

Kingdom of Cambodia
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Ministry of Agriculture, Forestry and Fisheries
General Directorate of Agriculture



**Strategic Development Plan of
Cambodian Conservation Agriculture Research for Development
Center (CARDEC) 2022-2026**

Developed by:
Department of Agricultural Land Resources Management

Phnom Penh, December 9, 2021

In partnership with and with the support of:



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**Strategic Development Plan of
Cambodian Conservation Agriculture Research for Development
Center (CARDEC) 2022-2026**

Foreword


Agriculture is one of the priority sectors of the Royal Government of Cambodia (RGC) and significantly helps drive the country's economic growth, ensure food security, promote rural economic development, and enhance people's livelihoods. The General Directorate of Agriculture (GDA) of the Ministry of Agriculture, Forestry and Fisheries (MAFF) has been implementing key policy measures of the RGC and the Agricultural Sector Development Plan 2019-2023, focusing on agricultural modernization, increasing agricultural productivity, agricultural diversification, and agri-trading. In addition, MAFF focuses on developing sustainable agriculture through research, development, and extension of innovative and climate-smart agricultural technologies, as well as the preservation of the quality of agricultural land to respond to the impacts of climate change.

The results of research on conservation agriculture (CA) since 2004 confirm the potential of Cambodia to promote an agroecological transition and sustainable intensification (SI), both of which have been widely recognized in the Southeast Asian region as a modern agricultural approach that responds to the need to preserve biodiversity and adapt to climate change. The **Strategic Development Plan of Cambodian Conservation Agriculture Research for Development Center (CARDEC) 2022-2026**, thus incorporates strategic objectives and priority actions that promote the wider adoption of CA, SI and Agroecology in Cambodia to help achieve the policies and strategies of the RGC and global development framework.

GDA greatly appreciates the initiative and effort invested by the Department of Agricultural Land Resources Management (DALRM) in developing such an important document with comments and inputs from the management and technical units of GDA, and with the financial support of Swisscontact and CIRAD. GDA strongly believes that this Strategic Development Plan should be used as a roadmap to incentivize and support the promotion of innovative agricultural development through conservation agriculture, SI and agroecology in Cambodia and in the region.



Phnom Penh, December 9, 2021


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Phnom Penh, December 9, 2021



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Acronyms

AFD	French Agency for Development
ALiSEA	Agroecology Learning alliance in Southeast Asia
AMAC	Agribusiness Machinery Association in Cambodia
ASEA	Agroecology for Southeast Asia (formerly known as CANSEA)
ASMC	Appropriate Scale Mechanization Consortium
ASSET	Agroecology and Safe food System Transitions Project
CA	Conservation Agriculture
CARDI	Cambodian Agricultural Research and Development Institute
CASC	Conservation Agriculture Service Center (DALRM/GDA/MAFF)
CASIC	Cambodia Conservation Agriculture and Sustainable Intensification Consortium
CE SAIN	Center of Excellence on Sustainable Agricultural Intensification and Nutrition
CIRAD	French Agricultural Research Centre for International Development
CMA	Cambodia Microfinance Association
CSAM	Centre for Sustainable Agricultural Mechanization (UN ESCAP)
CSDGs	Cambodia Sustainable Development Goals
DALRM	Department of Agricultural Land Resources Management (GDA/MAFF)
GDA	General Directorate of Agriculture (MAFF)
GRA	Global Research Alliance
ITC	Institute of Technology of Cambodia
KSU	Kansas State University
MAFF	Ministry of Agriculture, Forestry and Fisheries
MIGIP	Mekong Inclusive Growth and Innovation Program
NAP	National Action Program to Combat Land Degradation
NBSAP	National Biodiversity Strategy and Action Plan
NDC	Cambodia's Updated Nationally Determined Contribution
NUBB	National University of Battambang
PADAC	<i>Projet d'Amélioration de l'Agriculture Cambodgienne (Project)</i>
R4D	Research for Development
RGC	Royal Government of Cambodia
RUA	Royal University of Agriculture
SDC	Swiss Agency for Development and Cooperation
SI	Sustainable Intensification
SIIL	Sustainable Intensification Innovation Laboratory
SWOT	Strengths, Weaknesses, Opportunities, and Threats
UNCBD	United Nations Convention on Biological Diversity
UNCCD	United Nations Convention to Combat Desertification
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development
WAgN	Women in Agriculture Network (Project)
WAT4CAM	Water Resources Management and Agro-ecological Transition for Cambodia

1. Introduction

The commitment of the RGC to the development of the agricultural sector and environmental sustainability is clearly reflected in Rectangular Strategy IV through the focus on employment and support for agriculture as part of the core of the strategy with four angles, (1) promotion of agriculture and rural development, (2) sustainable management of natural and cultural resources, (3) urbanization management, and (4) environmental sustainability and preparedness to respond to climate change. In line with these priorities, the National Strategic Development Plan 2019-2023 also outlines the strategic objective of promoting and strengthening the agricultural sector by creating employment, ensuring food security, eliminating poverty, and supporting rural development by enhancing productivity, quality, and diversification. It is therefore crucial to invest in research and development of crop seeds, promote appropriate technical agricultural extension, improve the quality of agriculture inputs, and promote the use of smart and digital technology.

2. Policy Framework for Sustainable Agricultural Development

In line with the strategies and policies of the RGC, the Ministry of Agriculture, Forestry and Fisheries (MAFF) laid out its overall strategic objective to “promote the growth of the agricultural sector through competitiveness, quality, and nutrition, as well as the effective management of forestry land resources and sustainable fisheries”. In this strategy, the General Directorate of Agriculture (GDA) is the key agency of MAFF in promoting agricultural productivity and diversification by increasing agricultural research and extension services, enhancing the quality and safety of agricultural produce, providing capacity building for agriculture cooperatives, and increasing the effectiveness and sustainability of agricultural land management. In addition, a number of important policy frameworks relevant to agriculture and other sectors (discussed below) underline the willingness and commitment of the RGC to contribute to the sustainable development of the agricultural sector:

- The **Cambodian Sustainable Development Goals (CSDGs) Framework 2016-2030** encompasses goals related to food security, nutrition, and sustainable agricultural development that increases productivity and production, helps maintain ecosystems and the capacity for adaptation to climate change, and progressively improves soil quality (Goal 2); and the sustainable use of terrestrial ecosystems including forestry management, combatting land degradation, and halting biodiversity loss (Goal 15).
- The **Agricultural Sector Strategic Development Plan 2019-2023** outlines as strategic objectives the promotion of agricultural modernization, competitiveness, quality, safety, nutrition, as well as the effective and sustainable management of land, forestry, and fishery resources. Climate resilience and sustainability are among the core principles addressing adaptation to, and mitigation of the impacts of, climate change and issues related to agricultural land resources.
- The **National Action Program (NAP) to Combat Land Degradation 2018-2027** is coordinated by a permanent secretariat under the leadership of MAFF. The aim of NAP is to help solve and/or prevent land degradation problems under the obligation stated in the United Nations Convention to Combat Desertification (UNCCD), to conserve and protect agroecology. One of the four strategic objectives of NAP focus on the effective and sustainable management of agricultural land.
- The **National Policy on Green Growth** (developed in 2013) emphasizes the well-being and livelihoods of people in harmony with ecological safety through green growth. In parallel, the **National Strategic Plan on Green Growth 2013-2030** outlines the principles of green growth,

including the effective sustainable management of natural resources, more specifically through “green agriculture” to reduce the use of chemical inputs, “agriculture conservation” to improve land quality and reduce soil erosion, and “ecological agriculture” to increase yield while reducing adverse impacts on the environment.

- The **Cambodia Climate Change Strategic Plan 2014-2023** is a national plan to respond to climate change by supporting sustainable development, with the aim of shifting Cambodia onto a green development path by promoting low-carbon development and technologies. A number of relevant objectives include promotion of climate resilience by improving agricultural production systems, reducing vulnerability to climate change, promoting payment for ecosystem services, and analyzing low emission options and sources of emission.
- The **Climate Change Priorities Action Plan for Agriculture, Forestry and Fisheries Sector 2016-2020** highlights a number of relevant actions, including up-scaling sustainable farming systems, promoting appropriate climate-smart technologies to increase productivity and adaptation to climate change and mitigation of the impacts of climate change, developing knowledge and information systems on climate change, and using integrated socio-economic and climate scenarios with climate and land use models and establishing Carbon Accounting Systems for agriculture, forestry and fisheries.
- The **National Biodiversity Strategy and Action Plan (NBSAP)** was developed in 2002 and updated in February 2016 by the National Council for Sustainable Development (NCSD) and the Ministry of Environment (MoE), which coordinates the implementation of effective and sustainable management of biodiversity under the United Nations Convention on Biological Diversity (UNCBD). Under the theme of sustainable agriculture and animal production, the plan identified the need to promote public awareness of the value and importance of goods/services provided by agricultural biodiversity, as well as support for research to identify the most appropriate farming systems for the different ecosystems by addressing water management, the use of inputs, land protection, seed production, integrated farming systems, etc.
- **Cambodia’s Nationally Determined Contribution (NDC)**, updated in 2020 from its initial NDC in 2015, confirms the RGC’s commitment to combatting climate change and accelerating the transition to a climate-resilient, low-carbon sustainable mode of development under the principles of the United Nations Framework Convention on Climate Change (UNFCCC). According to Cambodia’s first Biennial Update Report (BUR) submitted in August 2020, agriculture is the second largest emitter sector (after Forest and Other Land Use – FOLU) in Cambodia, and “the main driver of the increase in GHG emissions is the development of rice cultivation, whose activity level and emissions increased by a rate of ~2.5 in the period 1994-2016”. The Updated NDC sets out the climate change mitigation targets in agriculture– an estimated reduction in emissions by 6.2 million tCO₂e per year or 23% by 2030 (under the NDC scenario)¹. Some relevant mitigation measures are closely linked to NAP to Combat Land Degradation, including “conservation agriculture” (which refers to effective and sustainable agriculture land management), and organic input agriculture and bio-slurry and deep placement fertilizer technology; as well as the promotion of fodder production to support cattle production. Parallel adaptation measures include actions linked to the agroecological transition in the uplands of Battambang, improvement of support services and capacity building for crop production resilient to climate change, and building climate change resilience

¹ The estimated reduction in emissions (with FOLU) by 2030 under the NDC scenario will be approximately 64.6 million tCO₂e per year (41.7% reduction of which 59.1% is from the FOLU) (source: Updated NDC, 2020).

into cassava production and processing, etc., with reference to key words including conservation agriculture, climate smart agriculture, integrated pest management (IPM), good agricultural practices (GAP), organic farming, sustainable rice platform (SRP), system of rice intensification (SRI), etc.

