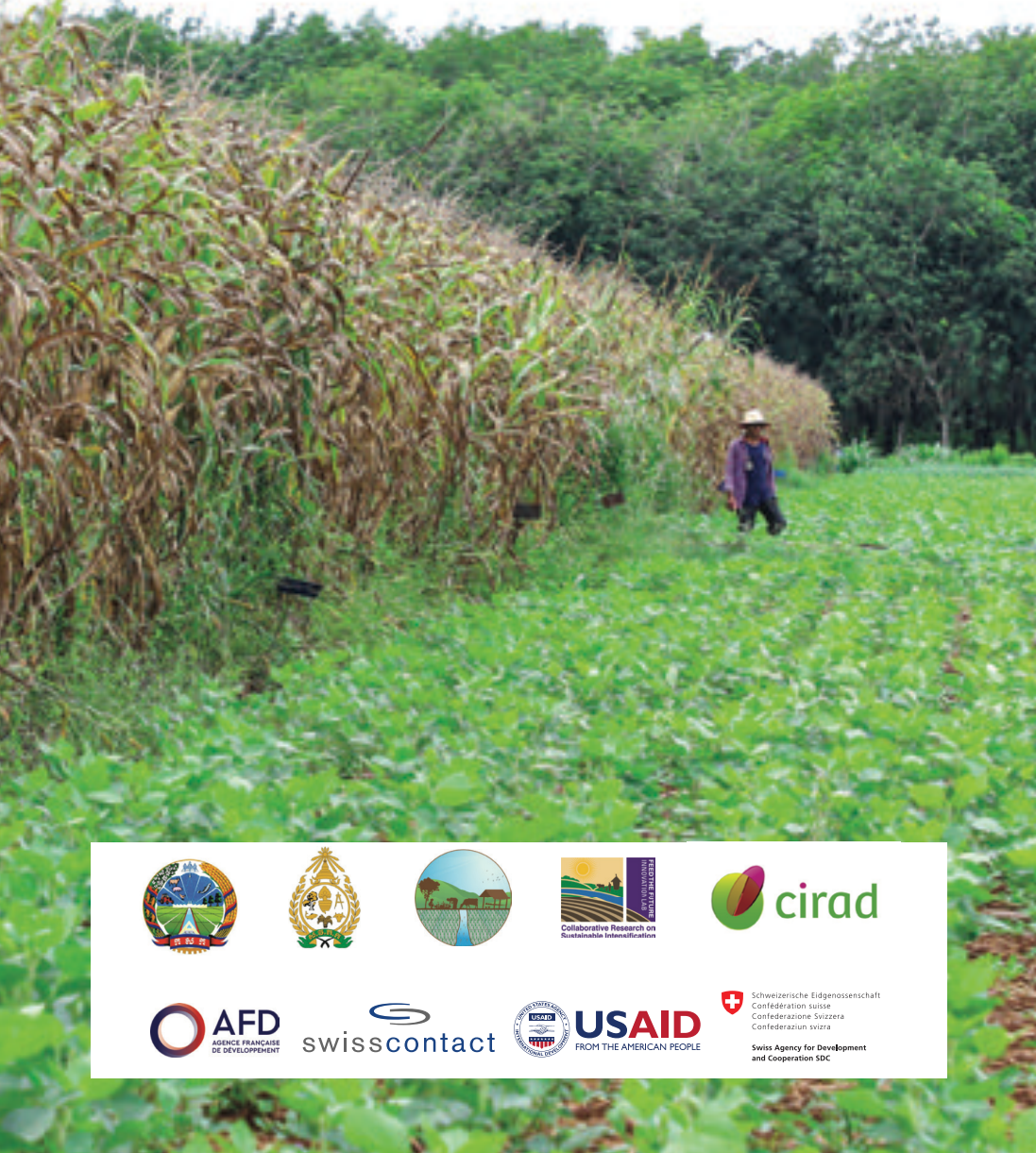
About CA/SI in Cambodia



Cambodia Conservation Agriculture and Sustainable Intensification Consortium

Collaborative Research on Sustainable Intensification

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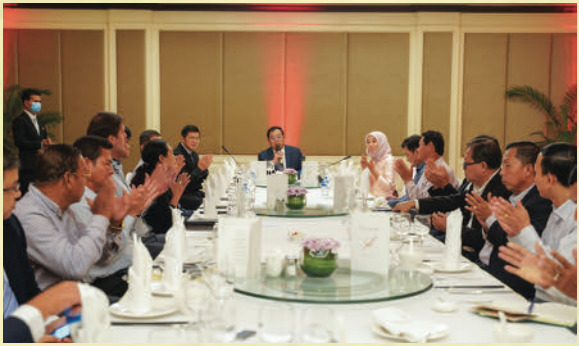
History of CA/SI in Cambodia

