively conduct extension services.

Table 3. Major challenges in and barriers to promoting CSA in Myanmar

Weakness of Farmers	Policy Constraint	Institutional Constraint
<ul style="list-style-type: none"> • Poor knowledge • Lack of infrastructure • Weak collaboration mechanism and practice • Weak technical capacity • Lack of access to credit and finance • Low information awareness of community/ farmers • Lack of finance, resources, and tools 	<ul style="list-style-type: none"> • Archaic land and water use policies 	<ul style="list-style-type: none"> • Poor organizational and institutional capacity • Insufficient research and development on CSA • Limited capacity (i.e., budget, human resources, and technologies) • Limited capacity of agricultural extension services • Weak information-sharing system of relevant government institutes • Limited enforcement of policies in all subsectors

Table 4. Opportunities/areas of action for scaling up CSA in Myanmar

Stakeholder	Opportunity Area
Government	<ul style="list-style-type: none"> • Reform land and water use policies • Invest in regional DAR stations • Invest in extension services • Translate the Myanmar CSA Strategy into an action plan • Establish an effective climate information service in Myanmar • Establish extension services for CSA capitalizing on farmer-to-farmer extension (i.e., FFS) and leverage the use of mobile technology and ICT
Donors	<ul style="list-style-type: none"> • Support the integration of CSA in country program strategies • Support capacity development of local NGOs • Provide technical assistance to government agencies in risk assessment, mapping, and planning. • Invest in strategic sectors, such as agricultural credit, financial inclusion, crop insurance, and other financial de-risking initiatives • Encourage donors to support and integrate climate change activities
International NGOs	<ul style="list-style-type: none"> • Integrate CSA processes in development programs • Co-develop with partners innovative models to support farmers shifting to CSA, including women's empowerment and youth engagement
Local NGOs	<ul style="list-style-type: none"> • Promote CSA in their community engagement; some ideas include agroforestry, SRI for rice production, use of climate hardy varieties, and use of climate information for better management • Support local communities to effectively adopt the technologies and approaches • Organize communities to engage with value chains
Academia	<ul style="list-style-type: none"> • Promote the guidelines/manuals/tools of the CSA practices and technologies, • Conduct relevant research addressing the unique challenges of Myanmar • Improve agricultural education • Provide technical assistance to government and non-governmental agricultural extension service to ensure effective outreach and delivery to farmers • Provide evidence for government policymaking
Private sector	<ul style="list-style-type: none"> • Encourage R&D in CSA • Develop new products to offer to farmers adopting CSA—financial products, information products, and new tools

Table 4 presents the various opportunity areas where stakeholders can take action and contribute to CSA upscaling. For the government, the priority is to continue the policy reforms it has started, particularly the integration of CSA in the existing extension system. Donors in Myanmar have a special opportunity to support the integration of CSA in their country program strategies. They can also mobilize and provide long-term investments to strengthen the government's capacity to do risk assessment, mapping, and extension services. The private sector can invest in services such as agricultural credit designed for CSA, crop insurance, and other financial de-risking initiatives.

For both local and international NGOs, which, as indicated above, are the key providers of capacity development and financial assistance at

the community level, there are opportunities to mainstream CSA into their various development programs, such as livelihood development, women's empowerment, and food security and nutrition. Being in the forefront of delivering support services to communities, NGOs can also lead in organizing and building capacities of farmer groups and farmer leaders so they can effectively engage in markets and value chains.

Finally, for academia, there are opportunities for research to develop CSA technologies appropriate for Myanmar's diverse agroecology, as well as to generate evidence for policymaking. Academia also has the primary role of molding and educating future agriculture professionals who are cognizant of the challenges of climate change vis-à-vis the requirements of agriculture.

The interviews and documents review included a special section on research as a key element in scaling up CSA in Myanmar. The respondents indicated that research should be in line with the long-term direction of government in building climate resilience in agriculture, such as the following:

- improving crop varieties and conserving Myanmar's agrobiodiversity
- improving nutrient and water management in the farm
- improving small livestock management as part of increasing farm productivity
- designing agroforestry systems for each agroecology in Myanmar
- developing agricultural development strategies for each agroecology, shifting from crop-focused research to system-focused research
- building science-based evidence on the economic, social, and environmental impacts of CSA to better inform future investments
- applying innovative tools for extension delivery in the agriculture sector, leveraging mobile technologies and information and communication technologies
- mainstreaming climate resilience in the broader development agenda for rural communities, e.g., biodiversity conservation, forest management, women's empowerment, and food systems

To ensure that the research areas mentioned above are addressed, it is important to support the research community in Myanmar by providing opportunities for learning via exchanges of scholars within the country as well as within the Southeast Asian region, particularly in countries with more advanced agricultural research communities.