3. Situation Analysis of Conservation Agriculture Development in Cambodia

Based on the key policy frameworks presented above, sustainable agricultural development is essential to ensure food security, food safety and farmers' livelihoods by strengthening soil quality, climate-responsive conservation and the production of crop seed, and the protection of agricultural biodiversity. In line with this goal and the principles at the level of the Southeast Asian region, the agroecological production system includes a number of innovative options (conservation agriculture, agro-forestry, crop-livestock integration, organic farming, sustainable rice intensification (SRI), home gardens, etc.) to enable an increase in agricultural production in the long term, to reduce the transformation of forests into agricultural land, the use of chemical fertilizers and pesticides, and the emission of GHG due to agricultural activities, while simultaneously increasing carbon sequestration. More specifically, agroecology enhances farmers' capacity for agricultural modernization, for the improvement and strengthening of agricultural biodiversity, as well as resilience to climate change.

Conservation agriculture (CA) is one of the agroecological practices that aims to improve and sustain agricultural productivity, profits, and food security while simultaneously preserving and enhancing the resource base and the environment. CA is characterized by three main principles: (1) minimum or no soil tillage, (2) a permanent organic soil cover (crop residues or cover crops), and (3) crop species diversification (intercropping, crop rotation, etc.). CA is a modernized and innovative cropping system that not only causes minimum disturbance of the soil and protects the permanent soil cover, but also allows farmers to cultivate different crop varieties. CA can therefore promote biodiversity and natural ecosystems over and under farmed land, and provide sufficient water and nutrients to support crop growth effectively. CA practices will enable current production systems to be more resilient to pests, enhance the livelihoods of farmers and communities and strengthen their capacity to address the economic and environmental impacts of climate change.

3.1. History of Conservation Agriculture in Cambodia

The development of CA in Cambodia has benefited from institutional support and from the commitment of the RGC. As the RGC's line ministry in charge of this sector, MAFF, in partnership with development partners and non-government organizations, has been working on CA promotion since the commencement of the design and testing of CA-based cropping in different agroecological systems in Cambodia in 2004 (Kong et al., 2020 [draft]). The first CA-related research started in 2004 as part of the Crop Diversification and Small-scale Rubber Plantation Development Project (SRDP) Phase 2, funded by the French Agency for Development (AFD) and implemented by the General Directorate of Rubber of MAFF in partnership with CIRAD, the French Agricultural Research Centre for International Development. From then on, Cambodia began to have human resources with CA technical knowledge and experience gained through experiments with and testing of cropping systems of upland annual crops as well as the development of a cover crop genetic bank that led to the start of crop genetic conservation in Bos Khnor village, Chamkar Leu district, Kampong Cham province.

In 2008, CA implementation was taken over by the General Directorate of Agriculture (GDA) under the AFD-funded 5-year PADAC project (*Projet d'Amélioration de l'Agriculture Cambodgienne*) with technical

support from CIRAD. The target areas were located in Kampong Cham and Battambang provinces, and the project focused on the design, promotion, and assessment of CA-based cropping systems in sustainable annual crop production in both upland and lowland areas. Other activities were also implemented in other areas in Battambang under Sustainable Agricultural and Natural Resources Management CRSP (SANREM-CSR) funded by the United States Agency for International Development (USAID) in 2010-2014 in the form of a partnership between the Department of Agriculture Land Resource Management (DALRM) of GDA, CIRAD, and North Carolina Agricultural and Technical State University.

3.2. Background of CASC

Following the assessment of institutional arrangements at the end of PADAC project, the Conservation Agriculture Service Center (CASC) was established in 2014 and integrated into the DALRM management structure of GDA². The key role of CASC is to sustain research for development (R4D) and CA development, as well as to preserve seeds of highland crops and cover crops with future commercial potential. Connected to the Agriculture Land Improvement Office, CASC has one member of staff in charge of general management and technical interventions. GDA provided DALRM with 14.5 hectares of land in Bos Khnor commune, Chamkar Leu district, Kampong Cham province for research, training, and crop seed conservation purposes. The site was named Bos Khnor Conservation Agriculture Research Station, and the name subsequently became widely known. Currently, CASC is implementing R4D on agroecology in cooperation with GDA and CIRAD. CASC oversees the Bos Khnor research station with two staff contracts, one site manager and one technician (with project funding). In addition, CASC also manages and supports R4D pilot extension in Battambang province (four project-based staff contracts), Preah Vihear province (one project-based staff contract), and Kampong Thom province (one project-based staff contract). Since 2014, CASC has provided CA-related services (including no-till planters) to rice, maize, and cassava farmers.

In 2016, the Sustainable Intensification Innovation Lab (SIIL) funded by USAID and coordinated by Kansas State University, supported cooperation between the Appropriate-Scale Mechanization Consortium (ASMC), Women in Agriculture Network (WAgN) and the Center of Excellence on Sustainable Agricultural Intensification and Nutrition (CE SAIN) to extend CA and SI in different agroecological systems in Cambodia. In cooperation with GDA and CE SAIN, Bos Khnor CA Research Station was incorporated in the Cambodian Technology Park network. Two other important projects were 'Towards Agroecological Transition in South-East Asia' (ACTAE) funded by AFD in 2015-2018 and (Ecological Intensification and Soil Ecosystem Functioning (EISOFUN) under the umbrella of the United Nations Convention to Combat Desertification (UNCCD) implemented by the Cambodia Climate Change Alliance (CCCA) in 2016-2019.

Apart from these initiatives and projects, the Center for Sustainable Agricultural Mechanization (CSAM), a regional institution of the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP), in partnership with GDA and other partners, organized an Asia and Pacific regional workshop in 2018 and another regional training course in 2019 on topics related to mechanization in CA. The training course in 2019 identified needs for future training to be provided by a number of partners and organizations.

² Notification 5193 K.S.K (dated August 9, 2013) issued by the General Secretariat of MAFF agreed with the request from the Director of PADAC through the letter 048 (dated June 10, 2013) from the PADAC Director to H.E. Ith Nody, Under Secretary of State of MAFF and Chair of PADAC Steering Committee.

For the sustainable development of CA, in addition to the services already provided by CASC, it is crucial to engage private sector actors throughout the agricultural value chains to provide the necessary technologies, inputs, operational know-how, and access to finance to help farmers accomplish the transition. Recognizing this need, the project Conservation Agriculture Services with a Fee (CASF) together with Mekong Inclusive Growth and Innovation Program (MIGIP) facilitated the engagement of the private sector and contributed to the commercialization of CA-related machinery and the production of cover crop seed. In the period 2018-2021, CASF was funded by USAID and implemented by CE SAIN in partnership with the Department of Agricultural Engineering (DAEng), DALRM/CASC, CIRAD and Swisscontact. MIGIP was funded by the Swiss Agency for Development and Cooperation (SDC) and implemented by Swisscontact, beginning in 2017.

Water Resources Management and Agro-ecological Transition for Cambodia (WAT4CAM) is a four-year (2020-2024) program funded by AFD and the EU, aimed at upgrading irrigation infrastructure and supporting innovative, climate-friendly farming in five provinces: Preah Vihear, Kampong Thom, Siem Reap, Battambang, and Kandal. One of its four components, led by MAFF through the GDA, focuses on innovative farming practices and the rice value chain. This agricultural component comprises four sub-components, one of which is R4D on agroecology with the support of CIRAD. The R4D sub-component aims to “explore new methods of intervention and cropping systems that match the principles of agroecology [...]. There is a need to improve the efficiency of water and nutrient use by safeguarding natural resources and producing higher quality rice and non-rice crops.”

In 2020, relevant stakeholders involved in CA and SI projects and programs in Cambodia created the Cambodia Conservation Agriculture and Sustainable Intensification Consortium (CASIC) following the decision letter from MAFF³, with the participation of a variety of stakeholders including the government, NGOs, and the private sector. In addition to CA, CASIC supports the promotion of SI, which offers one way to increase production and the food supply with minimal additional land use while simultaneously improving natural capital, protecting biodiversity, and supporting the agroecological transition. CASIC is a national and regional coordination mechanism under the leadership of a steering committee consisting of representatives of MAFF, the Ministry of the Interior (MoI), MoE, MoWRAM, and the Cambodian Chamber of Commerce (CCC). At the management level, CASIC's Executive Board is led by MAFF and is comprised of representatives of RUA, GDA, DALRM, DAEng, CARDI, and DEAFF. DALRM leads one of the four sub-committees on R4D. In addition, DALRM is also a member of the Permanent Secretariat of the National Action Program (NAP) to Combat Land Degradation, which is a coordination and monitoring mechanism for the implementation of NAP.

