Climate-Smart Villages in Southeast Asia: The Pivotal Role of Seed Systems in Rice-Based Landscapes

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ABSTRACT

Given the aggravating nature of climate change impacts, rice farming will increasingly rely on improved resilience to climate variability and extremes. To this end, the climate-smart village (CSV) approach was developed to address specific challenges of smallholder farmers. Within Southeast Asia, the CSV approach has so far been applied in Myanmar, Lao PDR, Cambodia, as well as in Vietnam and the Philippines where national programs have taken it up and established multiple CSVs. Despite distinct climatic conditions, all these CSVs have rice-based landscapes as a common denominator. This article focuses on the improvement of rice seed systems as the core of introducing climate-smart agriculture (CSA) in these villages. The experience of a CSV in Lao PDR clearly shows community-based seed (CBS) systems as a viable CSV component. Moreover, the efficiency of CBS systems is enhanced when applied in combination with the following supporting climate-smart interventions: (1) training in improved crop and pest management through farmers' field schools, (2) awareness raising through photo exhibits and seed fairs, (3) participatory variety selection, and (4) climate risk mapping as a means for targeted distribution of improved rice varieties. The study also explored direct market access for CSV products by advertising both the generic aspects of climate-smart adaptation strategies and the location-specific stories of smallholder farmers. To this end, the emerging online retail economy could offer viable avenues for highlighting specific aspects of food production in CSVs to different groups of consumers (e.g., the "buy local" preference in the domestic market and climate change concerns in the international market).

Keywords: climate-smart villages; climate-smart agriculture; adaptation; community-based seed system; climate risk mapping; crop management; pest management; photovoice; online retail; Lao PDR

JEL codes: Q01, Q18

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INTRODUCTION

Throughout Southeast Asia, climate variability due to climate change poses major threats to the sustained performance of local cropping systems (Venkatappa et al. 2021). Severe flooding problems are triggered by intensifying climate hazards, such as the 2008 Cyclone Nargis that struck the Ayeyarwady Delta in Myanmar, killing about 140,000 people and severely affecting 2.4 million people (Seekins 2009). Widespread droughts are associated with El Niño years and have worsened throughout the region (Qian, Qiu, and Zhang 2019). Moreover, rainfall patterns have become less and less predictable in all agroecological zones (Loo, Billa, and Singh 2015). The start of the monsoon season is especially important for the rainfed cropping systems; a delay in the initial rainfalls causes pronounced yield losses in rice, which is the region's staple crop (Wassmann et al. 2019b).

As the effects of climate change vary from location to location, coping strategies must be based on biophysical circumstances and site-specific community needs. Climate-smart agriculture (CSA) has emerged as a response to impacts of climate variability and change on agriculture. Although specific definitions may vary, CSA has typically three pillars: adaptation, mitigation, and productivity. The concept of climate-smart villages (CSVs) evolved from the recognition that adaptive technologies and practices (T&Ps) cannot be defined as blanket strategies; they will have to be anchored in location-specific contexts.

CSA is considered a pragmatic approach in that its T&Ps are often derived from existing applications in other locations (e.g., under the paradigm of climate analogues corresponding to the projected climatic conditions at the target region) (Ramírez-Villegas et al. 2011). It may also incorporate "no regrets" approaches that provide advantages to various aspects beyond climate change and that will be beneficial in the future, regardless of whether the worst projections materialize or not (Gonsalves et al. 2020). CSA recognizes that climatic risks to agriculture-based livelihood are occurring at a much greater pace and intensity than before. Context-specific local solutions to address these risks open up new opportunities for local adaptation, resilient livelihoods, agrobiodiversity conservation, and better nutrition (Gonsalves et al. 2015).

1. This article synthesizes the experiences and lessons learned from a set of CSVs. It has the following objectives:
2. To characterize the CSV approach as a mechanism for scaling up CSA by highlighting strategies that directly or indirectly relate to seed systems
3. To identify technical and organizational requirements for establishing and operating community-based seed (CBS) systems in the context of rice-dominated landscapes in Southeast Asia
4. To assess supporting measures for such seed systems to enhance the potential of scaling up CSV through a comprehensive approach ("Seed+")
5. To extract lessons learned from CSV case studies in Southeast Asia that can be exploited to improve future implementation of CSV projects

CSV APPROACH IN SUPPORT OF SMALLHOLDER FARMERS

General Principles and Conceptual Framework

By definition, a CSV comprises an explicit geographical domain—either an administrative or agroecological entity—as the starting point for scaling up across different hierarchical levels (Sebastian, Gonsalves, and Bernardo 2019; Wassmann et al. 2019b). The bundling of manifold activities within a relatively small area has obvious advantages in achieving tangible impacts (Aggarwal et al. 2018). In turn, the village-based approach can be seen as a "litmus test" for the selected T&Ps applied. If there is no adoption at the village scale, it is doubtful that adoption could be possible at a larger scale with a bigger set and more distant stakeholders.

Before the advent of CSA projects, the village-based concept had been already applied under a broader development agenda. For instance, the Millennium Village Project (Sachs 2018) was implemented in impoverished rural areas of Sub-Saharan Africa under three overarching principles: (1) integrated rural development approach, (2) incremental donor investment, and (3) community-based delivery. Likewise, government programs on climate change adaptation and mitigation have derived from village-based approaches, such as in Indonesia (Kolopaking 2016). Given the heterogeneity of land use systems in the tropics, however, the selection of "representative" villages inherently leads to some degree of situational bias if applied to the development of larger rural areas. Focusing on a given site also entails the risks of missing out certain interventions that may be suitable in many other locations, but do not fit the specific settings of the target village.

Irrespective of eventual disadvantages, the village-based concept has proved to be a viable approach in the context of Southeast Asia (Gonsalves et al. 2020). Meanwhile, CSVs provide platforms for ensuring that various interventions converge at the local level, where it matters most. While communities test, develop, and subsequently adopt T&Ps, the successful CSVs can act as "lighthouse projects" to demonstrate the modalities as well as the potential impacts of CSA practices (Le et al. 2018; SEARCA 2020). Moreover, the CSV approach can yield customized decision-support tools developed at the local level, which can be adapted—eventually with slight modifications—to a wider range of locations.

The CSV approach as a specific form of scaling up CSA has been described in detail by Aggarwal (2016) and Vernooy and Bouroncle (2019), so that this article will elaborate only on scaling mechanisms derived from seed system improvements. Conceptually, the scaling pathways can be distinguished between horizontal "outscaling" (within a given scale from one unit to another unit) and vertical "upscaling" (from a lower to a higher scale). Figure 1 shows this concept, highlighting the role of seed systems.