DISCUSSION

Approaches to Scaling Up

As earlier discussed, there are two approaches to scaling up CSA—the push approach and the pull approach ([Wigboldus and Brouwers 2016](#)). Based on the information collected, the push approach is relevant in Myanmar, especially among the agencies interviewed, the majority of whom are involved in developing technologies and new approaches. These technologies include improving crop varieties (DAR's focus), improving production systems (i.e., sustainable aquaculture), and leveraging access to mobile technologies to improve information sharing in agriculture. More studies are still needed to support current evidence on the value of scaling up these technologies more widely. To further advance the push approach, information on these technologies and their application needs to be disseminated. A significant opportunity is seen for digital tools since 43 percent of the Myanmar population already have access to the internet ([Kemp 2021](#)).

While numerous CSA technologies have already been implemented and more are in the pipeline for development, the enabling conditions to further scale up CSA is lacking. Moreover, while much has been accomplished in building a positive condition for policymaking and governance, more still needs to be done to continue along this path.

Importance of Policy Context in Climate Change Adaptation

The importance of the policy context in climate change adaptation is amply discussed in the literature ([Burton et al. 2002](#)). Policy context has two main dimensions—existing policies and new policies ([Urwin and Jordan 2008](#)). This paper describes the existing policies and programs supportive of CSA in Myanmar, as well as new policies needed to further advance climate change adaptation in agriculture. Policy context is important because it can either support or hinder adaptation. Future policymaking must ensure that

policies do not hinder adaptation, but instead facilitate and enhance efforts toward Myanmar's climate proofing (Urwin and Jordan 2008). Currently two policies directly support climate change adaptation in agriculture—the Myanmar CSA Strategy and the Myanmar CC Strategy and Action Plan. These policies indicate some level of climate proofing in that they have integrated the language of climate change mitigation and adaptation in non-climate change-related policies, such as the Myanmar Sustainable Development Plan 2018–2030 and the National Comprehensive Development Plan 2011–2031.

A Look into Policy Field and Policy Integration

The study of the link between policy and climate change adaptation includes an understanding of policy field and policy integration. A policy field is the context wherein policies are shaped and changed. Massey and Huitema (2013) describe policy field as the interaction of substantive authority, institutional order, and substantive expertise. It is an important consideration in the shaping of public policy for climate change—as important as the policy in itself. It is noted that prior to the political transition of Myanmar from a democratic form of government to the current “state of emergency,” the country has made progress in improving its policy field by strengthening its democratic institutions. It held elections, had a free press, and strengthened local governance and policies on citizens’ engagement. This is evidenced by the number of policies and programs (some are described in this study) that the Myanmar democratic government had adopted before its removal.

On the other hand, policy integration, also called “mainstreaming” and “policy coordination,” is the process of including policy issues across “the mostly fragmented and siloed policymaking of most modern governments” (Candel and Biesbroek 2016). Biesbroek (2021) presents an analysis of the processes and important conditions for policy integration. He proposes four conditions for enabling and dis-enabling the process of policy

integration: (1) political and ideological interests, (2) institutional alignment, (3) attention toward the issue, and (4) framing of the issue.

On political and ideological interests, a number of studies have found that an individual's political ideology or interests and psychological constructs are bigger determinants of whether the individual will support climate change policies than determinants such as gender, income, education, and age (Beiser-McGrath and Huber 2018; Hornsey et al. 2016). Prior to the political crisis in Myanmar, the overarching political and ideological interests of the political leaders and the majority of citizens had been democratic reforms and liberalization of the economy and society. The Myanmar people welcomed the country's shift to a democratic society, as indicated by the huge turnout of support and engagement in the electoral processes in 2015 and 2020.

Institutional alignment is important because it determines the level of engagement among agencies, dictates the transaction costs between and among agencies implementing policies and programs, and can terminate policies (Biesbroek 2021). The study shows little alignment among Myanmar's government agencies in terms of programming, as indicated by the above-discussed policies and programs which appear to be done in silos. This was not due to the lack of willingness to align, but because the capacities in running a democratic government was still being built. A number of externally supported technical assistance described earlier provided the momentum for interagency coordination, raising the hope of building more institutional alignment in climate change policymaking.