Recently, DALRM joined the Agroecology and Safe food System Transitions (ASSET), a regional project funded by the EU and AFD and co-implemented by GRET and CIRAD in four Southeast Asian countries in 2020-2025. The main objective of ASSET is to “harness the potential of agroecology in Southeast Asia to transform food and agricultural systems into more sustainable systems, notably safer and inclusive” (ASSET project information). The key government partners of ASSET in Cambodia include GDA (DALRM) and the Institute of Technology of Cambodia (ITC), with support from CIRAD and Swisscontact.

³ MAFF's decision letter 201, dated May 21, 2021, on the establishment of steering committee and executive board of CASIC.

3.3. Key achievements of CASC

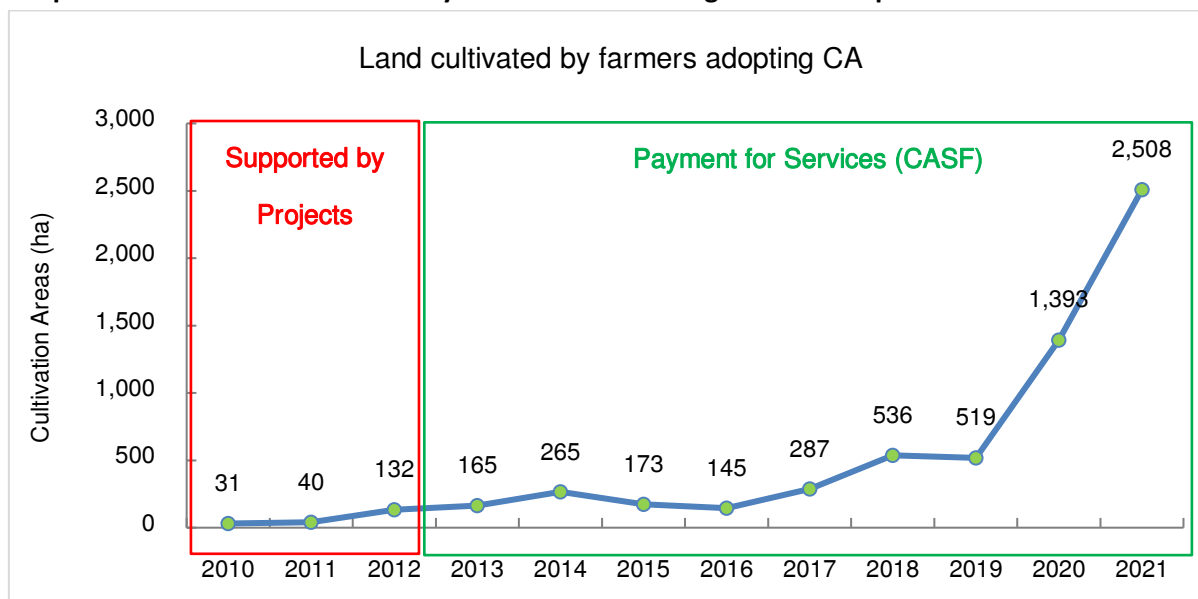
CASC has had many achievements in the implementation of its activities at the Bos Khnor Research Station and in pilot extension areas to date. Most of its achievements are linked to experiments and research on improved and innovative production systems in line with the principles of CA and SI, crop seed conservation, and extension and technology transfer to farmers, as well as establishing partnerships with the private sector. These achievements illustrate the importance and potential of CA in contributing to achieving the goals outlined in the policy and strategic framework for sustainable agricultural development, response to the impacts of climate change, and efforts to combat land degradation as well as biodiversity and ecological protection. Key achievements include:

- Research and experimentation on rice, cassava, soybean, and maize:
 - Experiments conducted on cropping systems, conservation of crop seeds, carbon sequestration techniques, and setting up demonstration farms for crop expansion at the Bos Khnor research station;
 - Experiments conducted on cropping systems, irrigated farms, plantations, and demonstration farms in Battambang and Kampong Thom;
 - Experimentation and setting up simpler cropping systems with permanent living cover crops will be expanded at the station and continually piloted with farmers, beginning in 2021;
 - Experiments on the climate-resilience of crop seeds (water saving and resource use efficiency).
- Conservation, production, and assessment of crop seeds at Bos Khnor Station:
 - A total of 46 species consisting of 216 varieties of crop genetics, including grains, cover crops, and fodder crops (as of 2020) for the purposes of research and extension aimed at helping farmers to improve soil nutrients and to start using crop rotation;
 - Cooperation with Smart Agro to expand the production of cover crop seeds in terms of both quantity and varieties to supply to farmers at subsidized prices.
- Increased support for CA practices (2019 data from CASC)
 - Distribution of 5,225 kilograms of cover and pasture crop seeds with technical advice (production techniques, care, and management) for 233 producers, encompassing a total of 180 hectares of farmland in Battambang, Kampong Thom, and Preah Vihear;
 - Technical support was provided to 99 producers involving 405 hectares of farmland in 5 villages in Rattanak Mondul district, in Battambang, to support farmers in their transition from conventional farming to CA with the provision of no-till machinery services;
 - Technical support was provided to 46 rice farmers involving 30 hectares of land in 3 villages in Kampong Thom.
- Extension, training, and knowledge transfer (2019 data from CASC)
 - Increased knowledge transfer and technical extension to smallholder farmers and communities (227 producers on 559 hectares) in Battambang and Kampong Thom (pilot extension areas);
 - in Banan district in Battambang, the promotion of cover crops and fodder crops that are appropriate for the improvement of soil nutrients and as additional sources of animal feed;
 - Promotion of no-tillage concept and services involving 80 producers on 144 hectares in 9 villages;

- Training for producers on keeping cover crop seeds, and cooperation with Smart Agro in providing training to contractual seed producer groups on producing seed both for their own use and for sale;
- Training for other stakeholders including:
 - Training for local machinery service providers (no-till planters);
 - regional training on appropriate scale mechanization for CA (cooperation between DAEng, Swisscontact, and UN-ESCAP) that identified key topics for training at Bos Khnor research station in the coming years (37 participants from 18 Asia Pacific countries);
 - short-term training in seed production, conservation, use, and distribution in Battambang;
 - training in appropriate scale mechanization for SI (RUA and DAEng) in Battambang for farmers, service providers, extension agents, machinery workshops, cooperative representatives, students, and local authorities (80 participants);
 - meetings and exchange programs among producers, study tours, and field days in a number of target areas (more than 700 participants in 2019).
- Hosting domestic and international students, researchers, and scholars during internships and visits for research at Bos Khnor research station and pilot extension areas in Battambang (BSc, MSc, PhD as well as writing research articles to be published in scientific journals, etc.), a total of 54 students and 67 interns were hosted from 2004 to 2021.
- Development and compilation of technical material:
 - Production of short video clips on cropping systems, the benefits of cover crops, and key components of CA, together with dissemination on social media (e-learning resources)
 - Facebook page “Conservation Agriculture Service Center” with 3,108 likes and 3,265 followers (as of July 2021);
 - YouTube channel “Soil is Life” with 7.96K subscribers and a total of over 3 million views for 273 clips (as of July 2021).
- Cooperation with private companies (Larano and Smart Agro) investing in the supply of agricultural machinery and services, and suppliers of cover crop seeds to local farmers aimed at:
 - increasing the number of no-till planters (cooperation between DAEng, Swisscontact and CE SAIN);
 - producing and supplying cover crops through seed producer networks/groups.

As a result of these research activities, knowledge transfer, and the provision of technical support, as well as facilitation for the supply of cover crop and appropriate scale mechanization services, farmers’ adoption of CA technology has increased significantly (see Graph 1). The land on which farmers have been applying CA principles (at all stages) with service fees increased from 1,393 hectares in 2020 to 2,508 hectares in 2021, an approximately 4.8 fold increase in the number of hectares under CA in 2019.

Graph 1: Extent of land cultivated by farmers transitioning to CA in the period 2010-2021



Source: Summary progress report by CASC

The results of CA research and extension in a variety of agroecological systems in Cambodia at both the research station and on demonstration farms/plantations indicate that:

- In the first year of the cropping transition period, CA helps reduce soil erosion by up to 92.7% with an annual soil erosion of only 3 tons per hectare, compared with 42 tons per hectare of Mollisol soil type under tillage practices used for upland (5% slope) maize production in Rattanak Mondul district in Battambang province.
- CA reduces the money spent on chemical fertilizer by approximately 42% or US\$50 per hectare on average and total production costs by around 10%, leading to a 12% increase in net profit or US\$117 per hectare, compared with the tillage practices used for upland maize production in Rattanak Mondul, while CA increases the average yield by 0.8 tons per hectare and hence net profit by about US\$200 of rain-fed rice in Banan district, Battambang province.
- CA increases the quantity of soil organic carbon on an average of 390 kilograms per hectare per year (0-40cm) in 3 years after the adoption of CA, depending on cropping frequency (1 or 2-3 cycles per year) of irrigated rice production in Steung Chinith in Kampong Thom province, specifically in a Yellow Podzol soil, categorized as deteriorated. In parallel, soil organic carbon increases by 490 kilograms per hectare per year (0-40cm) 6 years after adoption of CA-based soybean cropping systems on Red Oxisol soil at the Bos Khnor research station.
- CA increases the availability of nitrogen nutrients (NH_4^+ & NO_3^-) in soil 2-fold compared with conventional practices. NH_4^+ & NO_3^- is an indicator of an increase in soil nutrient cycling. The increase in nitrogen is associated with the use of cover crops that absorb nitrogen from the atmosphere producing soil nutrients, and with the end of soil tillage, thus increasing the stability and vigor of soil micro-organisms.
- CA increases (264 ml/mn) the water infiltration rate of soil 2-fold compared with conventional tillage (125 ml/mn).