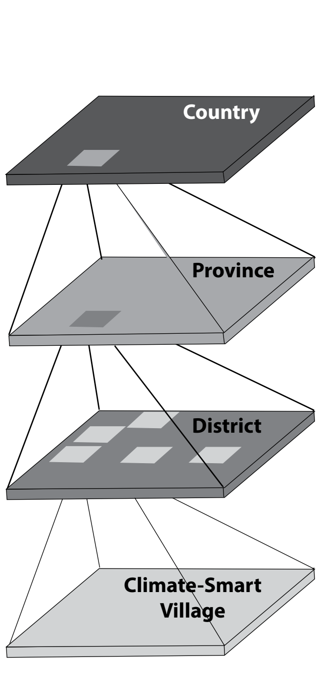
Cutting across the different activities listed under this concept are the following six elements that underlay scaling mechanisms:

1. Landscape: the topography, soil quality, and water availability determine the type of CSA technology and practices that can be applied to a specific location.
2. Technology: developing and fine-tuning viable solutions—that is, T&Ps that are adjusted to climate variability and change
3. Cognitive: understanding the effectiveness of a variety of CSA options to build climate resilience, increase adaptive capacity, and, wherever possible, reduce greenhouse gas (GHG) emissions
4. Community: understanding the socioeconomic settings, including gender, which may accelerate or impede CSA adoption
5. Cultural: aligning the interventions with local beliefs, practices, and traditional knowledge
6. Institutional: ensuring alignment with local and national agencies in charge of research, rural development, and policies

CSVs in Southeast Asia

The CSVs in Southeast Asia were established as part of the Consultative Group on International Agricultural Research (CGIAR) program on Climate Change Agriculture and Food Security (CCAFS) as well as through other projects of the International Institute of Rural Reconstruction (IIRR). The obvious first step was to select the villages, which was done in collaboration with national institutions. In principle, these villages should be representative of the typical agronomic conditions and problems in the targeted agroecological zone (e.g., the Mekong plain of southern Lao PDR in the case of Phailom). This criterion is inherently vague, however, allowing for numerous villages to be selected based on similar biophysical and socioeconomic settings. The site selection was also influenced by pragmatic reasons,

Figure 1. Conceptual framework of scale-dependent sources of internal variation juxtaposed with their respective scaling approaches for seed systems



Hierarchy of Scales	Scale-Dependent Source of Internal Variation	Scaling Approach for Seed Systems
Country	• Agroecological zones determined by climate and land use characteristics • Diverging socioeconomic development • Regional crop prioritization in national development plans	• Networking with national plant breeding institutes • Assisting in formulating seed policy directives • Compiling training materials to be distributed to different stakeholders in the country
Province	• Irrigation infrastructure • Heterogeneity of landscapes (plains, mountains, etc.) • Distance to cities and local markets • Capabilities of provincial seed centers	• Capacity building for seed centers • Facilitating transfer of new stress-tolerant varieties from national/ provincial seed centers • Engaging private sector in marketing strategies
District	• Dominance of different land use systems • Land suitability and exposure to risks • Reliability of irrigation supply • Qualification and engagement of extension staff	• Establishing demonstration trials of stress-tolerant cultivars to be visited by farmers from different villages • Coordinating seed banks across different villages
Climate-Smart Village	• Soil quality and topography at smaller landscape level • Farmers' perceptions and know-how • Gender and youth participation in decision-making	• Establishing and operating a community-based seed bank • Working closely with "champion" farmers, farmers' field school, women/youth participation

Note: Adapted from Wassmann et al. 2019b

particularly capitalizing on previous research projects in the village. In the case of Phailom, the CSV project built on local contacts established at the initial phase of the WeRise Project[1] (Hayashi et al. 2018). Likewise, several other CSV sites in Southeast Asia were based on the legacy of previous projects, typically conducted by the leading institute. While this may constitute an arbitrary element in the site selection process, it seems justified in the Southeast Asian context, where CSVs are scattered across the region. Given the pronounced heterogeneity of the agroecological zones, the zone-specific distinctions are typically larger than the site-specific variations within a given zone.

Figure 2 and Table 1 provide an overview of the different CSVs. These are complemented by Annex Tables 1 and 2, which present a comprehensive collection of web-based documents describing these CSVs within the regional context and their specific settings.

According to Sebastian and Bernardo (2019), the CSVs approach as applied in Southeast Asia addresses four opportunities and challenges in the region, which are critically assessed below based on the available body of evidence:

a) *Coping with climate change for smallholder farmers*

   The village-based approach facilitates direct interaction with smallholder farmers; thus, it has clear advantages over activities dispersed across the subnational or national scale.

b) *Sustaining national and regional food and nutrition security*

   While food and nutrition security can be directly improved at the village level, the scaling up of these impacts will have

[1] Weather-Rice-Nutrient integrated decision support system (https://werise.irri.org/)

Figure 2. Map of CSV case studies in Southeast Asia implemented by projects under the CCAFS and IIRR project portfolios

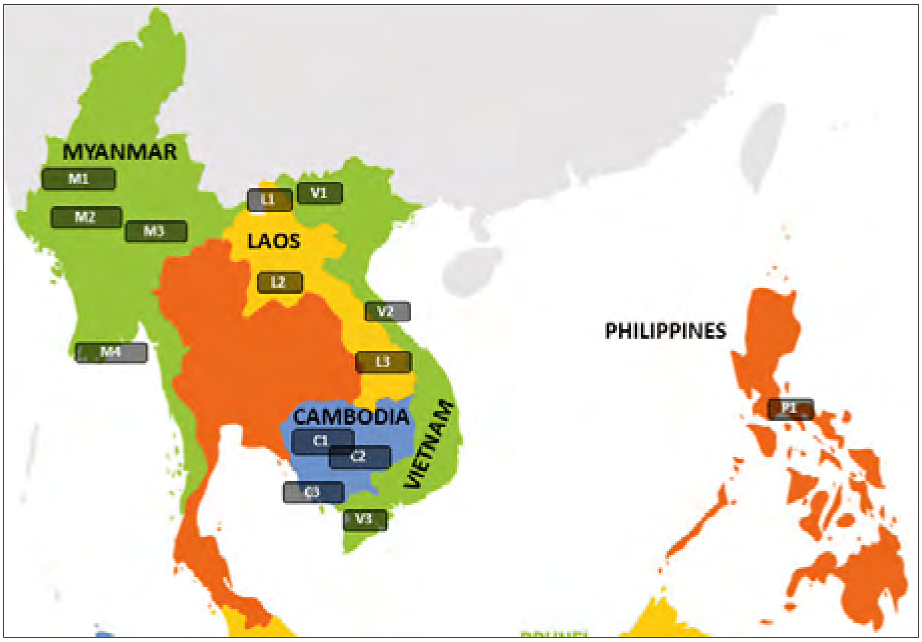


Table 1. CSV case studies (see Figure 2) and focus of CSV interventions established under the umbrella of CCAFS, IIRR, or as their collaborative projects

Acronym	Location	Targeted Land Use System and Intervention	Successful Measure
Cambodia			
C1 (CCAFS)	Rohal Suong, Battambang Province	Improvement of fisheries and rice, water harvesting	Water catchments through small pools in temporarily flooded areas
C2 (IIRR)	Mondul Kiri Province	Low carbon, small-scale livestock production, intensive market gardening	Demonstration that CSA can be profitable, nutritionally relevant, and environmentally sound
C3 (IIRR)	Koh Kong Province	Local financing for CSA (village development funds), agroforestry and small livestock production	Community-led and managed local financing in support of community-based adaptation
Lao PDR			
L1 (IIRR)	Phongsaly Province	School and community gardens supporting schools' meal programs, fruit tree-based agroforestry in rotational agricultural landscapes	Integration of climate change adaptation into humanitarian work of WFP
L2 (CCAFS)	Ekxang, Vientiane Province	Irrigation for vegetables	Improved access to local wells
L3 (CCAFS)	Phailom, Savannakhet Province	Improvement of rainfed rice, water harvesting, vegetable gardens, direct market linkages	Establishment and operation of community-based seed systems