Information dissemination and activism are key drivers in raising public attention to the issue of climate change (Biesbroek 2021). Climate change adaptation policies, such as the INDCs and NAPAs, are mostly top-down policies with very little input from citizens and other actors. Consequently, it is not surprising if the implementation of these policies is met with resistance from citizens and stakeholders, which further hampers progress in climate change policymaking (Kythreotis et al. 2019). During

the time of democratic governance in Myanmar, citizen discourse and action had been encouraged. The former government passed the Association Law, which gave rise to the establishment of many local civil society organizations, the entry of international development organizations, and the creation of alliances and consortia that further amplify citizens' awareness and engagement in climate change policymaking. The UN Cluster System in Myanmar was also broadened to include national NGOs (Kauffmann and Krüger 2010), providing a venue for discourse between citizens and the government.

Finally, on framing the climate change issue, Biesbroek (2021) suggests that the framing be synergistic and bear the language of co-benefits or mutual advantage of the various stakeholders and agencies. The assessment of Myanmar's policies and programs shows that the climate change issue has been framed as an integral element for attaining sustainable development of the country and for building resilient communities, most of which are dependent on agriculture. The Myanmar people, government, and other stakeholders have learned their shortcomings, the challenges, and important lessons after experiencing cyclone Nargis in 2008. This experience underscored the need for resilience building as an important component of Myanmar's development and climate change agenda (Howe 2019).

The scaling up of CSA can be driven by innovative technologies and practices, making use of the vibrant agricultural research community composed of the government, academia, and NGOs. Most agencies that participated in this rapid assessment indicated that their work on CSA focused on technologies, such as improving crop varieties and production systems. However, technologies and new practices will not be enough to ensure that CSA will be scaled up more widely in Myanmar. It is important to set up and strengthen the enabling conditions for scaling up. The policy context—the policy itself and its integration with other policies—and the system for engaging citizens and agencies constitute the enabling conditions.

CONCLUSION

The desk review and key informant interviews show that Myanmar has many past and ongoing programs and technical support that promote climate resilience in agriculture. While agricultural policies *directly* related to climate change and CSA needs in Myanmar are limited, there are policies and strategies *indirectly* addressing adaptation and mitigation strategies in the agriculture sector. Many of these initiatives are in the form of technical assistance to government agencies. Very few government programs deliver direct community support that facilitates the transition of farmers' production systems to climate-resilient systems. This is expected as it is the NGOs that provide de facto extension services in many agriculture-based communities in the country.

A number of agencies have implemented various actions to promote climate resilience in agriculture. Technology development is the most common action, followed by capacity development and provision of financial support to farmers. Most international NGOs and UN agencies bundled capacity building activities with delivery of financial and material assistance to incentivize early adopters. For farmers, the priority areas for capacity development are crop productivity and diversification of production by integrating trees and small animals in their farming systems. For development agencies, the priority is to build their capacities in the use of participatory approaches to effectively facilitate the conduct of farmers' field schools, farmer learning groups, and farmer field days. The NGOs also need to improve their skills in community organizing and developing farmers' leadership.

Policymaking and enhancement received less attention. The identified areas for policymaking and reforms are the government agricultural extension, market-based incentives, and land tenure. Much work is still needed to strengthen the role of research in making and reforming policies.

The Myanmar policy context reveals that the language of national plans and international

commitments cover climate change adaptation in agriculture. Further, some policies specifically address resilience of the agriculture sector. In particular, climate change has been framed as a key component in the achievement of the country's sustainable development plans, especially after the 2008 Cyclone Nargis. Myanmar values the building of climate resilience in agriculture due to its contributions to food security and poverty reduction.

Prior to the shift in government in February 2021, Myanmar was in a positive policy field; government leaders and citizens were committed to creating better climate change adaptation policies, a number of government reforms were initiated such as having free elections and a free press, and key agencies were undergoing capacity development.

The current political situation in Myanmar has changed the country's policy field; consequently, the processes of policymaking and policy integration have also changed. Given this change, according to the interviewed key stakeholders, the impetus for shaping the enabling environment for scaling up CSA will now need to come from active citizen engagement via the local NGOs, the private sector, and independent academic institutions. Moreover, international donors need to continue supporting the efforts of nongovernmental stakeholders, including the business sector, in promoting climate resilience in agriculture. The existing mechanisms for coordination and integration started by the UN Cluster System can be further strengthened for use as a vehicle for scaling up climate resilience in agriculture in the country.