To sum up, research results prove that CA not only increases the effectiveness of the use of agricultural resources and inputs (soil, water, fertilizers, pesticides), productivity and producers' net income, but

also restores soil health, which contributes to food security and safety, enhances environmental quality and human health, increases adaptation to climate change and mitigates its impacts.

3.4. Key Challenges

In parallel with the achievements listed above, CA-related interventions have also had to face a lack of resources to support the continuation and expansion of research, experimentation, and training and extension activities. The following challenges require urgent attention in the near future:

- Lack of human resources to fully and effectively support the implementation of activities:
 - Staff at the research station and pilot extension areas are contractual, indicative of a lack of sustainability.
 - There are not enough staff members to carry out the activities. Currently, there is only one government official from DALRM working with technical support from CIRAD and 2 contractual staff members at the research station in charge of activities linked to experimentation, administration, field days, and training courses.
 - The capacity of the technical staff remains limited, and needs more capacity building, especially for innovative technologies.
- Lack of physical infrastructure and tools/equipment to support research and training:
 - The meeting and training rooms and the dormitory at the CASC compound are very simple, without sufficient tools and equipment to meet specific standards.
 - The warehouse used to store crop seeds and fertilizer is old and consequently not able to store crop seed resources adequately.
 - There are no facilities for experimentation.
 - The total amount of land available for experimentation and research at the Bos Khnor research station (14.5 hectares) is limited and is already used to full capacity, it is consequently impossible to conduct research on other cropping systems (e.g., other annual crops, fruit trees, crop-livestock integration, agro-forestry, etc.)
 - Agricultural machinery required for research and pilot projects at the station and for use on farm in a timely manner is also lacking.
 - The machinery required for CA is very expensive compared to the equipment used in conventional plow-based cropping systems, meaning machinery service suppliers cannot afford to invest in such machinery.
 - Supplies of cover crop seeds for CA extension activities are also lacking.
- Awareness of the key CA principles remains limited among farmers, development partners, and other stakeholders
 - Apart from better off farmers who consider participating, many farmers (especially smallholders) have no interest due to the mistaken belief that switching to CA requires heavy investment and possibly affects soil and environmental quality in the long run.
 - No participation or support for the promotion of CA and extension is provided by the provincial departments of agriculture, forestry, and fisheries (PDAFF) to date.
 - CA has not yet been clearly integrated in the activities and policies of MAFF.
- Investment by the private sector to support CA interventions is still limited: only one machinery company and one seed supplier have participated, while financial institutions have not yet expressed explicit interest.
- Research and experimentation are not yet sufficiently widely conducted, and have to rely to a great extent on available resources and potential development projects (no budget has been

allocated by the government). Despite the importance of certain topics, there is no technical capacity or resources to carry out the necessary research.

3.5. SWOT Analysis of CASC

Table 1 below presents a SWOT analysis “Strengths, Weaknesses, Opportunities, and Threats” of CASC. SWOT analysis consists of an internal review of the strengths and weaknesses of CASC and a sectoral overview of opportunities and threats. This analysis provides a good base for the development priorities of CASC’s 5-year Strategic Plan.

Table 1: SWOT Analysis of CASC

Strengths	Weaknesses
<ul style="list-style-type: none"> • Long history of research for development (R4D) in CA, SI, and agroecology in Cambodia and in the region concerned, i.e. both at the Bos Khnor station and through on-farm support; • Established group of experts with technical knowledge and capabilities in CA, SI, and agroecology; • CASC is a member of Executive Board of CASIC, an official body endorsed by MAFF and has the support of a variety of stakeholders; • CASC is a well-known member/partner in regional platforms and projects on agroecology. 	<ul style="list-style-type: none"> • Lack of wide promotion and of presentation of the benefits of CA, SI, and agroecology to key stakeholders including farmers, service providers, development practitioners, and policy makers; • Limited explicit visibility of CA, SI, and/or agroecology in RGC policies despite the overall priority of sustainable agricultural development; • Absence of a master plan outlining priority areas for CASC; • Lack of financial and human resources to support efforts to expand the development and promotion of CA and SI; • Lack of assessment to determine priority / appropriate areas for CA and SI practices; • Lack of an information system to track the progress of CA and SI.
Opportunities	Threats
<ul style="list-style-type: none"> • Innovations for agroecological transitions; • Positive impacts of CA and SI practices on organic soil carbon, improved water use efficiency, adaptation to climate change (GHG emissions) and mitigation of the impacts of climate change; • Growing interest and support from development partners and regional agroecology initiatives/programs • Adoption of CA and SI by farmers shows convincing agronomic and economic performances; • Growing demand for quality agriculture produce (nutrition and safety) given the improved income of consumers; 	<ul style="list-style-type: none"> • Limited awareness of CA and SI among farmers, the private sector, and other stakeholders, including the misperception of CA and SI practices • Tendency to risk-aversion, wait-and-see behavior, and land tenure issues among farmers that prevent early adapters from transitioning to CA and SI practices; • Lack of a financial mechanism to reward farmers who invest in soil improvement and market actors who support transition processes; • Limited engagement from the private sector throughout supply chains and limited funds to facilitate and speed up adaption of CA and SI by farmers.

- | | |
|---|--|
| <ul style="list-style-type: none"> • Potential support from DEAFF and PDAFF for wider CA and SI promotion and extension. | |
|---|--|

3.6. Strategic Plan Development and Revision of Center Title

The preparation of the Strategic Development Plan for CASC was initiated by the Department of Agricultural Land Resource Management (DALRM) of the General Directorate of Agriculture (GDA) thanks to the Decision of DALRM to establish a Working Group for Strategic Plan Development (dated May 13, 2020). The working group received technical and financial support in the framework of the partnership and collaboration between DALRM, CIRAD, and Swisscontact. Since September 2020, the Strategic Plan Development process has been facilitated by the consultant team of BDtruS with active and comprehensive participation of DALRM’s Working Group via various meetings to review the key policy framework, relevant documents, and priorities of CASC and the development of CA, SI, and biodiversity within the agroecological framework.

In addition, the direction and key priority actions of the draft Strategic Plan were also the subject of bilateral consultation with the appropriate experts and stakeholders in Cambodia and at the regional/international level, including RUA, CE SAIN, CARDI, GRET (regional office), CIRAD (regional office), AFD, USAID, FAO (regional and Phnom Penh offices), EU, SDC, ADB, GiZ, Kansas State University, Global Research Alliance (GRA) and CSAM.

As a result of several discussion sessions, the DALRM Working Group developed the first draft of the Strategic Plan and organized a consultative workshop with the other departments of GDA in October 2021. The comments and input collected during the workshop were indispensable for the improvement of this document prior to review and adoption by the GDA management. There were comments that the use of the word “service” in the name of “Conservation Agriculture Service Center (CASC)” would likely lead to misconception that CASC provided profit-earning services, even though CASC aimed to enhance the services being provided by the private sector. The Working Group considered this as a justification to change the name “CASC” to “**Cambodian Conservation Agriculture Research for Development Center (CARDEC)**” ១

4. CARDEC Strategic Development Plan 2022-2026

In the regional development context, the momentum and potential of agroecology including conservation agriculture and integrated and sustainable agricultural practices has sparked the interest of development practitioners, researchers, development partners and other stakeholders. At the national level, CA & SI and agroecology (through CASIC) have been actively promoted by MAFF as well as by national and international stakeholders. The scope of the strategic development plan of CARDEC (2022-2026) is therefore broader, beyond the current CA scope of CARDEC, and also includes activities that are relevant to other practices of agroecology and SI.

4.1. Vision

The vision of **CARDEC** is to become a leading national and regional center for the promotion of the agroecological transition, food security, and nutrition in the context of climate-smart agricultural modernization.

4.2. Mission

The mission of **CARDEC** is to conserve crop genetic resources, conduct experiments, and assess and promote agricultural production systems based on agroecological and sustainable intensification, by building the capacity of appropriate stakeholders, especially farmers, in order to increase agricultural productivity and promote the livelihoods of rural communities.

4.3. Goal and Overall Objective

In order to achieve the stated vision and mission, CARDEC has defined an overall goal for the next five years: to strengthen and expand research and the promotion of CARDEC, the Bos Khnor station, and interventions in its pilot extension areas in order to transform itself into a center for research, capacity building, and development of CA & SI and agroecology, thereby contributing to the fulfilment of national strategic plans related to the agricultural sector, national mechanisms for sustainable intensification, and joint goals at regional level to support agroecology.