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Table 1 continued

Acronym	Location	Targeted Land Use System and Intervention	Successful Measure
Myanmar			
M1 (IIRR)	Sakta, Chin State	Agroforestry in degraded landscapes, small livestock, agro-biodiversity conservation, improved crop productivity in mixed farming systems	Sedenterization of shifting cultivation landscapes with agroforestry
M2 (IIRR)	Taungkhamuak, Shan State	Agroforestry, small-scale native livestock project, upland rice, corn, and millet	Maximized homestead and family farming niches through diversification and intensification
M3 (IIRR)	Htee Pu, Mandalay Region	Dryland horticulture, recovery of sorghum and pigeonpea cultivars, homestead agroforestry, and small livestock	Dryland fruit tree-based horticulture embedded in traditional legume based (peanut) cropping systems
M4 (IIRR)	Masein, Ayeyarwady Region	Multi-storied cropping systems in homestead areas, small livestock production, indigenous fish species conservation, and intensive betel vine systems	Homestead use for income generation for the landless and near landless (including women), duck and native pig raising
Philippines			
P1 (CCAFS, IIRR)	Guinayangan, Quezon Province	Improvement of multiple cropping and swine husbandry, agroforestry with emphasis on fruit, coffee and cacao, legume reintroduction (mung bean and peanuts), and coastal agriculture	Emergence of impact areas (pockets of excellence) in agroforestry (coffee and fruit trees), demonstrating that fishers can be good homestead farmers, native pig breed conservation and production
Vietnam			
V1 (CCAFS	Ma, Yen Bai Province	Crop residue and animal manure management; intercropping on slopes; conservation agriculture	Conservation agriculture
V2 (CCAFS)	My Loi, Ha Tinh Province	Introduction of agroforestry system and climate information	Engagement of village communes in CSA programs
V3 (CCAFS)	Tra Hat, Bac Lieu Province	Improvement of irrigated rice through plant clinics and recycling of straw	Mushroom production based on rice straw

to be assessed individually for specific CSVs and T&Ps. In terms of CSVs in rice-based landscapes, improvement in the seed systems is an approach that can be straightforwardly replicated in other villages, as it does not require big investments in infrastructure. This replicability aspect of given T&Ps may not have been sufficiently addressed in previous CSA concepts described in the literature.

c) *Enhancing competitiveness in agriculture*

The CSV approach comprises incremental steps in increasing profitability and, thus, the competitiveness of farmers applying adaptive T&Ps. As CSV activities include awareness raising (e.g., through photovoice events), the impact of the CSV approach may go well beyond the life cycle of a typical project (3–5 years) in that the participating farmers will become more prudent in selecting farming practices based on climate resilience. The active participation of farmers in the CSVs throughout Southeast Asia shows that the communities generally view the respective activities as assets that positively address their challenges in farming.

d) *Moving toward regional integration*
Regional integration is a long-term goal of the CSV approach. As of now, this aspect cannot yet be fully assessed in the ongoing CSV activities. However, the broad interest expressed by national research and extension agencies indicates a growing awareness across scale.

Interaction among different CSVs could be strengthened through roving workshops organized in different Southeast Asian countries (SEARCA 2020). These roving workshops have demonstrated how local-level "outscaling" of climate-resilient agricultural practices can be undertaken under different agroecosystems and conditions in a given CSV. The workshops commonly gathered 10–15 participants from the CSVs, composed of "champion farmers" and country-specific resource persons to ensure proper communication during the workshop. The main activities were field visits, during which the best CSA practices in a given CSV were showcased. For instance, in the roving workshop in Guinayangan (Philippines), the participants learned about intercropping and other interventions in an upland agricultural system, with emphasis on corn production. This was followed by a visit to a farm that featured small-scale, low external input, low carbon footprint methods of pig raising using resilient but improved breeds of native pig—an alternative source of livelihood of farmers. For fishery and coastal agriculture, the participants visited areas featuring reforestation and diversification of livelihoods of coastal fishing families. Finally, the group as a whole and the country subgroups discussed take-home messages and follow-up activities for their respective CSVs. An example of the workshop's outcomes is farmers from the Mekong Delta applying improved vermiculture practices after visiting a CSV in North Vietnam.

Given the individual projects' limited resources, multiplying CSVs in different agroecological zones will require the adoption of this concept by national institutions. Vietnam and the Philippines present evolving examples of successfully establishing multiple CSVs at the national scale. Vietnam's Nong Thon Moi (New Rural Development) Initiative aims to expand countrywide to 9,000 communes (Bui et al. 2021; Koerner et al. 2019b). Inspired by a field visit to the CSV in Ma village, Yen Bai province, the program's design has incorporated the CSV's basic principle of merging local tradition and knowledge. In the Philippines, the Department of Agriculture's Adaptation and Mitigation in Agriculture (AMIA) Program created "AMIA villages" in 17 provinces.[2] Each AMIA village has distinct geographic, political, social, and demographic characteristics, as well as its own priorities in adopting T&Ps (Koerner et al. 2019a).

SIGNIFICANCE OF SEED SYSTEMS IN RICE-DOMINATED LANDSCAPES

Formal vs Informal Seed Systems

Seed quality comprises purity and vigor of the grain; it is one of the main factors determining the productivity of rice and other cropping systems (Cromwell, Friis-Hansen, and Turner 1992). Poor seed quality leads to deficient canopy development and infestations of weeds, insects, and diseases. A seed system can be broadly defined as a "framework of institutions/farmer groups organized together by their involvement or influence on the seed multiplication, processing, quality assurance and marketing of seeds" (Chauhan et al. 2017). Since access to quality seeds is an important development issue, improvements of seed systems have been addressed in many policy debates to modernize agriculture (Gill et al. 2013). The literature generally distinguishes between formal and informal systems, as characterized in

[2] http://amia.da.gov.ph/index.php/documents/

Table 2. However, definitions and terminologies may vary from study to study and include terms like farmer networks, local seed systems, etc.

The formal system encompasses officially released varieties and involves the entire chain of activities from breeding and registration to the production of certified seeds (Reddy et al. 2007). It clearly distinguishes between seeded and harvested grain. On the other hand, the informal seed system is based on locally grown varieties without a given protocol for seed production. Activities are typically organized by farmers themselves, tapping their own harvest for seed exchange among peers or the local grain markets. Although the principal activities from seed selection to dissemination largely correspond to the formal sector, the informal seed production takes place as an integral part of farmers' production systems (Almekinders and Louwaars 2002). The advantages of the informal system are lower seed costs and added income for farmers who sell seeds (Sombilla and Quilloy 2014). The problem, however, is that farmers often consume their seed during times of scarcity (e.g., due to poor weather conditions).

Notwithstanding the inherent distinctions between the formal and informal systems, seed systems in many rice-growing regions combine elements of both (Louwaars 2007, 151). For instance, to produce better seeds, farmers involved in informal seed trade may, from time to time, buy new seeds from the formal system (e.g., a new variety). Thus, these two types of seed systems can be seen as antagonistic points in a continuum that encompasses many transitions and combinations of individual traits. Countries like Vietnam, Thailand, and the Philippines have heavily invested in building up their formal seed systems to supply rice farmers with certified seeds (Louwaars 2007). In the meantime, a dense network of seed stations scattered throughout the main rice-growing areas had been established to ensure easy access to seeds by the vast majority of local farmers. The use of certified seeds has been intensively promoted also in technology campaigns on good agricultural practices (GAP) in these countries. Moreover, the role of the private sector in seed supply continues to grow. Currently, several rice seed companies provide high-quality and high-yielding rice seeds that have high tolerance of extreme weather, pests, and disease. Despite these efforts, many farmers continue to produce their own seeds. In 2001, 81 percent of rice farmers in Vietnam, 67 percent in Thailand, and 60 percent in the Philippines used seeds from their own harvest (Manzanilla et al. 2011).