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REFERENCES

- Beiser-McGrath, L.F., and R.A. Huber. 2018. "Assessing the Relative Importance of Psychological and Demographic Factors for Predicting Climate and Environmental Attitudes." *Climatic Change* 149 (3–4): 335–47. doi:10.1007/s10584-018-2260-9
- Biesbroek, R. 2021. "Policy Integration and Climate Change Adaptation." *Current Opinion, Environmental Sustainability* 52: 75–81. doi:10.1016/j.cosust.2021.07.003
- Burton, I., S. Huq, B. Lim, O. Pilifosova, and E.L. Schipper. 2002. "From Impacts Assessment to Adaptation Priorities: The Shaping of Adaptation Policy." *Climate Policy* 2 (2–3): 145–59. doi:10.3763/cpol.2002.0217
- Candel, J.J.L., and R. Biesbroek. 2016. "Toward a Processual Understanding of Policy Integration." *Policy Sciences* 49 (3): 211–31. doi:10.1007/s11077-016-9248-y
- FAO (Food and Agriculture Organization). 2020. "Follow Up Survey to Identify Drivers Affecting Monsoon Crops Plantation Area and Productivity of Small-Scale Farmers during COVID-19 Pandemic: Result of Telephone Interview." Nay Pyi Taw: FAO.
- . 2013. *Climate-Smart Agriculture Sourcebook*. Rome, Italy: FAO. Accessed 10 April 2022. <https://www.fao.org/docrep/018/i3325e/i3325e.pdf>

- FAO and YAU (Yezin Agriculture University). 2020. *Proceedings of the National Workshop on Green Ecology in Myanmar*. Nay Pyi Taw: FAO and YAU.
- GORUM (Government of the Republic of the Union of Myanmar). 2016. *National Action Plan for Agriculture (NAPA) Working Paper 6 : Coastal Resources Management*. Nay Pyi Taw, Myanmar: GORUM.
- . 2018. *Myanmar Sustainable Development Plan (2018–2030)*. Nay Pyi Taw, Myanmar: GORUM.
- . 2021. *Nationally Determined Contributions*. July 2021. Nay Pyi Taw, Myanmar: GORUM.
- Halbherr, L. 2019. “Building and Mainstreaming Resilience for Smallholder Farming Communities in Vietnam.” MS Thesis. Wageningen University, Wageningen, the Netherlands.
- Hom N.H., Htwe N.M., Hein Y., Than S.M., Kywe M., and Htut T. 2015. *Myanmar Climate-Smart Agriculture Strategy*. Naypyitaw, Myanmar: Ministry of Agriculture and Irrigation; CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS); International Rice Research Institute (IRRI). Accessed 15 July 2021. <https://hdl.handle.net/10568/69091>
- Hornsey, M.J., E.A. Harris, P.G. Bain, and K.S. Fielding. 2016. “Meta-Analyses of the Determinants and Outcomes of Belief in Climate Change.” *Nature Climate Change* 6 (6): 622–26. doi:10.1038/nclimate2943
- Horton, R., M. De Mel, D. Peters, C. Lesk, R. Bartlett, H. Helsing, D. Bader, P. Capizzi, S. Martin, and C. Rosenzweig. 2017. *Assessing Climate Risk in Myanmar: Summary for Policymakers and Planners*. New York, NY, USA: Columbia University Center for Climate Systems Research, WWF-US and WWF-Myanmar, UN Habitat Myanmar.
- Howe, B. 2019. “Cyclone Nargis in Myanmar: The Perfect Storm?” In *Human Security and Cross-Border Cooperation in East Asia. Security, Development and Human Rights in East Asia*, edited by C. Hernandez, E. Kim, Y. Mine, and R. Xiao. Palgrave Macmillan Cham. doi:10.1007/978-3-319-95240-6_6
- Htwe N. M., The N. E. M., Naing N. N. Z., and Hein Y. 2019. “Documenting the Application of the Myanmar Climate-Smart Agriculture Strategy.” *CCAFS Working Paper No. 292*. Wageningen, the Netherlands: CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). www.ccafs.cgiar.org
- IRRI (International Rice Research Institute). 2020. *Myanmar and IRRI*. Los Baños, Philippines: IRRI. Accessed 10 July 2021. http://books.irri.org/Myanmar_IRRI_brochure.pdf
- Kauffmann, D., and S. Krüger. 2010. *IASC Cluster Approach Evaluation, Country Study - Myanmar: 2nd Phase*. Inter-Agency Standing Committee (IASC). Accessed 21 November 2021. <https://www.alnap.org/help-library/iasc-cluster-approach-evaluation-country-study-myanmar-2nd-phase>
- Kemp, S. 2021. *Digital 2021: Myanmar*. Accessed 21 November 2021. <https://datareportal.com/reports/digital-2021-myanmar>
- Kythreotis, A.P., C. Mantyka-Pringle, T.G. Mercer, L.E. Whitmarsh, A. Corner, J. Paavola, C. Chambers, B.A. Miller, and N. Castree. 2019. “Citizen Social Science for More Integrative and Effective Climate Action: A Science-Policy Perspective.” *Frontiers in Environmental Science* 7: 10. doi:10.3389/fenvs.2019.00010
- Kyu K.L., Shwe T., and C.V. Sameer Kumar. 2016. “Overview of Pigeonpea Research in Myanmar.” *Legume Perspectives* 11: 41–43. Accessed 10 July 2021. <http://ils.nsseme.com/assets/LegumPerspect11.pdf>
- Massey, E., and D. Huitema. 2013. “The Emergence of Climate Change Adaptation as a Policy Field: The Case of England.” *Regional Environmental Change* 13 (2): 341–52. doi:10.1007/s10113-012-0341-2
- MOALI (Ministry of Agriculture, Livestock and Irrigation). 2018. *Myanmar Agriculture Development Strategy and Investment Plan (2018/19–2022/23)*. Nay Pyi Taw, Myanmar: Republic of the Union of Myanmar.
- MONREC (Ministry of Natural Resources and Environmental Conservation). 2017. *Myanmar Climate Change Strategy and Action Plan*. Nay Pyi Taw, Myanmar: Republic of the Union of Myanmar.
- NAPA (National Adaptation Programme of Action). 2012. *Myanmar National Adaptation Programme of Action Report*. Myanmar: Department of Meteorology and Hydrology, Ministry of Transport. Accessed 10 April 2022. <https://unfccc.int/resource/docs/napa/mmr01.pdf>
- RIMES (Regional Integrated Multi-hazard Early Warning Systems). 2011. *Managing Climate Change Risks for Food Security in Myanmar*. Technical Report Support to the EC Programme