The Overall of Cambodia's Agricultural Practices

The design of CA and SI farming systems has evolved in line with the rapid transformation of agricultural systems that occurred in Cambodia and notably in the Uplands. Within the past two decades, agricultural land has expanded at the detriment of the forest and fallows (Kong et al., 2019)1. Farmers have rapidly shifted from extensive cropping systems based on shifting cultivation and long fallow periods to more intensive and permanent mono-cropping systems. Soil fertility decreased due to organic matter mineralization and erosion, which adversely affects the technical performances of agricultural production systems. Rice is the cornerstone of farming systems in the region and maize and cassava cultivation have boomed over the past two decades in the uplands explaining why these three crops have been and are still at the center of CA systems design.

Since 2004, CA-based cropping systems have been designed and tested in different agroecosystems of Cambodia. Back in 2004, the Ministry of Agriculture, Forestry and Fisheries (MAFF) partnered with the French Agricultural Research Centre for International Development (CIRAD) to form the Crop Diversification and Small-scale Rubber Plantation project funded by the French Agency for Development (AFD). In 2008, the PADAC (Projet d'Amélioration de l'Agriculture Cambodgienne, AFD) was launched with as main targeted areas Kampong Cham and Battambang provinces. Activities were also initiated in the pioneer front of Battambang from 2010 to 2014 under the Sustainable Agriculture and Natural Resources Management CRSP (USAID), and through a partnership between the General Directorate of Agriculture (GDA), Department of Agricultural Land Resources Management (DALRM), CIRAD and North Carolina A&T State University.



CASIC's Steering Comittee Meeting

From 2014 onwards, PADAC was converted to the Conservation Agriculture Service Center (CASC) and integrated as a unit of DALRM/GDA. GDA provided DALRM/CASC with 14.5 ha of land in Bos Khnor (Kampong Cham, Chamcarleu) for research, training, and seed preservation purposes.
In 2016, the Feed the Future Innovation Lab for Collaborative Research on Sustainable Intensification (Appropriate-Scale Mechanization Consortium, Women in Agriculture Network and the Center of Excellence on Sustainable Agricultural Intensification and Nutrition - CE SAIN, USAID) was launched extending Sustainable Intensification and CA activities in different agroecosystems of Cambodia. CE SAIN also established a network of Technology Parks with Bos Khnor among them, to further promote these activities.

CASIC's Technology Park in Bos Khnor

ACTAE (Towards Agroecological Transition in South-East Asia, 2015 – 2018, AFD) and Ecological Intensification and Soil Ecosystem Functioning (EISOFUN, UNCCD/CCCA) are other projects contributing to CA and agroecology promotion.

In April 2018 and then in May 2019, The Centre for Sustainable Agricultural Mechanization (CSAM), a regional institution of the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP), was instrumental in organizing jointly with GDA and other partners one Regional Workshop on the Role of Mechanization in Strengthening Smallholders' Resilience through Conservation Agriculture in Asia and the Pacific, and a Regional Training on Appropriate Scale Mechanisation for Conservation Agriculture was held on May 6-9, 2019 (Siem Reap and Bos Khnor) that brought together 17 countries from the Asia and Pacific region. The latter training was also the first step contributing to the identification of needs for future training to be offered by GDA, CE SAIN along with the Bos Khnor CA Research Station.

In Battambang, since 2014, CASC has been providing CA-related services for rice, maize, cassava and fruit trees. However, the agricultural implements and other costs associated with the provision of the services were still funded through projects. For a sustainable change to occur in farming systems, these cropping systems and practices have to be adopted by the private sector as they play a crucial role in providing technologies, operational know-how and information needed for different value-chains. Thus, there was a need to engage with the private sector and specifically the local service providers to transition from intensive plough-based cultivation to CA-based management both in the uplands and lowlands of Battambang. The Conservation Agriculture Services with a Fee (CASF, USAID) and Mekong Inclusive Growth and Innovation Program (MIGIP, SDC) contribute to this goal enhancing an engagement of the private sector. Swisscontact runs MIGIP and focusses on engaging the private sector in technologies. CE SAIN runs CASF, in partnership with DAEng, DALRM/CASC/CIRAD and Swisscontact and funds the activities of the different partners. These two projects have helped to initiate the commercialization of CA machinery and seeds of cover crops based on the foundations laid earlier.