In other Southeast Asian countries, the formal seed sector is still underdeveloped, such as in Lao PDR and Myanmar. Back in 2010, the amount of certified seeds produced in Lao PDR corresponded to a planting area of less than 60,000 ha, or a seed renewal rate (i.e., the percentage of rice area planted to certified seeds) of only 6 percent

Table 2. Characteristics of formal vs. informal seed systems

Attribute	Formal	Informal
Definition[1)]	Deliberately constructed system that involves a chain of activities leading to genetically improved products: certified seed of verified varieties.	Based on farmer-saved seed, where farmers themselves produce, disseminate, and access seed directly from their own harvest
Seed value chain	Standardized procedures backed up by relevant information on varieties through public- or private-sector entities	Driven by mutual agreements and social structures
Seed quality	Certified seeds comprising officially released varieties and sanitary standards	No standard protocol for quality assurance
Distribution	Seed access via public seed centers (free or subsidized) or commercial dealers	Exchange, purchase, or barter trading with family, friends, neighbors, farmer groups, and at local markets

Source: https://agrilinks.org/post/seed-system-definitions

(Eliste, Santos, and Pravongviengkham 2012, 175). While it can be assumed that this seed renewal rate has increased to a certain extent over the past decade, the availability of certified seeds remains one of Lao PDR's major production constraints, especially in remote places such as Phailom.

With climate becoming increasingly erratic and unpredictable, there is a need for improved seed storage and distribution. In turn, access to stress-tolerant rice varieties has become an important feature of CSA. Ideally, this access is channeled through the formal seed system. The provincial seed centers are supposed to act as pivots between the national plant breeding institutes and gene banks and the local farmers. In reality, however, the work in the different CSVs (including in Phailom) has revealed serious shortcomings in the transfer of improved, stress-tolerant varieties to the seed centers and subsequently to the farmers. These transfer bottlenecks are important not only in the dissemination of new varieties, but also in farmers' access to traditional varieties that could be more resilient than the popular ones grown over recent decades (Das and Das 2014). Traditional varieties have been successfully reintroduced in previous projects to recover from drastic biodiversity loss. Most notable of these efforts had been in Cambodia in the 1980s, which distributed rice seeds derived from collections done by the International Rice Research Institute (IRRI) in the 1960s (Scoville 1990). On the other hand, the reintroduction of traditional rice seeds to cope with climate change has not (yet) been mainstreamed into development policies. With the growing recognition of the linkages between gene banks and farmers' seed systems (Westengen et al. 2018), however, this can be expected to change in the near future. The dire need for more resilient rice varieties may provide a new stimulus for the concept of local biodiversity within a given land use system.

Community-Based Seed Systems

General principles

CBS systems are promoted as a viable alternative to capture the inherent advantages of both formal and informal seed systems. The principal operations required for establishing a CBS system have been laid out in training manuals and resource books such as Manzanilla, Janiya, and Johnson (2013); Bèye, Jones, and Simpson (2009); and Vernooy et al. (2015, 2016). Farmers are required to organize themselves into small groups to receive support in the form of training along with the supply of good quality foundation seeds for multiplication. The only infrastructure required is a place for storage and processing of the seeds.

This type of seed system has a positive aspect in terms of gender equity. Lack of access to new varieties is one of the main barriers to CSA adoption by both women and men (Duyen et al. 2020). Seed selection and preparation are generally seen as key contributions of women farmers. The role of women in seed production and other farm activities is especially pronounced in villages with high out-migration of the male population (Tran et al. 2019).

Establishment of a community-based seed system in CSV Phailom (Lao PDR)

Phailom is in southern Lao PDR, where rainfed rice is the dominant element of the landscape, covering more than 90 percent of the agricultural land (Villanueva et al. 2015a; Yen et al. 2015). At a glance, it is evident that access to water is a priority need to enhance the cropping system and overall farming productivity. At this point, however, plans for new irrigation schemes are rather vague, resulting in CSA interventions having to focus on other strategies to increase production. In recent years, the local weather patterns have become increasingly erratic and unpredictable, resulting in delays in the start and in shorter durations of the wet season crop. In these resource-poor communities, a singular year with reduced rice harvest immediately threatens food security and livelihoods (Wassmann et al. 2019b).

CSV Phailom's focus on seed systems considers the land use systems in southern Lao PDR, which are characterized by very low inputs. Application rates of fertilizers and pesticides are very low at best, so that there are only a few entry points to improve crop management. Thus, improving the seed systems stands out almost as a default strategy that can be applied across scales.

The CBS system established in Phailom has three components: (1) a community seed bank serving as storage place (see details below), (2) a training program (farmers' field schools) and training materials for farmers and extension staff, and (3) awareness raising through seed fairs.

IRRI organized the necessary activities under a CCAFS project in collaboration with partners from the National Agriculture and Forestry Research Institute (NAFRI) and Cuso International, a Canadian nongovernment organization (NGO) (Villanueva 2015b). After a successful start in Phailom, the CBS system approach was expanded to the other villages in Savannakhet province, in partnership with the FAO Climate Adaptation in Wetlands Areas (CAWA) project.[3] This collaboration eventually led to FAO's funding of a small house for use as a seed bank in Phailom. The house was designed and constructed by the local farmers, with assistance from the project and NAFRI staff. The design was very basic and in line with local construction practices to prevent moisture from getting into the structure and to allow free flow of air. The house was located outside the flood-prone area in the village to protect it from possible flooding that could lead to seed losses. The initial seeds (foundation seeds) were sourced from the regional NAFRI seed stations as well as from farmers after respective seed quality checks. The farmers themselves set up the rules and regulations on accessing the seeds (e.g., frequency and allowed quantities for retrieval). While the formulation of these rules and regulations were guided by the local government staff, the community soon developed a local leadership structure to manage the seed bank on their own. Individual farmers were free to decide how much seeds to use to restock the seed bank and how much to keep for themselves.

The training was conducted using a farmers' field school approach (Braun et al. 2005). The training courses and materials were designed to provide skills to local farmer groups or seed producers. The training curriculum encompassed the principles of good crop management: field preparation, weed management, nutrient management, pest/disease management, and postharvest practices. While farmers' skills are an important aspect in climate change adaptation, the active participation of extension workers in the training is crucial to ensure their ability to provide timely advice and services to farmers in the future. Through this exercise, a team of skilled individuals was able to enhance the quality of the village's seed production, resulting in improved incomes and livelihoods.

The CSV project generated a specific manual (available online)[4] consisting of five modules:

Module 1: Introduction

The objectives of this introductory module are to identify the actual needs and problems (i.e., seed availability, access, quality, varieties, etc.), develop a team to work at the grassroots level, and ensure that all stakeholders understand and agree with the proposed intervention. This is done after the target community has been identified.