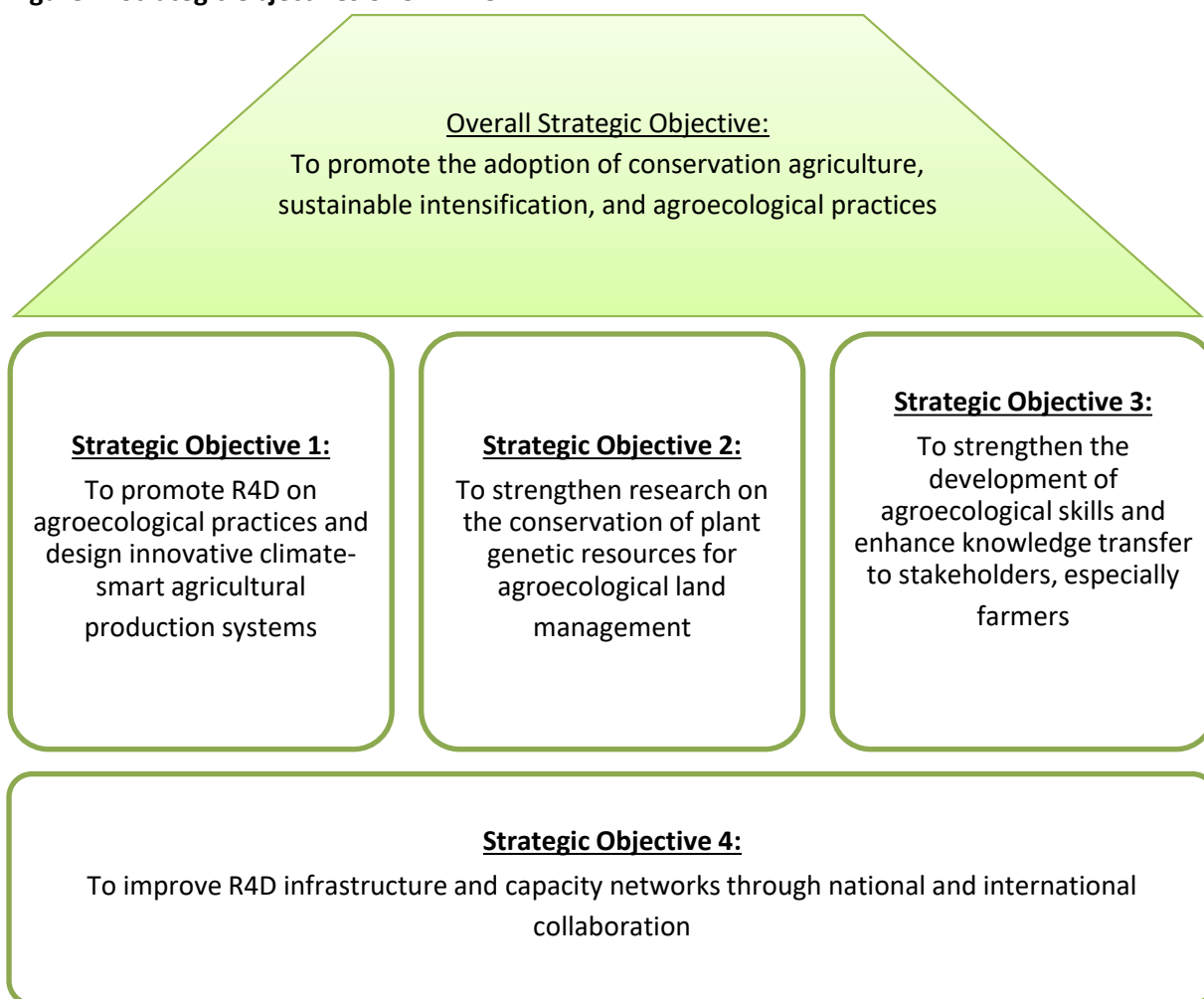
Through this strategic plan, it is expected that by 2025, CARDEC will achieve its overall objective of promoting the adoption of climate-smart agroecological practices to contribute to sustainable management of agricultural land resources and to ensure food security and safety, rural economic development, environmental protection, and to safeguard farmers' livelihoods.

4.4. Strategic Objectives and Priority Actions

To achieve the stated overall strategic objective, the strategic plan lays out the four following inter-linked and mutually supportive strategic objectives:

1. To promote research for development (R4D) on agroecological practices and to design innovative climate-smart agricultural production systems;
2. To strengthen research on the conservation of plant genetic resources for agroecological land management;
3. To strengthen the development of agroecological skills and enhance knowledge transfer to stakeholders, especially farmers;
4. To improve R4D infrastructure and capacity through national and international collaboration.

Figure 1: Strategic Objectives of CARDEC



4.4.1. Strategic Objective 1: To promote R4D on agroecological practices and design innovative climate-smart agricultural production systems

Strategic Objective 1 aims to strengthen and expand the scope of research for development (R4D), experimentation, design, and assessment of innovative climate-smart agricultural production systems on topics related to CA, SI, and agroecology. Key priority actions include the following:

a. Strengthening experimentation and research on current production systems

- Continue long-term experiments and research on maize, soybean, and cassava in order to document the long-term impact on C dynamics, soil health, greenhouse gas emissions and other ecology system services in order to support agroecological transitions.
- Develop and assess innovative agricultural production systems that are highly effective both in terms of yield and economic returns, particularly the effective use of land and water resources, fuel, agricultural inputs, as well as labor and time, especially for women, and increased resilience and capacity to adapt to climate change.
- Expand experimentation and research on increased safety of agricultural produce through the integration of agroecological crop management in the cropping system in order to:
 - Reduce pesticide use (to a minimum level or zero use) on crops targeting end consumers with premium prices (e.g. rice, vegetables, fruit, and medicinal cannabis)

at both Bos Khnor station and on-farm application by farmer/producer networks in the target areas.

- Align agroecological cropping systems with the requirements of various food safety standards (e.g., GAP and organic) to help farmers qualify for safe agricultural production standards, which is a great incentive for them to adopt agroecology practices. This will benefit farmers by inspiring consumers' recognition of the values and the quality agricultural produce, thus greatly incentivizing farmers to invest in sustainable land management and in reducing GHG emissions.
- Research on the appropriate scale for tool/machinery use in agroecology and SI practices, which are both innovative and suit the needs and affordability requirements of smallholder farmers, especially women.
- Research on new techniques and technologies to save water used for agricultural production to help adapt to climate change and mitigate its impacts.
- Experimentation and research on livestock integration in annual and perennial cropping systems (integrated agriculture systems) with focus on fodder crops that are suitable for land improvement, pest management, and the maximization of land use and resource efficiency in order to produce higher profits (This will require additional land at the Bos Khnor station).
- Regularly document the agronomic and economic impacts on farmers who have adopted CA- and SI-based production systems.

b. Expanding the scope of experimentation and research on other agricultural production systems

- Conduct experiments and research on vegetable cultivation both inside and outside net houses.
- Conduct mapping studies to identify priority areas for the promotion of agroecological practices and knowledge and technology transfer.
- Study the feasibility of research on agroecological cropping systems for orchard/industrial crops, crop-livestock integration, and crop diversification in accordance with agro-forestry systems including:
 - The feasibility of cooperation with other research stations/centers under the management of GDA and PDAFFs.
 - The possibility of obtaining additional land for the planned experimentation on agroecological systems, through situational analysis and documentation of evidence and justification explaining the effective and efficient use of currently available land, as well as the needs and importance of the additional land accompanied by a concrete land use plan.

4.4.2. Strategic Objective 2: To strengthen research on the conservation of plant genetic resources for agroecological land management

Strategic Objective 2 aims to improve the conservation of crop genetic resources, especially staple crops like mung bean, cowpea and other pulses, other under-used species, a large number of cover crops, and fodder crops for CA and SI. Key priority actions include:

- Collection, preservation, characterization, production, and distribution of crop seeds.
- Production of crop seeds for the purpose of experimentation, research, and the piloting of innovative production systems rolled out to farmers and provided to satellite crop genetic

banks in key universities and local communities, as well as the production of foundation seeds or breeder seeds for supply to seed producer groups and companies.

- Strengthening the organization of the “Crop Genetic Bank” with sufficient qualified personnel, packaging equipment, and coolbots for longer storage.
- Study of the criteria and requirements for the registration of the preserved crop seed (intellectual property rights and license ownership) with support from the Crop Seed Department of GDA
- Setting up a mechanism to charge fees from commercial companies who produce and distribute the preserved crop seeds (foundation seeds), as a source of income to finance the running of the center.

4.4.3. Strategic Objective 3: To strengthen the development of agroecological skills and to enhance knowledge transfer to stakeholders, especially farmers

Strategic Objective 3 aims to strengthen the development and transfer of technology, knowledge, and information related to CA, SI, and agroecology, as well as the delivery of technical support for farmers and other stakeholders through training, field visits, and information, educational and communication (IEC) materials and video clips for sharing on various media. Major priority actions include:

a. Technical capacity development and support service delivery

- Translate the results of the research and scientific articles into simple, easy-to-understand language and produce materials that are easy-to-use for non-technical people, especially farmers.
- Support the coordinated transfer of technology and knowledge to farmers in collaboration with appropriate stakeholders (DEAFF, PDAFF, and other development practitioners) through:
 - Technical training for PDAFFs, district extension agents, and other relevant development practitioners from NGOs and the private sector to become master trainers.
 - Technical support for PDAFFs and district extension agents who will then train members of agriculture cooperatives, farmers, and local service providers (basically using the model of Metkaksekor⁴).
- Develop knowledge for research by hosting young researchers and agronomists from Cambodian and international universities/schools at all levels (Bachelor, Master, Doctoral and Post-doctoral programs) by means of short-term and long-term internships or the provision of research support for thesis completion.
- Provide fee-paying technical services and advice, such as testing agriculture machinery and crop seeds; and consultancy, design, and technical support to improve land resources and cropping systems of large farms in accordance with the principles of conservation agriculture and sustainable intensification, etc.
- Design and provide tailored training courses for any entities on topics related to the technicalities and lessons learned from the implementation of conservation agriculture and sustainable intensification
- Assess the need for the development of agroecological skills among members of the DALRM/CARDEC team, and subsequently strengthen their skills based on the assessment

⁴ “Metkaksekor” is an open market model that focuses on the early adapters of products as a driver for agricultural extension. Metkaksekor opens up markets for investment from the private sector on sustainable intensification through government agencies and the private sector to smallholder farmers in Cambodia.