Progress on CA and SI in Cambodia

CA systems have been shown to improve land and labor productivity when appropriate mechanization is available (Boulakia et al., 2019; Kong et al., 2016)2 . CA systems have also been shown to have a positive impact on soil biological functioning (Hok et al., 2018; Pheap et al., 2019)3 , soil organic carbon accumulation (Hok et al., 2015; Le et al., 2018)4 , water infiltration rate and nutrient cycling (Pheap et al., 2019) 5. In a recent study in Battambang Province (northwest Cambodia), Vernet et al. (2020) assessed the opportunity and profitability for service providers to invest in no-till planters and offer no-till services for rice, maize and cassava planting.

Whereas land degradation is widely acknowledged as an important issue in Cambodia, the dissemination of soil conservation technologies and approaches including conservation agriculture is still low. There are no aggregated data related to CA and SI adoption in Cambodia, but based on available project data, it is estimated that about 2,000 smallholder farmers (about 2,000 ha) are engaged in minimum tillage with crop residue management, amongst which less than 500 households are using cover crops in diversified cropping systems.

Five main technical changes can be observed in CA systems past recent development:

- Reducing tillage and covering the soil was the prevailing entry point at the early stage of the implementation (2004) to stop soil erosion and combat plough-induced land degradation. No-tillage and agricultural systems diversification using staple, cash crops and cover crops were jointly promoted from the start (Boulakia et al., 2010; Kong et al., 2016)6 .

  In line with the rising concerns related to herbicide mis-use and over-use in the region, the mechanical control of cover crops has rapidly emerged as a high-ranking priority in CA systems development. Stylosanthes guianensis, a perennial legume forage used in many intercropping systems, was successfully controlled simply using rollers with cutting knives and discs (Boulakia et al., 2013)7 .

- CA vegetable production along with drip irrigation has been implemented since 2009 within the joint SANREM CRSP and Horticulture Innovation Labs funded project (Edralin et al., 2017)8 and later on by the Sustainable Intensification Innovation Lab (RUA/CE SAIN, Kansas State University).

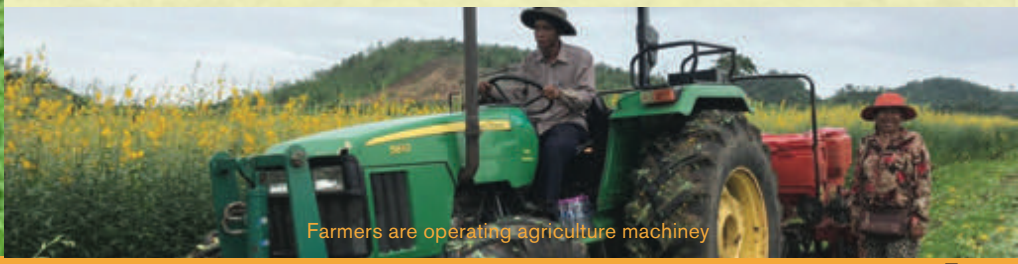
- More recently, research on CA has been focusing on identifying the best cover crops mixtures according to ecologies, agricultural systems, and expected ecosystem services, assuming that these mixtures support increased productivity and stability as compared to a single cover crop. Pearl millet, sorghum, Crotalaria juncea, Crotalaria ochroleuca, cowpea and Stylosanthes guianensis are the main cover crops used at the moment in CA systems for their agronomic and ecological performances, but also for their capacity to be locally multiplied.

- The sowing in green standing vegetation is currently experienced to increase the flexibility of agricultural operations, reduce production costs, and improve water, nutrients, and weed control management as compared to the sowing in a dead mulch. Green sowing is also a pathway towards organic CA cropping systems in which cover crops are terminated mechanically using roller crimpers with cutting discs or elliptical bars.