Module 2: Selection of demonstration sites

Given that seeds should be produced under favorable field conditions, it is important that all stakeholders inspect suitable demonstration sites and jointly assess the following seed production requirements: soil fertility, cropping history (including diseases and pests), drainage, and accessibility.

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[3] http://www.fao.org/in-action/climate-adaptation-in-wetland-areas-in-lao-pdr-cawa/en/

[4] https://docs.google.com/document/d/1rlJeJp4cLfuFMIdelHtpnrRL0gPaZV6V/edit

Module 3: Development of a cropping calendar alongside the action plan

Emphasis is given to improving farmers' understanding of the necessary actions and their timing to achieve good seeds. Thus, farmers need to take an active role in planning all field activities and in developing a joint action plan detailing the activities from field preparation to harvest. This process will be supported by simple drawing tools to help the group and individual farmers ensure timeliness in undertaking specific farm operations.

Module 4: Launch of CBS production

The official launch of the rice seed system involves the local authorities and other stakeholders to raise awareness of the CBS system. In the case of Phailom, this included the government extension staff, interested private companies, research institutions, and NGOs.

Module 5: Community seed fair

The training is backed up by several seed fairs, which serve as a venue for farmers and other stakeholders to share experiences and learn from each other, as well as buy, sell, or exchange rice seeds. The key features of the seed fairs include a seed display and an open forum where farmers, researchers, and extension agents discuss various issues related to rice seed production. The discussions focus on the suitability of seed varieties in light of climate change impacts experienced in the region and specific challenges relating to rice seeds in the CSV.

SUPPORTING MEASURES FOR A COMPREHENSIVE SEED APPROACH ("SEED+")

Although our work in different CSVs in Southeast Asia clearly shows the significant role of seed systems as a common denominator, it has been obvious also that exclusively targeting this component of the production system is not sufficient to achieve tangible benefits in terms of resilience. Thus, instead of pursuing improvements of the seed system as a stand-alone approach, we considered other interventions that have been tested in CSVs in Vietnam (i.e., adjusted management, participatory variety selection, climate risk mapping) and Lao PDR (i.e., awareness raising).

Adjusted Crop, Water, and Pest Management

The work on adjusted management was focused on the CSV in Vietnam. It was aligned with a Vietnamese technology campaign titled "1 Must Do, 5 Reductions." This package of best practice management options, which was rolled out in the Mekong Delta in 2013, has reached at least 100,000 rice farmers cultivating over 119,000 ha (Flor et al. 2021). It entails the compulsory use of certified seeds, combined with reductions in (1) seed rate, (2) fertilizer use, (3) pesticide use, (4) water use, and (5) postharvest losses. This paper highlights the activities on climate-smart water and pest management.

Typical in the Mekong Delta, the CSV in Tra Hat is dominated by irrigated rice production. However, even in this deltaic environment, the supply of irrigation water can be limited in the dry season when the canal system is largely affected by salinity intrusion. Moreover, there is a strong pressure to increase water use efficiency due to competing water uses from other sectors, unreliable rainfall patterns, and, most importantly, changes in the river discharge entering the delta as a result of upstream development (Wassmann et al. 2019b). Hence, optimizing irrigation practices to minimize water input is a logical entry point for CSA. Water-saving techniques, such as alternate wetting and drying (AwD) (Sander, Samson, and Buresh 2014), can reduce water consumption by 20–30 percent. AwD techniques in rice production also translate into mitigation of GHG emissions, which is a CSA pillar, along with adaptation and food security. Continuously flooded rice produces methane, and water-saving technologies can reduce such emission by 30–70 percent (Sander, Wassmann, and Siopongco 2016).

Climate change generally contributes to new and escalating crop pests and diseases. To address this, the Plant Clinic approach was developed, based on a framework model that mimics a human clinic (Sivapragasam et al. 2017). The Centre for Agriculture and Bioscience International (CABI) Malaysia[5] spearheaded the work on climate-smart pest control in CSVs in Southeast Asia. The work focused on the promotion of innovative participatory and climate-adaptive agricultural practices and the use of nonchemical approaches underpinned by an advisory framework (Costa, Thanarajoo, and Sivapragasam 2018). Several training, education, and awareness-raising events were organized, such as plant health rallies on the use of pesticides in the rice ecosystem and survey of farmers to assess their need for advisory support, among others. These training activities led to the identification of champion farmers ("plant doctors")—a key objective—who later would serve as resource and contact persons for the pest-smart activities. Affected farmers could bring diseased crops to the clinic for diagnosis and receive crop and pest management recommendations.

The training topics covered rice and other crops (i.e., fruits and vegetables) and innovative communication resources (e.g., plant health knowledge bank, pest management decision guides, fact sheets) at both field and landscape levels to enhance ecosystem biodiversity. At the landscape level, ecological engineering was introduced to support resilient rice farming, such as the cultivation of nectar-producing flowering plants (Gurr, Wratten, and Altieri 2004). The CSV Tra Hat planted sesame (*Sesamum indicum*) and cosmos flowers (*Cosmos bipinnatus*) on rice bunds to attract and provide refugia for parasitoids and beneficial insects, thereby providing opportunities for biological control of rice pests. The concept was introduced to farmers through field trials, particularly the "no-spray within the first 40 days" demonstrations (Sivapragasam et al. 2017).

Participatory Variety Selection

Despite the steady development of new rice varieties, many rice farmers remain reluctant to switch to these agronomical improved varieties. In part, this reluctance can be attributed to their lack of information on the potential yield increase as a result of using modern varieties (Paris et al. 2011). This problem can be addressed by better extension services. On the other hand, there is a dilemma when introducing a new variety in that variety testing is often done through on-station trials, where conditions are different from those in farmers' fields (Corales et al. 2019). Moreover, the adoption of a new variety also depends on social and cultural dimensions of rice farming, not just the new variety's agronomic traits. Collectively these complex decision-making processes on the part of farmers require a holistic approach to breeding and dissemination programs, one that considers farmers' needs and preferences right from the onset of the variety selection process and not just at the end (Atlin, Cairns, and Das 2017).

While participatory variety selection (PVS) was originally conceived to streamline plant breeding, it has proved to be an effective strategy for accelerating the dissemination of new varieties (Witcombe et al. 1996). Newly bred varieties often show better performance under favorable conditions, but grain yield increase may not always be the ultimate criterion for selection (Paris et al. 2011). While there have been remarkable successes in breeding to cope with abiotic stresses such as salinity intrusion (Islam et al. 2008), these stresses often appear in locally distinct patterns and intensities that are difficult to emulate in on-station trials. Moreover, farmers who are used to traditional varieties often give importance to the eating quality of leftover rice, thus rejecting varieties that lose softness in a short time after cooking (Paris et al. 2001). Thus, as the PVS approach is based on field activities involving the distribution and testing of seed materials, it offers synergy—in terms of training and logistics—when applied in combination with the CBS system.

[5] https://www.cabi.org/what-we-do/cabi-centre/malaysia/

Awareness Raising (Photovoice)

Photovoice is a "qualitative method used in community-based participatory research to document and reflect reality" (WHO 2020). Developed in the 1990s, this approach combines photography with grassroots social action (Wang and Burris 1997). Using photovoice, a wealth of experiences in different sectors (public health, education, agriculture, etc.) have been documented, including reflections of individuals on "the strengths and concerns of their community" (Kuratani and Lai 2011). In addition to gathering information on needs and preferred solutions, the approach also establishes a partnership within the community as well as information exchange with outside stakeholders, ranging from local extension service to policymakers.