b. Compiling scientific documentation (journals)

- Continue providing technical support for scientific research on a number of topics including the assessment of the impact of land use on greenhouse gas emission, changes in soil physics, biology and chemistry (soil health), (based on the research and on the involvement of Master, PhD, and post-docs) to be published in national and international scientific journals, with support from and through graduate and post graduate research cooperation with Cambodian and international universities and research institutions.

c. Sharing and dissemination of information and technical knowledge

- Design and develop information, educational, and communication (IEC) materials including leaflets/brochures, banners, short video clips, and farmer testimonials on CA, SI, and agroecology for dissemination on various platforms and includes training, workshops, field visits, on a Facebook page, and YouTube channel of the center, as well as those of the General Directorate of Agriculture (GDA) and MAFF
- Develop a website or possibly a webpage attached to the existing GDA website (<https://gda.maff.gov.kh>) to post relevant documents, research articles, information on training schedules, a stakeholder directory (including the private sector) and useful links at both national and international levels, for information, knowledge, and guides to benefit the general public, researchers, and other stakeholders who are interested in information on conservation agriculture and sustainable intensification.
- Work with media (e.g., agriculture programs on radio and TV channels) to disseminate research results and the potential benefits of practicing agroecology and sustainable intensification to a broader audience.
- Seek support from the Department of Extension of Agriculture, Forestry and Fisheries of MAFF in obtaining support and cooperation with PDAFFs and the district/municipal administrations (district extension agents) in promoting CA and SI and providing technical support to local producers, and in cooperation with Swisscontact (together with CIRAD, Kansas State University and CE SAIN), which is currently commencing its Metkaksekor (meaning “Farmers’ Friends”) project with the aim of increasing the participation of PDAFF in providing producers with extension services related to conservation agriculture and sustainable intensification.

4.4.4. Strategic Objective 4: To improve R4D infrastructure and networks through national and international collaboration

Strategic Objective 4 is a very important basis and has a direct supporting link with the three preceding objectives. This Strategic Objective aims to strengthen and enhance appropriate and necessary infrastructure and institutional capacity to implement priority actions. At the same time, this objective intends to strengthen cooperation with relevant networks, entities, and stakeholders at MAFF, other relevant ministries, research institutes, higher education institutions, and training entities at both national and international levels, in order to gather support and collaboration for the promotion of R4D and the adoption of the CA & SI and agroecology practices in Cambodia. Key priority actions include:

- Changing the name of the center to reflect its scope of work and core activities on research, capacity building, and the development of agroecology and sustainable intensification.

- Advocate for the integration of the center in the formal structure of DALRM and/or GDA in order to access the Royal Government's budget to cover the cost of the personnel and research implementation.
- Increase human resources at the center (trainers, technicians, and researchers) and provide technical and soft skill capacity building to these members of staff:
 - Integrate existing staff and recruit additional staff in line with the organizational structure proposed in this strategic plan (management and operational framework of the center).
 - Strengthen the knowledge and capacity of the staff for research/experimentation, the management of genetic resources, data analysis, and provide training to enable them to obtain post-graduate scholarships (Master's and PhD programs) as well as to take part in exchange programs and short-term training courses.
- Assess the infrastructure design and planning required to become a standardized research and training center.
- Strengthen physical infrastructure, tools, and equipment (see list of tools, equipment, and machinery in the appendix) to become a standard research and training center, encompassing the following priorities:
 - Construct a laboratory in the existing building and equip it with the necessary tools including a sample drying oven, soil sample dividing tools, a soil museum, and a seed lab for seed testing.
 - Seek support from development partners in installing additional tools and equipment that apply to a national and international training center.
 - Seek cooperation with the private sector to acquire agricultural inputs and machinery or to participate in the experimental and research activities of the center.
 - Construct/repair key infrastructure and extend the existing land used for experimentation and research through cooperation and support from the RGC, specifically GDA and MAFF
- Strengthen national cooperation through active participation in CASIC to promote the development of conservation agriculture and sustainable intensification in Cambodia.
 - Support CASIC through DALRM's leadership in the Sub-committee on Research by providing expertise and technical inputs on experimentation, research for development, training, and extension, as well as strong scientific evidence for policy advocacy at the national and regional levels.
 - Seek support from CASIC on policy advocacy at the national and sub-national levels for cooperation with the appropriate departments, entities, and PDAFFs under the management of MAFF, as well as other relevant ministries and all three levels of sub-national administrations.
 - Other departments under GDA including the Department of Agricultural Engineering, Rice Crop Department, Industrial Crop Department, Horticulture and Secondary Crop Department, etc.
 - Other entities under MAFF, including the Forestry Administration, General Directorate of Rubber, and General Directorate of Animal Health and Production, etc.

- Cross-sectoral coordinating mechanisms including the Permanent Secretariat of NAP to Combat Land Degradation and National Council for Sustainable Development (housed in the Ministry of Environment).
 - Other line ministries like the Ministry of Environment, Ministry of Water Resources and Meteorology, etc.
- Strengthen international cooperation in partnership with universities, research and training institutions (local and international entities located in Cambodia and abroad) in research, experimentation, compilation and publication of scientific research papers, and training and knowledge transfer, in addition to policy advocacy at ASEAN level.
 - Universities: RUA, Institute of Technology of Cambodia (ITC), National University of Battambang (NUBB), Prek Leap National Institute of Agriculture, KSU, etc.
 - Research institutions: CARDI and other research stations/centers belonging to government and development partners.
 - The private sector: importers and manufacturers/repairers of machinery, local service providers, seed producing companies, seed producer groups/networks, and financial institutions, as well as Agribusiness Machinery Association in Cambodia (AMAC), Cambodia Rice Federation (CRF), and Cambodia Microfinance Association (CMA), etc.
 - National and international NGOs and other entities/institutions: CIRAD, Swisscontact, IRD, UN-ESCAP (CSAM), Global Research Alliance (GRA), Appropriate Scale Mechanization Consortium for Sustainable Intensification (ASMC) project, the ASSET program, etc.
 - Regional networks: ASEA/CANSEA, ALiSEA, LICA, etc.

4.5. Inclusiveness of Smallholder Farmers and Women

Under the overall agricultural development framework, inclusiveness is an important aspect of achieving the vision stated in policy documents and in the draft agricultural sector master plan. The agricultural sector in Cambodia shall be developed with equity, with the participation of all actors along the value chains, be inclusive of smallholder farmers with little farm land, limited financial capability, and pressing challenges in terms of production competitiveness, high economic effectiveness, and adaptability to the impacts of climate change.

The gender gap in agriculture, especially access to support services and agriculture extension, remains a challenge due a number of problems facing women, including the distant location of extension services, limited literacy, lack of time, lack of childcare services, the burden of household chores, inability to travel far from home, and other socio-cultural factors. In addition, women’s utilization rate of tools/equipment and technology remains lower than that of men. Therefore, the policy and framework for gender mainstreaming of MAFF (2016-2020) clearly states MAFF’s commitment to “enhancing women’s economic empowerment through the capacity of women in accessing goods and services related to agricultural development and market” for women to have better access to agricultural resources as well as to information, knowledge, and technical extension services to support their agricultural activities.

The inclusiveness of smallholder farmers and women in agroecology is no different from that in agricultural sector in general. This strategic plan considers and supports smallholder farmers’ and women’s access to technical adoption at appropriate levels in accordance with their technical and

financial capabilities. The center should focus its research on agroecology and sustainable intensification technology and techniques that are easy to understand and apply in terms of technical and financial aspects. To achieve effectiveness and efficiency, the center should work with appropriate stakeholders who coordinate and support producer groups/networks and/or agriculture cooperatives, which provide the basis for collective and scalable production (better access to agriculture inputs and support services) and supply to market, in order to ensure higher economic effectiveness among farmers.

In Cambodia, land ownership and management, as well as decision-making in agriculture related work, are generally jointly exercised by men and women. The practices of conservation agriculture lead to a reduction in time and labor, and better and sustainable land management for both men and women. Due to the fact that women play an important role in household decisions to adopt new agricultural techniques and technology, especially decisions related to spending, women need information about the financial benefits of adopting conservation agriculture before they make any decisions. Promotion and training should take into consideration the need to provide women with sufficient information for economic analysis, as well as the need to help women participate with ease (including scheduling, location, and appropriate means of transport).

4.6 Risk Management

For the implementation of the priority actions in this 5-year CARDEC strategic plan, a number of risks and corresponding mitigation strategies were analyzed and are listed in the table below. Among the the most pressing risks in the current context and, perhaps in the next few years of the roadmap, are the uncertainties linked to the Covid-19 pandemic. For this reason, CARDEC and Bos Khnor station are required to have adaptive management capacities and be prepared to adjust their working approach and methods in response to any context, especially during the first stage of implementation of the roadmap. Another important risk is associated with the priorities, commitment, and resources of the RGC with respect to institutional support and priority actions stated in this strategic plan.