Dual Crops, one of Conservative Agriculture Universal Practice

Apart from technical innovations in CA systems development, major changes in the actors involved in the innovation process and in out-scaling strategies can also be noticed:

- Favoring farmers access to CA-specific agricultural equipment and/or services. In a context of increasing labor scarcity in agriculture, CA systems must conciliate labor productivity improvement without introducing bottlenecks in working calendar (Chan et al., 2018)9 . Since the early 2000's, a large range of CA-specific agricultural equipment have been introduced, tested and adapted to local conditions (ASMC, 2019)10 . At the beginning, governmental extension agencies were targeted in out-scaling strategies to manage agricultural equipment supply and provide CA services to farmers. More recently, a specific attention has been given in to agricultural cooperatives and local service providers to increase no-till planting services to farmers (Chan et al., 2018; Vernet et al., 2020). Since 2018, Swisscontact supports local importers and manufacturers in getting access to CA agricultural equipment through the Mekong Inclusive Growth and Innovation Program (MIGIP, SDC) and the Conservation Agriculture Service with a Fee (CASF) project (USAID). These projects promote a demand-creation process by pooling together manufacturers, local workshops, service providers (individuals and agricultural cooperatives), and farmer communities in order to match supply and demand, and create new economic opportunities. Four main implements are currently being promoted i.e.: land plane leveler for both lowlands and uplands, no-till planters (maize, soybean, cassava), seed broadcasters (rice, fodder species), and roller crimpers.
- Favoring farmers access to diversified and open-pollinated cover crop material: CA systems performance is highly depending on the quantity and diversity of the biomass produced and restituted to the soil. A large genetic bank of cover crops (> 45 species and > 200 cultivars) is managed by GDA/DALRM (Bos Khnor CA research station) with the main objectives to ensure high quality of the genetic materials and to share this biodiversity with farmer communities and private sector (Chett et al., 2018)11 . The low availability of cover crop seeds, and the lack of value chains for cover crops are regularly emphasized as the main bottlenecks for the dissemination of CA systems (Kong et al., 2016; Oung et al., 2018)12 . Swisscontact supports local enterprises and farmers to produce cover crops seeds for the national market (MIGIP and CASF projects).
- Investing in social capital and collective learning to enhance adaptation and adoption. Learning processes need to be location specific, multi-stakeholder and iterative. The objective is to empower, to 'develop the capacity' of local stakeholders, and notably of key farmers, service providers, retailers that are instrumental in the design of CA systems, in their promotion and practical implementation.
- Policy dialogue. CA and SI in Cambodia still corresponds at the present to a sum of isolated initiatives. This is the objective of CASIC to enhance synergies and coordination across sectors and among a diversity of stakeholders (governmental and non-governmental institutions, universities and research institutions, representatives from farmers and the private sector).



Farmers are operating agriculture machiney

Challenges of CA/SI adaptation,adoption, and perspectives in Cambodia

A range of challenges are emphasized hereafter and only collective efforts to raise awareness of policy makers, development partners, land planners and agronomists along with the integration of CA&SI on the political and educational agenda will bring these innovations to scale.

Limited access yet to key inputs: cover crop seeds, mechanization, and bio-products

There is a need to facilitate access to key agricultural inputs that are needed for a broad-scale dissemination of CA and SI in Cambodia.

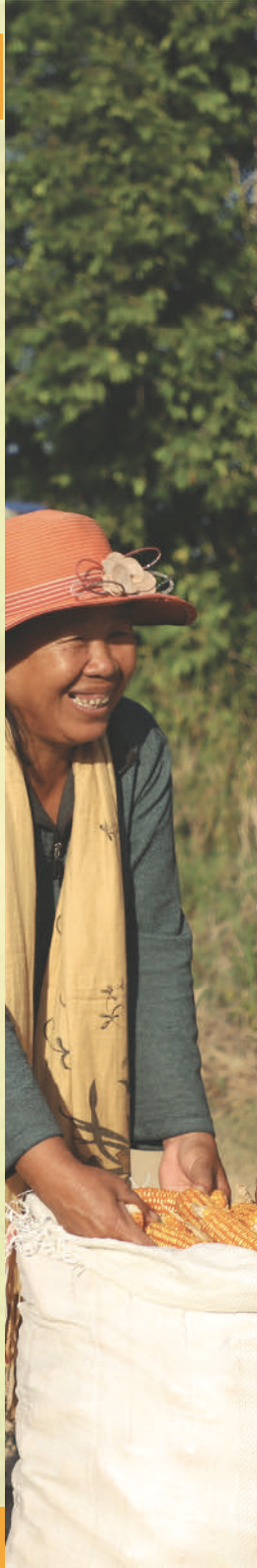
- Favouring farmers access to appropriate CA mechanization and services. MIGIP and CASF projects results are promising but need to be reinforced. Business models supporting farmers increased access to CA-specific agricultural equipment and equipment maintenance facilities have still to be explored through the involvement of local agricultural workshops (Vernet et al., 2020).
- Favoring farmers access to diversified and open-pollinated cover crop material.
- Bio-product development and biological control. The high (and increasing) use of pesticides in agricultural systems is a common and crucial issue throughout the region. If CA systems promote a decrease in pesticide use mainly through the re-design of cropping systems and landscapes, the substitution of conventional pesticides by bio-products (e.g. elicitors, bio-pesticide, bio-repellent) is still highly needed towards healthier food and landscape systems. Policies and regulations allowing the testing and homologation of bio-products are needed.