When used in the context of a CSV, photovoice can vividly illustrate climate change impacts that are detrimental to the livelihood of farmers and to agricultural productivity. In CSV Phailom, the meaningful photographs taken by farmers heightened the stakeholders' interest in the community as a whole and catalyzed the formation of a core group of farmers who were especially interested in CSV activities. As in other development projects, these local champions have been key to further adoption of newly introduced T&Ps. As such, we expanded the use of photovoice beyond the transfer of generic T&P information by also capturing farmers' perceptions of the actual design and implementation of the CSA interventions.

In particular, photovoice was made an integral part of the CSV project in Phailom, resulting in brochures[6] and a video[7] on the project. The participating farmers were given a crash course on photography. They were provided with cameras to capture images of climate change impacts and livelihood challenges. Selected photos were used to create individual climate change storyboards with synoptic narratives. These storyboards have been presented to the CSV as well as in outside events (e.g., agricultural fairs) where pertinent issues were discussed with other farmers and policymakers.

After several workshops and exhibits were done in CSV Phailom and neighboring villages, the following specific objectives of the photovoice activity were established:

- To identify priority areas for climate-smart interventions
- To strengthen farmers' abilities in directly communicating climate change challenges and livelihood issues to policymakers
- To initiate the replication of the CBS system in CSV Phailom in other villages ("outscaling")
- To facilitate information dissemination of the successful CBS approach to decision-makers at the provincial and national levels, with a view to possible adoption in these levels (upscaling)
- To improve access to seeds in the provincial seed station, particularly of drought-resistant rice varieties, through direct contact with researchers attending the photovoice exhibits

Climate Risk Mapping to Identify Suitable Varieties

While the Green Revolution bred modern rice varieties primarily for enhanced solar energy absorption and fertilizer use efficiency (Barker and Herdt 1985), the 1990s saw the development of varieties that can tolerate adverse environmental conditions (Sombilla and Quilloy 2014). In recent decades, stress tolerance to climate-related stresses (e.g., drought, flooding, and salinity) has been incorporated into high-yielding varieties, capitalizing on advanced biotechnology (Gregorio et al. 2013). The development and dissemination of adapted germplasm have proved to be a very effective approach in addressing climate change impacts (Jagadish et al. 2012).

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6 https://drive.google.com/file/d/1gXjk9ClH4gPALwwgyxkYNF1qH9Qvyrlj/view?usp=sharing
https://drive.google.com/file/d/1ClxUU4Z0psjZsZXfZn7FC58gV9wLQuL6/view?usp=sharing

7 https://drive.google.com/file/d/1ikOtzTyZp2SrTr4D17mluXbMtO9Lans2/view

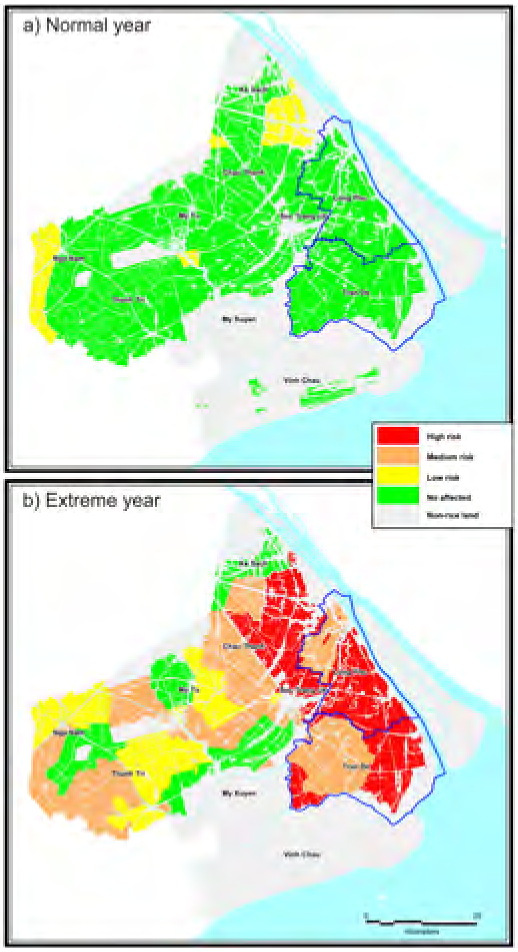
Despite the individual success stories, however, the uptake of these stress-tolerant varieties remains fragmented. Even those provinces in the Mekong Delta with large salinity-affected areas have a low adoption rate; for instance, in Kien Giang Province, less than 5 percent of all varieties planted are classified as salinity tolerant (Bui et al. 2019). Instead, many farmers have adapted to higher salinity intrusion by shifting from double rice cropping system to rice-shrimp system or, in some areas, by completely eliminating the rice crop (Loc et al. 2021).

The El Niño-Southern Oscillation mainly drives the interannual variability in the Mekong Delta, where more than 90 percent of Vietnam's rice export is produced. This causal relation was clearly seen in 2016 when the deficit in rainfall affected the river discharge, which, in turn, led to tide-driven seawater intrusion that reached the inland areas typically protected by the buffering effect of large amounts of water flowing into the sea (Son, Yen, and Sebastian 2018), resulting in yield losses. Subsequently, the Ministry of Agriculture and Rural Development (MARD) of Vietnam through its Department of Crop Production and the CGIAR Research Program on CCAFS in Southeast Asia collaborated to develop and test climate risk maps. Such maps are expected to enable a more targeted preparation and response actions in the face of climate risks (Son, Yen, and Sebastian 2018).

Climate-smart mapping supports decision-making under interannual variability by identifying spatially and temporally explicit risks for agricultural production (Yen et al. 2019). It has a five-step participatory process involving experts from various local and national offices, as follows: (1) identifying the relevant climate-related risks in the target area, (2) delineating the affected areas and risk levels, (3) proposing corresponding adaptive plans, (4) fine tuning and verifying proposed measures, and (5) developing integrated provincial and regional adaptation plans (Son, Yen, and Sebastian 2018).

This methodology has been applied at the village and district levels in major rice-growing regions of the Mekong Delta. In the case of Soc Trang province, the resulting risk maps (Figure 3) show two salinity conditions: normal and extreme. While the eastern part of the province is unaffected by salinity in a normal year, during an extreme year, salinity poses high and medium risks in two of the nine provincial districts. As a first step, farmers in the affected areas were encouraged to modify their cropping calendar. However, a more fundamental adaptation of the entire production system may be needed to ensure stable yields in the future. As Figure 3 shows, the climate risk map allows a clear identification of salinity hot-spots, which can thus be prioritized for seed distribution of resilient varieties. Such decision-making and action will

Figure 3. Maps of salinity intrusion risks in Soc Trang Province, displaying Tran De and Long Phu districts in a normal year (a) and an extreme year (b)



require the combined efforts of the provincial seed center, extension staff, and the community of farmers in the affected districts. While the experiences have so far been limited to rice in the Mekong Delta, the general principles of climate risk mapping should be universally applicable to other production systems and environments.

Direct Market Access

The project also studied the potential of adding value to rice produced by the participating villages. While a local market for rice products with added value exists, it was observed that the farmers lacked entrepreneurial risk-taking capacities and access to financing for investment in value-adding processes. Securing direct market access by selling surplus harvest was seen by stakeholders as a major improvement over the previous situation.