Table 1: Risk assumptions and mitigation strategies

Risk Assumptions	Risk Mitigation Strategies
Continued impacts of Covid-19 on resource prioritization by the RGC, development partners, and the private sector	<ul style="list-style-type: none"> • Continue to assess the situation and adjust the approach, work plan, and budget as needed • Ensure high levels of flexibility and adaptive management capacity
Impact of Covid-19 on the organization of awareness-raising, extension, and capacity building events	<ul style="list-style-type: none"> • Continue to assess the situation and adjust the approach and work plan and conduct important events and campaigns on virtual platforms
Changes in the RGC, sector and ministry strategic plans/policies, and changes in these organizations' functions and responsibilities	<ul style="list-style-type: none"> • Continue effective advocacy efforts (through CASIC at the national level and regional networks at ASEAN level) for the integration of agroecology and SI in government policies, strategies, and plans • Identify and prioritise human resources based on real needs

Vulnerabilities caused by natural disasters, climate change, and degradation of biodiversity, possibly affecting the results of cropping techniques transferred to farmers

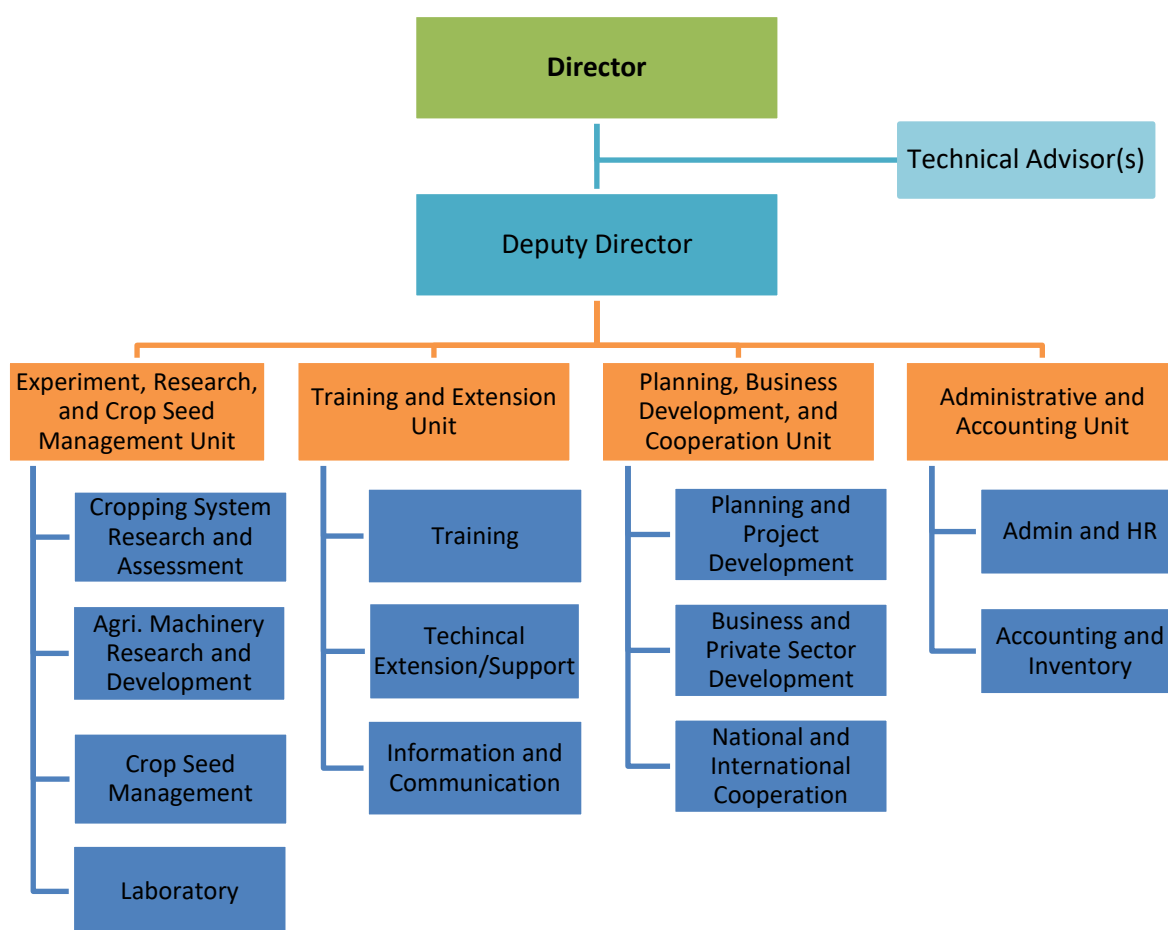
- Continue and accelerate research and experiments on cropping systems and seeds that are more resilient to climate shocks

5. Management and Operation Structure of CARDEC

In the implementation of this 5-year strategic plan, DALRM of GDA/MAFF is responsible for overseeing CARDEC activities. As part of this strategic plan, the structure of the center, the research station, and pilot extension areas was reviewed and modified and the human resources and responsibilities designated for each of the units in response to the strategic objectives and priority actions mentioned above. The appropriateness of this organizational structure will be reviewed and revised in accordance with the specific framework and entity hierarchy after the official decision is taken to recognize CARDEC.

Within this management and operational structure, a Director is responsible for leading, managing, reviewing, steering, and approving the actions and financial plans and reports on CARDEC, with technical support from an expert technical team that will include national and international entities and organizations like CARDI, RUA, CIRAD, Swisscontact, and KSU. The Deputy Director of CARDEC will be responsible for daily management, fundraising, reporting, and direct supervision of the technical, administrative, and cooperative tasks. The core tasks are divided into four units: (1) experimentation, research, and crop seed management unit, (2) training and extension unit, (3) planning, business development, and cooperation unit, and (4) administrative and accounting unit. Each unit will be led by a Unit Chief and/or Deputy Chief and supported by Technical Officers in charge of the key roles and responsibilities outlined below.

Picture 1: Management and Operational Structure of the Center (CARDEC)



Due to the problem of limited human resources, the existing staff, more specifically officials in charge and contractual staff, will continue their work tenures, with the participation of and the responsibilities shared by the management and officials of DALRM during the interim period. In the medium to long-term, CARDEC will seek to obtain support for personnel in the program budget of the RGC and funding from development partners. Appendix 1 lists the responsibilities and individuals in charge (during the interim period) in accordance with the stated organizational structure.

6. Resource Mobilization

This roadmap is an important tool for CARDEC to continue maintaining and mobilizing both technical assistance and financial resources from the government (particularly from MAFF), from local and international NGOs and development partners to help execute the key priority actions in the coming years:

- Seek support for (1) the integration of the center in the formal structure of DALRM or GDA with government staff in charge of the tasks specified in the proposed organizational structure, and (2) integration of the key priority actions in the Budget Strategic Plan and annual Program Budget of DALRM (prioritizing the most important and most relevant activities considering the annual budget ceiling of the government)
- Continue to apply existing mechanisms in collaboration with national and international organizations and development partners
- Expand the scope of resource mobilization through:

- Participation with CASIC, the Technical Working Group on Agriculture and Water, to combat land degradation and related to adaptation and mitigation of the impacts of climate change (Ministry of Environment and the National Committee on Sustainable Development), as well as a number of relevant projects and programs organized by development partners (ADB, EU, AFD, SDC, GIZ, etc.), and regional networks, etc.
- Identify other financing mechanisms that could support interventions related to agroecology and SI by assessing a number of financing platforms including certain foundations and biodiversity and climate change financing mechanisms, such as payment for ecosystem services, REDD+ initiative, the green development mechanism, and financing under the United Nations Framework Convention for Climate Change.
- Invest effort in attracting more interest and investments by the private sector through continued support and cooperation in addressing technical and business challenges faced by the private sector.

7. Monitoring and Evaluation

Important outputs and outcomes have been identified for the implementation of the strategic plan for the purposes of M&E (see list of indicators and targets in Appendix 3). The progress of implementation will be monitored through detailed annual operational plans and regular reporting of actual results, including comparison with planned targets. This strategic plan will be reviewed and overseen by the Director of CARDEC and the Director of DALRM with advisory input from CASIC. The M&E results will inform the executive teams and decision-makers about the progress, achievements, challenges/obstacles, opportunities, and lessons learned, for the continuation and possible adjustment of activities in the remaining timeline of the strategic plan at both institutional and program intervention levels. Core strategies and activities for M&E are outlined below:

- Monthly meetings with monthly reports and actions
- Quarterly, semesterly, 9-monthly, and annual performance reports and action plans
- Mid-term review
- Final evaluation at the end of the strategic plan.

8. Conclusion

In order to ensure food safety and security, reduce poverty, and promote economic development, the development of CA, SI, and Agroecology is crucial. It will help promote intensification and diversification, ensure sustainable management and preservation of agricultural land resources, and better adaptation to climate change. The CARDEC Strategic Development Plan outlines the key strategic objectives and priority actions for 2022-2026 to guide implementation of the action plan and to encourage stakeholder engagement.

To successfully and fruitfully achieve this Strategic Plan, CARDEC requires strong support from the Royal Government of Cambodia (particularly from MAFF and relevant ministries/agencies), national and international organizations, development partners, and the private sector in the form of advocacy, technical assistance, and financial resources to improve its experimentation, R4D, and training and technical extension provided to farmers (especially women and young people) and other stakeholders for the development of CA, SI, and Agroecology in Cambodia and Southeast Asia.