Negotiating trade-offs between the different biomass users

Communal grazing and fire after crops harvest are widespread traditional territory management rules in Cambodia and specifically around the Tonle Sap Lake (Oung et al., 2018). Trade-off on biomass use must be negotiated at village community level, using territorial approaches and participatory land use planning (Castella et al., 2018)13.

Sustaining long-term experiments and networks of on-farm demonstrations

Long-term experiments and networks of on-farm demonstrations are instrumental to CA-systems development and knowledge production. The long-term experimental sites of Bos Khnor (Leng et al., 2018)14 are essentials to: (i) design and assess CA systems (technical requirements, performances and ecological balance shifts), (ii) assess biological processes that sustain and enhance CA systems, (iii) maintain genetic banks of staple, cash and cover crops and to ensure the connection with rural communities and seed suppliers, (iv) provide training and build capacities of smallholder farmers and development operators (youth, women and men) on innovative cropping systems management, appropriate-scale mechanization, use of a large diversity of plant species and bio-products, and (v) provide science-based evidence to land-managers, policy-makers and donors on medium to long-term benefits of CA systems. Although essential, the long-term sustainability of these CA R&D platforms remains uncertain.



Exploring financial mechanisms to support farmers investments in soil fertility restoration through e.g. CA.

Different mechanisms exist and should be explored including: (i) Carbon funding or carbon credit (REDD+) mechanisms; (ii) payment for environmental services (PES) mechanisms with the establishment of funds managed by the private sector or tax incentives (bonus / malus system applied to the exports of specific agricultural products); (iii) micro-finance which also seeks to invest in sustainable intensification.

Capacity building and awareness raising

Regular field days, continuous awareness raising events across sectors and trainings should be sustained in the long term, designed, and adapted to a diversity of audience. RUA/CE SAIN and UBB invest into building capacity of young agronomists and researchers. In addition, the network of Agricultural Technology Parks implemented by CE SAIN is one of the main support to offer training to smallholder farmers, women and youth, and development operators. The experimental station of Bos Khnor is also a fundamental support for training and capacity building at the national and regional level. GDA ambitions to develop Bos Khnor as a regional training center that also encompass the longest experiments under CA in the region.

Extension approaches

Two main strategies are complementary targeting: (i) CA social networks development at local level, and (ii) CA extension services delivery by state agencies (MAFF/GDA, PDAFF and district agricultural office), universities (Agricultural Technology Parks) along with the private sector. Swisscontact and CE SAIN, with various partners, will pilot the Metkasekor model in which the pluralistic extension service is institutionalized by the private sector.

Gender and Youth

Women play a key role in household decision-making regarding innovation adoption, especially while related to household disbursement for inputs, new technologies, or services (Sumner et al., 2017)15 . Tailored communication and training strategies are needed to engage women into CA innovation process (Jones et al., 2019)16 .

Political willingness, common vision and theory of change

As mentioned previously, CA&SI in Cambodia still corresponds at the moment to a sum of isolated initiatives whose impact is yet difficult to measure. To engage into a real dissemination, it is necessary to reaffirm political willingness to engage into CA&SI promotion, and engage the different stakeholders into the definition of a common vision and collectively agreed strategy at multiple levels (local, provincial and national).

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