In the course of our work in CSV Phailom, we realized that a better market access for rice would be a major incentive for the farmers to aspire for higher production levels. This raised a new question: Is there a marketing benefit to using the specifics of the CSV to "brand" the locally and sustainably produced food for the environmentally conscious consumers. A quick internet search showed that there are currently no food products available for consumers that are specifically marketed as coming from CSVs—not in Southeast Asia nor anywhere else.

In particular, we considered the option of using a potential market mechanism to maintain and possibly expand the use of CBS materials in a given CSV (i.e., Phailom). As part of the CSV project, the rice variety TDK8, which is drought and flood tolerant, was promoted—using subsidized foundation seed materials given to local CBS producers—as a means to achieve higher harvests.[8] However, because the CSV project was to end soon (December 2021), we instead explored a direct market linkage for this rice product. Hopefully this linkage would lead to a continuous use of the CBS approach beyond the lifetime of the CSV project, and potentially trigger similar approaches in other projects.

Another concern was that the small production scale of the CSV project did not allow the establishment of a stand-alone process of traceability and certification for sustainable rice production. Hence, we opted to look for potential partners domestically and internationally. We contacted a German online retailer of specialty rice,[9] known for its detailed product descriptions and focus on grain quality. The CSV project offered to supply glutinous rice, which is the predominant type produced in Lao PDR; it also commissioned an independent laboratory for chemical analysis of residues and possible contaminants to show compliance with the European Union's import standards on food safety. The German retail company tested rice samples from CSV Phailom for satisfactory taste, high grade flavor, and suitable texture, the results of which showed a promising market niche for this rice product. It considered the product's CSV origin as an interesting aspect for advertising, highlighting it as a special brand of organic rice. Given that this agricultural product is from Lao PDR, it can be classified—almost by default—as organically produced due to the generally low level of fertilizer and pesticide use, compared with other countries.

The CSV farmers group in Lao PDR was poorly linked to milling and shipment facilities, however. The domestic value chain needed to be improved first in order to connect the CSA producers to their identified export market. Eventually, the project was able to team up with a Lao company[10] engaged in seed production, purchase of (unmilled) paddy, milling, and export. The company also provides the know-how, infrastructure, and logistics for quality control and export of rice. Its business model gives specific emphasis on the varieties being traded. Fortunately, the company found TDK8 very suitable from a marketing perspective.

8 https://ricetoday.irri.org/laos-village-eyes-sustainable-rice-production-with-quality-and-resilient-seeds/

9 https://www.reishunger.de

10 https://www.idp-laos.com/

Although the contract between the CSV Phailom's farmers and the Lao company have not been finalized yet as of this writing, this "matching" of a local supplier and an international trader represents an important step to overcoming the problem of small production scale. Both supplier and trader require a minimum amount of traded rice to warrant profitability in a given transaction. The Lao company agreed to provide the CSV farmers with seeds for the ensuing cropping seasons and to purchase their harvest, a contract-farming arrangement similar to what is done in other countries with larger production scale, such as Vietnam (Demont and Rutsaert 2017). For its next step, the CSV project plans to produce a brochure to provide information and illustration for advertising purposes. The information material will highlight the sustainability and health attributes of the rice product, as well as stories of smallholder farmers coping with climate change impacts.

Alternatively, the CSV farmers group can target the domestic market. In this case, the marketing of the product can exploit the "buy local" attitude of domestic consumers in support of local smallholder farmers. Given the rapidly growing middle classes in Southeast Asia's economies, it seems a realistic scenario to expect a pronounced trend toward more sustainable, organic, and "home-grown" food products. As a survey in Vietnam shows (My et al. 2018), domestic consumers were willing to pay a premium of up to 33 percent of the prevailing rice price as long as the claim of sustainable production and healthy quality is backed by credible information on traceability.

On the other hand, the CSA concept is known to a minority of consumers only, in both domestic and international markets. Thus, it would be helpful to have a distinct product standard and verification procedures to facilitate clear messaging on sustainable food production. For example, the 2020 Rainforest Alliance Sustainable Agriculture Standard[11] covers multiple crops such as coffee, tea, cacao, vegetables, spices, and others,[12] but currently still excludes rice products. As an alternative approach to a multi-crop label and in view of the overarching significance of rice consumption, the Sustainable Rice Platform (SRP 2019) has developed a specific label that allows for a clear claim of sustainable cultivation, and this has been taken up by a European supermarket chain.[13]

The SRP Standard includes selecting a suitable rice variety and ensuring seed quality, which the producer has to documented via thorough record keeping. It requires that "certified seeds must comply with applicable national law/regulation or the regulation of the destination market" (SRP 2019) to reach the highest score. As of now, the seed system has no such specific requirements, but this extension of the SRP standard could be seen as a logical step to address sustainability concerns and stricter auditing processes in some destination markets.

The SRP Standard also covers crop management techniques, including high resource use efficiencies and low GHG emissions (e.g., water saving and residue recycling), so that the product marketing could be broadened to all three pillars of CSA, namely, adaptation, mitigation, and productivity. In the future, the coupling of the "generic" sustainability traits with location-specific CBS production under a CSV framework may offer very good entry points in directly communicating with online consumers. This marketing approach may go well beyond rice products and include traditional cooking ware such as bamboo steamers for glutinous rice. In the broader picture, this approach could be considered a pathway for linking sustainable rice production to changing consumer behavior, with the projected "experience economy" in view (Pine and Gilmore 1998).

11 https://www.rainforest-alliance.org/resource-item/2020-sustainable-agriculture-standard-farm-requirements/

12 https://www.rainforest-alliance.org/wp-content/uploads/2020/06/2020-Rainforest-Alliance-Certification-and-Auditing-Rules.pdf

13 https://preferredbynature.org/newsroom/first-1045-farms-now-ready-deliver-srp-verified-sustainable-rice

CONCLUSION

The concept of CSA and its scaling up through CSVs are broad approaches that encompass a range of T&Ps and social interactions. The supply of rice seeds is a very efficient and cost-effective entry point for CSA in the rice-dominated landscapes of Southeast Asia because it can be aligned well with interactions at the community level. In the context of this study, the following are the specific pros and cons of CBS systems:

- CBS systems have a proven track record as a viable component of CSA in rice-based landscapes. This corroborates findings from earlier studies that highlight their importance not only in rice-based landscapes but in other types of landscapes and agroecosystems (Sthapit, Joshi, and Witcombe 1996).
- Due to a large variation in seed quality in Southeast Asia, the impact of CBS systems will be especially pronounced in countries with a weak formal seed system.
- Poor seed quality is typically found in rice-growing environments that lack irrigation and other resource inputs. In turn, there is a very limited scope to optimize resource use efficiencies, which are key for CSA in high-input rice systems. As such, seed systems remain, almost by default, the best bet for CSA interventions.
- The establishment of CBS systems does not require high investments or fundamental changes in farmers' cropping practices. For CSA development projects, the interventions offer a good cost-benefit ratio and a high probability of success. The necessary technical knowledge can be provided by a wide range of easily accessible training materials.
- The development of CBS systems is well aligned with the priorities of the national research and extension services as these complement the formal seed systems and improve the predominant informal systems. At the local level, extension services can provide valuable support in building the capacity of the farming communities.
- Once a new seed bank for rice has been established in the community, it could easily store seeds of other crops, in support of goals to diversify the local cropping systems and thus have a wider range of CSA options.
- The critical point for a newly established seed bank is the continuity of its operation by the community beyond the life cycle of the development project. As for the other community-based interventions, having local champions is critical in ensuring the interventions' long-term functionality.