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- Climate Change Priorities Action Plan for Agriculture, Forestry and Fisheries Sector 2016-2020
- National Action Program (NAP) to Combat Land Degradation 2018-2027
- National Biodiversity Strategy and Action Plan (NBSAP) (updated 2016)
- National Policy on Green Growth (developed in 2013)
- National Strategic Plan on Green Growth (2013-2030)
- Policy and Framework of Gender Mainstreaming of MAFF (2016-2020)
- Progress Report for 2019 and Action Plan for 2020 of CASC
- Progress Report for 2020 of CASC, Summary (draft)
- Progress Report for June 2021 of CASC, Summary (draft)
- Progress Reports of various programs/projects implemented by CASC

Appendix 1: Milestones of CARDEC Strategic Development Plan 2022-2026

Strategic Objectives and Indicators	Unit	Baseline	Targets					Means of Verification
		2020 / 2021	2022	2023	2024	2025	2026	
Overall Strategic Objective: To promote the adoption of conservation agriculture and sustainable intensification based on climate smart agroecological principles that contribute to sustainable agricultural land resource management and to ensure food security and safety, economic development, environmental protection, and farmers' livelihoods.								
1. Number of farmer households implementing CA/SI & AE	Households	709	1,000	1,500	2,000	2,500	3,000	Department report and PDAFF reports
2. Land under CA/SI & AE in hectares	ha	2,508	3,000	4,000	5,000	6,000	7,000	Department report and PDAFF reports
3. Increase in soil carbon nutrient stocks (annual increase 0.12%)	Ton/ha	55.00	55.07	55.13	55.198	55.264	55.33	Field experiment report
4. Recognition of CARDEC as a national and regional research and training center	-	Not yet recognized	-	-	-	-	Recognized	MAFF's prakas
Strategic Objective 1: To promote R4D on agroecological practices and to design innovative climate-smart cropping systems								
1. Land under CA/SI & AE cropping systems designed & assessed	ha	14.5	14.5	50	50	50	50	Field experiment report
2. Number of studies on soil C & GHG	Articles	1	1	1	1	1	1	Publication on recognized platforms
3. Number of studies on ground water, nutrient cycling and soil biodiversity	Articles	1	1	1	1	1	1	Publication on recognized platforms
4. Number of studies on productivity, profitability (land, labor), farming system analysis, agricultural mechanization/technologies, etc.	Articles	1	1	2	2	2	2	Publications on recognized platforms
5. Number of appropriate-scale mechanization & technologies assessed	Number	1	2	2	2	2	2	Field experiment report
6. Feasibility mission for R4D agroecological planning	Number	0	0	1	0	0	0	Feasibility mission
Strategic Objective 2: To strengthen research on plant genetic resource conservation for agroecological land management								
1. Number of species & varieties conserved	Species	46	46	52	52	52	52	Monthly report
	Varieties	216	216	335	335	335	335	Monthly report
2. Quantity of crop seeds distributed to farmers, farmer groups, and other projects	Kg	8,216	10,000	15,000	20,000	20,000	20,000	Monthly report
3. Crop genetic bank with appropriate technical conditions	Number	1	1	1	1	1	1	Annual report
4. Satellite genetic banks receiving seeds (universities, communities)	Number	1	1	3	3	5	5	Annual report
5. Support for the registration of cover crops	Number	n/a	1	1	1	1	1	Annual report

Strategic Objectives and Indicators	Unit	Baseline	Targets					Means of Verification
		2020 / 2021	2022	2023	2024	2025	2026	
Strategic Objective 3: To strengthen agroecological skills development and to enhance knowledge transfer to stakeholders, especially farmers								
1. Number of field days and consultations with farmers, NGOs, and private sector - <i>40% are female participants</i>	Field days	10	10	12	26	32	40	Training report
2. Number of short-term training courses (for farmers, NGOs, and private sector) - <i>40% are female participants</i>	Trainings	0	2	4	4	6	6	Training report
3. Number of interns, researchers, and scholars doing research at the research station (in year n°)	Persons	2	2	3	3	4	4	Training report
4. Number of farmers receiving technical support (including producers and receivers of crop seeds) - <i>of which 40% female</i>	Households	378	400	500	500	600	600	Annual report
5. Number of provinces with PDAFF staff providing training and extension services (total number of provinces)	Provinces	4	4	4	5	6	6	Training report
6. Number of sessions to strengthen skills on agroecology of DALRM/CARDEC's team (in year n°)	Sessions	0	2	3	3	4	4	Training sessions for DALRM/CARDEC
7. Feasibility mission for the development of agroecological skills	Number	0	0	1	0	0	0	Feasibility mission
Strategic Objective 4: To improve R4D infrastructures and networks through national and international collaboration								
1. Number of government staff (total)	Persons	1	1	2	3	4	5	Administrative report
2. Number of government contractual staff (total)	Persons	0	0	1	2	3	4	Administrative report
3. Research and training infrastructure improved and strengthened	-	Insufficient	-	-	-	-	Sufficient	Equipment and facility inventory list (appendix 2)
4. Feasibility mission on the design & planning of infrastructure for the research & training center on CA/SI & AE	Number	0	0	1	0	0	0	Feasibility mission for infrastructure design and planning

Appendix 2: List of Tools, Equipment, and Machinery

	Description	Purpose	Total (US\$)
Strategic Objective 1: To promote R4D on agroecological practices and to design innovative climate-smart cropping systems			370,000
1	Laboratory tools	Experimentation	100,000
2	MIR for SOC analysis	Experimentation	65,000
3	Tools to quantify GHG	Experimentation	75,000
4	Small tractor (50-60 hp)	Agri. tool/equipment	25,000
5	NT planters for small-scale experiments with seed metric systems	Agri. tool/equipment	40,000
6	Combine harvester for experimental use	Agri. tool/equipment	65,000
Strategic Objective 2: To strengthen research on plant genetic resource conservation for agroecological land management			70,000
1	Coolbot (20 feet) with supporting base	Seed preservation	20,000
2	Seed sorting and cleaning machine	Agri. tool/equipment	20,000
3	Seed dryer	Agri. tool/equipment	15,000
4	Equipment quality control and software for monitoring seed storage	Agri. tool/equipment	15,000
Strategic Objective 3: To strengthen agroecological skills development and to enhance knowledge transfer to stakeholders, especially farmers			231,000
1	Mobile toilets	Training (sanitary)	2,000
2	Tractor (120 hp)	Agri. tool/equipment	65,000
3	Small NT planter	Agri. tool/equipment	15,000
4	Carts for tractor	Agri. tool/equipment	4,000
5	Grass cutters	Agri. tool/equipment	6,000
6	Mounted sprayers for tractor	Agri. tool/equipment	24,000
7	NT planter for <u>grains (maize, soybean and cover crops)</u>	Agri. tool/equipment	25,000
8	Roller crimper	Agri. tool/equipment	40,000
9	Round baller	Agri. tool/equipment	15,000
10	Small truck with crane	Agri. tool/equipment	35,000
Strategic Objective 4: To improve R4D infrastructure and networks through national and international collaboration			2,096,000
1	Printer and photocopier (color)	Admin (training)	7,000
2	Computers	Field staff & admin	8,000
3	Air conditioning units for training rooms	Admin (training)	6,000
4	Air conditioning units for dormitories	Admin (training)	5,000
5	Pickup truck	Logistics (training)	60,000
6	Motorcycle	Logistics (training)	10,000
7	Dormitory and training facilities	Admin (training)	1,500,000
8	Fencing and landscaping	Admin (station)	500,000
Total			2,767,000

Appendix 3: Budget Estimates for CARDEC Strategic Development Plan 2022-2026

Description	Budget Estimates (US\$)					
	2022	2023	2024	2025	2026	Total
Strategic Objective 1: To promote R4D on agroecological practices and to design innovative climate-smart cropping systems						
Investment in tools/equipment/machinery	10,000	70,000	290,000	-	-	370,000
Funds for research and experimentation	29,000	110,000	121,000	133,100	146,410	539,510
Sub-total	39,000	180,000	411,000	133,100	146,410	909,510
Strategic Objective 2: To strengthen research on plant genetic resource conservation for agroecological land management						
Investment in tools/equipment/machinery	20,000	-	50,000	-	-	70,000
Investment in seed production	16,430	22,000	36,300	53,240	58,560	186,530
Sub-total	36,430	22,000	86,300	53,240	58,560	256,530
Strategic Objective 3: To strengthen agroecological skills and to enhance knowledge transfer to stakeholders, especially farmers						
Investment in tools/equipment/machinery	4,000	32,000	195,000	-	-	231,000
Cost of Field days	3,750	4,730	10,750	13,890	18,230	51,350
Cost of Training	12,800	30,770	54,020	60,430	83,510	241,530
Cost of Technical support to farmers	30,000	33,000	36,300	39,930	43,920	183,150
Cost of Supporting provincial/district technical extensions	20,000	20,000	25,000	25,000	30,000	120,000
Cost of Supporting interns/researchers	3,600	5,670	5,950	8,330	8,750	32,300
Cost of Strengthening capacities of DALRM/CARDEC team	6,000	9,000	15,000	20,000	24,000	74,000
Sub-total	80,150	135,170	342,020	167,580	208,410	933,330
Strategic Objective 4: To improve R4D infrastructures and networks through national and international collaboration						
Investment in tools/equipment/machinery	8,000	28,000	1,560,000	500,000	-	2,096,000
<u>Personnel expenses (Staff costs)</u>	102,000	107,280	126,600	133,080	150,600	619,560
Expenses involved in Feasibility study on infrastructure design, R4D, and capacity building planning	-	50,000	-	-	-	50,000
Promotional materials and media	6,200	6,700	7,250	7,860	8,530	36,540
Office supplies, hygiene, and communication	7,200	7,560	7,940	8,340	8,760	39,800
Mission/travel	16,800	16,800	18,900	18,900	21,000	92,400
Fuel	8,000	8,800	9,680	10,650	11,720	48,850
Repair and maintenance - buildings	1,500	1,800	2,160	2,590	3,110	11,160
Repair and maintenance - vehicles	4,000	4,800	5,760	6,910	8,290	29,760
Repair and maintenance - agricultural tools and equipment	4,000	4,400	4,840	5,320	5,850	24,410
Other contingency expenses	2,500	2,500	2,500	2,500	2,500	12,500
Sub-total	160,200	238,640	1,745,630	696,150	220,360	3,060,980
Grand total	315,780	575,810	2,584,950	1,050,070	633,740	5,160,350