- on Linking Information and Decision Making to Improve Food Security for Selected Greater Mekong Sub-Regional Countries. Accessed 10 April 2022. <https://tinyurl.com/yc49vt3a>
- Schaafsma, M., and A. Bell. 2018. *Scaling Up Climate Smart Agriculture: Lessons from ESPA Research*. Edinburg, United Kingdom: Ecosystem Services for Poverty Alleviation. Accessed 10 July 2021. https://assets.publishing.service.gov.uk/media/5ac63819ed915d76a313cbd3/Scaling_up_climate-smart_agriculture_final_web.pdf
- Shikuku, K., Van Tran, and M. S. N. Khin. 2019. *A Step-by-Step Practical Guide for Participatory Prioritization of Climate Smart Aquaculture in Myanmar*. Myanmar: WorldFish. Accessed 10 July 2021. <https://hdl.handle.net/20.500.12348/4038>
- Totin, E., A. Segnon, M. Schut, H. Affognon, R. Zougmore, T. Rosenstock, and P. Thornton. 2018. "Institutional Perspectives of Climate-Smart Agriculture: A Systematic Literature Review." *Sustainability* 10 (6): 1990. doi:10.3390/su10061990
- Urwin, K., and A. Jordan. 2008. "Does Public Policy Support or Undermine Climate Change Adaptation? Exploring Policy Interplay across Different Scales of Governance." *Global Environmental Change* 18 (1): 180–91. doi:10.1016/j.gloenvcha.2007.08.002
- Wigboldus, S., and J. Brouwers. 2016. *Using a Theory of Scaling to Guide Decision Making: Towards a Structured Approach to Support Responsible Scaling of Innovations in the Context of Agrifood Systems*. Wageningen, the Netherlands: Wageningen University & Research. <https://edepot.wur.nl/405915>