It must be noted that the full potential of CBS systems can only be exploited in conjunction with supporting measures such as improved crop management and climate risk mapping. While current literature talks of CBS systems as a stand-alone approach, this paper presents it as the pivot of a package of measures to achieve more resilient rice production systems. We have addressed several options that accomplish incremental improvements as stand-alone CSA approaches, but the experience of our project shows that advancement in rice farming resilience relies on the synergy of these approaches with CBS systems.

The main lesson from the awareness-raising component is that photovoice is a promising and versatile visual tool to capture community-level narratives on climate change impacts. To have tangible outputs, the use of photovoice should integrate small-grant funding for farmers to enable immediate actions. It must also involve government actors to ensure wider awareness of the existing problems and perceived solutions.

As for the direct marketing approach, the question remains: Can the presented model be extended to other CSVs? Our answer is that the adoption of this approach is feasible but should be assessed beyond the specific settings of the case in our study. Obviously, the market niche of food produced in a CSV (here, glutinous rice from southern Lao PDR) is rather small, so that a one-to-one replication of this case seems not very promising. Instead, our major takeaway from this example is the scoping of specific traits of the food produced in a given CSV and the identification of possible marketing avenues. The emerging online retail economy offers potential viable avenues.

The key for any CSA intervention is to optimize the complementary nature of different T&Ps within a site-specific context. To this end, the establishment of a community-operated seed bank has an inherently site-specific dimension, which ideally fits the CSV approach, as illustrated in this paper. Though limited in spatial scope, each CBS system could serve as a local incubator in support of the sustainable development goal on "climate action" and aligned with the goals on "life on land", "zero hunger," and "gender equality."

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ANNEXES

Annex Table 1. References of the entire set of all CSV case studies in Southeast Asia

https://www.cgiar.org/annual-report/performance-report-2019/climate-smart-villages-in-southeast-asia/
https://www.naro.go.jp/english/laboratory/niaes/files/fftc-marco_book2019_201.pdf
https://cgspace.cgiar.org/bitstream/handle/10568/83284/SEACSVInventory.pdf
https://cgspace.cgiar.org/bitstream/handle/10568/100123/CCAFS%20WP%20257_CSV%20Roving%20Workshop.pdf
https://cgspace.cgiar.org/bitstream/handle/10568/99100/CCAFS%20WP%20248_%20Analyzing%20Farm%20Household.pdf
https://www.searca.org/pubs/proceeding-workshop-reports?pid=462

Annex Table 2. References of individual CSV case studies in Southeast Asia

Acronym	Location	Linked reference
Cambodia		
C1	Rohal Suong, Battambang Province	https://ccafs.cgiar.org/news/cambodia-climate-smart-village-enhances-livelihoods-better-water-management
C2	Mondul Kiri Province	https://cgspace.cgiar.org/bitstream/handle/10568/111541/ADB_BCC%20policy%20brief%203_ecosystems%20based%20adaptation.pdf
C3	Koh Kong Province	
Lao PDR		
L1	Phongsaly Province	https://cgspace.cgiar.org/handle/10568/111542
L2	Ekxang, Vientiane Province	https://www.iwmi.cgiar.org/2019/01/community-managed-groundwater-irrigation-on-the-vientiane-plain-of-lao-pdr-planning-implementation-and-findings-from-a-pilot-trial/ https://cgspace.cgiar.org/handle/10568/72438 https://ccafs.cgiar.org/resources/publications/summary-baseline-household-survey-results-phonghong-district-vientiane

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Annex Table 2 continued

Acronym	Location	Linked reference
L3	Phailom, Savannakhet Province	https://cgspace.cgiar.org/bitstream/handle/10568/80497/OBS_Pailom.pdf https://cgspace.cgiar.org/bitstream/handle/10568/80495/VBS_Pailom%20report.pdf https://cgspace.cgiar.org/bitstream/handle/10568/76329/05%20SANA%20Pailom%2010Apr16.pdf https://ricetoday.irri.org/laos-village-eyes-sustainable-rice-production-with-quality-and-resilient-seeds/
Myanmar		
M1	Makyauk Aia, Chin State	https://ccafs.cgiar.org/news/climate-smart-villages-launch-myanmar https://iirr.org/iirr-stories/advancing-rural-development-and-resilient-building-in-myanmar/ https://ccafs.cgiar.org/news/climate-smart-and-nutrition-smart-villages-key-food-secure-myanmar
M2	Kyaut Ngat, Shan State	
M3	Htee Pu, Mandalay Region	
M4	Ma Sein, Ayeyarwady Region	
Philippines		
P1	Guinayangan, Quezon	https://www.clim-adapt.com/post/guinayangan-a-pilot-climate-smart-village-in-central-philippines https://iirr.org/iirr-stories/climate-smart-agriculture-and-covid-19/ https://www.worldagroforestry.org/news/new-climate-smart-village-philippines https://cgspace.cgiar.org/handle/10568/114770 https://cgspace.cgiar.org/bitstream/handle/10568/108081/Native%20pig%20primer.pdf
Vietnam		
V1	Ma, Yen Bai	https://ciat.cgiar.org/ma-village-in-northern-vietnam-a-living-lab-to-test-climate-smart-agriculture/ https://cgspace.cgiar.org/bitstream/handle/10568/114949/Info%20Note_CSV-NTM_final.pdf https://cgspace.cgiar.org/bitstream/handle/10568/90628/CCAFS%20WP%20222%20Biophysical%20Assesment.pdf https://cgspace.cgiar.org/bitstream/handle/10568/72437/Ma%20Village_SANA.pdf https://cgspace.cgiar.org/bitstream/handle/10568/79890/VBS_Ma%20report.pdf https://cgspace.cgiar.org/bitstream/handle/10568/80493/OBS_Ma.pdf
V2	My Loi, Ha Tinh	https://worldagroforestry.org/climate-smart-agriculture-ha-tinh-province-viet-nam https://ccafs.cgiar.org/news/how-vietnamese-farmers-increase-their-profits-cultivating-peanuts http://blog.worldagroforestry.org/index.php/2018/05/22/sharing-knowledge-loi-climate-smart-village-viet-nam/

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Annex Table 2 continued

Acronym	Location	Linked reference
V3	Tra Hat, Bac Lieu	https://cgspace.cgiar.org/bitstream/handle/10568/80485/OBS_TraHat%20FINAL.pdf https://cgspace.cgiar.org/bitstream/handle/10568/103814/CCAFS%20WP%20280_CSA%20KI.pdf https://cgspace.cgiar.org/bitstream/handle/10568/103815/CCAFS%20WP%20281_CSA%20Prioritization.pdf https://cgspace.cgiar.org/bitstream/handle/10568/80485/OBS_TraHat%20FINAL.pdf https://cgspace.cgiar.org/bitstream/handle/10568/80490/VBS_Tra%20Hat%20report.pdf https://cgspace.cgiar.org/bitstream/handle/10568/78577/Vietnam%20TraHat%20%20HHBS%20report%20FINAL.pdf