DEIMEAS

Report 2022 - 2025

Exploring Financial Mechanism for Agroecology Transition

Battambang province, Cambodia

October, 2025

Project lead:

Developer: cirad SmartAgro swisscontact

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Project: Agroecology and Safe Food System Transition (ASSET) in Southeast Asia

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Contents

Acronyms

AE	Agroecology
AEA	Agro-economic Assessment
AFD	French Development Agency
ASSET	Agroecology and Safe Food System Transitions in Southeast Asia
AWD	Alternate Wetting and Drying
BAU	Business as Usual
BUAC	Battambang Union of Agriculture cooperatives
CA	Conservation Agriculture
CAO	Commune Agriculture Officer
CARDEC	Cambodian Conservation Agriculture Research for Development Center
CASIC	Conservation Agriculture and Sustainable Intensification Consortium
CC	Cover Crop
CDM	Clean Development Mechanism
CIRAD	French Agricultural Research Centre for International Development
COP	Conference of Parties
CORSIA	Carbon Offsetting and Reduction Scheme for International Aviation
DALRM	Department of Agricultural and Land Resources Management
DAS	Days After Sowing
FAO	Food and Agriculture Organization of the United Nations
FFEM	French Facility for Global Environment
FWUC	Farmer Water User Community
GDA	General Directorate of Agriculture
GHG	Greenhouse gas
Ha	Hectare
ITC	Institute Technologique Du Cambodge
ITMO	Internationally Transferred Mitigation Outcomes
MAFF	Ministry of Agriculture, Forestry and Fisheries
MC / SC	Main Canal / Secondary Canal

MIR	Mid-Infra-Red
MRV	Monitoring Reporting and Verification
NDC	National Determined Contribution
NTP	No-Till Planter
PDAFF	Provincial Department of Agricultural Forestry and Fisheries
SG	Sub-Group
SOC	Soil Organic Carbon
SRP	Sustainable Rice Platform
TA	Technical Assistance
tCO2eq	Ton of CO_2 Equivalent
WAT4CAM	Water Resource Management and Agro-ecological Transition for Cambodia

Summary

1. Key messages

DeiMeas (Golden Soil) is a research-based pilot of 3 years (2022-2025), led by DALRM/GDA, that aims to explore financial mechanisms for a sustainable transition of smallholder farmers toward agroecology (AE) practices. The first phase of the pilot, located in 2 areas of Battambang province, ended in June 2025, and the main lesson learned, and recommendations are:

193

farmers transition to Agroecology

290

hectares implementing agroecology practices annually

- **Finance gap:** the 3 years agro-economic assessment conducted in the Kanghot irrigation scheme of Battambang province (2022-2024) has revealed that farmers spent on average 91.5US$/ha/year on adoption of agroecology practices, representing an increase of +17% of the production costs when considering the 1st rice cycle in Kanghot. Additional support and revenues are needed to ensure a safe and profitable transition to smallholder farmers. The reward system is what pushes the farmers toward the transition for the first years of implementation. The reward influence short-term planning of farmers but this is the knowledge and know-how gathered by farmers that are seen as more important for the long term implementation.

- **Carbon farming** practices can technically generate carbon credits, but require continuous technical support for transition, accessible and calibrated Monitoring Reporting and Verification (MRV) technologies, and sufficient and fair incentives for agricultural cooperatives and farmers.

- **Smallholder farmers**: Carbon farming is yet to be adapted to smallholder farmers due to high field and MRV costs (requires scales to break even). There is a need to develop and/or adapt mechanisms that does not exclude smallholders.

- **No silver bullet:** Transition to agroecology requires time and a context-specific approach taking into consideration the social and institutional organizations in place that requires innovations and cropping systems to be co-designed alongside farmers organizations (ACs, FWUC, local operators). Carbon market often seeks simplicity, which could be opposed to transitioning agricultural systems under an agroecology and holistic lens.

- **Cropping system approach vs. 'simple' technology:** A systemic approach focusing on the different components of a cropping system (water, soil, crops and technology/products) is key, rather than focusing on simple technologies and products that are too often promoted in isolation. In addition, technical support needs to be upgraded at farm and territory levels to address their social and institutional diversity and connectivity across farming system components such as crops and livestock.

- The "**Boots on the ground**" representing the team working on-site and providing technical support to main operators and beneficiaries for the implementation of project activities, are undervalued in carbon farming projects. While these projects often have detailed financial systems, they frequently lack farmers' training programmes and technical assistance during the transition period, as well as support with data collection and field measurements. We estimated ground costs between ~17 and ~40 US$/ha/year (according to project scale). This cost could be minimized under a medium-term approach with the skills reinforcement of agricultural cooperatives or other operators such as FWUC for the irrigation scheme.

- **Alternate Wetting and Drying (AWD)** shows high potential as a methane-reduction strategy in rice systems. Yet, several challenges on collective water management and land management need to be addressed. AWD along with some prerequisite (exportation of crop residues to reduce the methanogenesis) is often in contradiction with an integrated soil fertility management; scaling efforts must be embedded in a broader systemic agroecological approach. Through the implementation of AWD during the rice cycle, it could be estimated a potential mitigation impact of 1.01 to 3.46 tCO_2eq/ha, leading to a potential avoidance of ~33.8 to 115.9 tCO_2eq from from the area (33.5 ha) under AWD at the SG-17.

- **Natural AWD:** Future AWD projects aiming to generate carbon credits will require conducting detailed baseline to avoid false mitigation claims, as "natural" drainages and drying periods are largely implemented in more than half of plots in the targeted area (Kanghot), without project intervention.

- **MRV is crucial** and define the quality and transparency of any initiative whether the target is practice or impact-based. Support in developing innovative low-cost technologies and approaches to address the diversity of the MRV will greatly improve access to smallholder farmers to innovative financial mechanisms.

- **Co-benefits:** Agroecology brings more than carbon or climate benefits and these additional outcomes also should be measured and valued. Innovative financial mechanisms are being developed, recognizing and incentivizing these co-benefits (Outcome-based payment, practice-based certifications…).

- **Carbon market is a tool not an objective**. Carbon finance plays an important role in supporting project implementation and promoting the adoption of sustainable practices among farmers. However, it is not sufficient to finance the entire business plan or cover the whole project costs. While it can provide additional revenue, carbon finance should be considered a complementary source of funding rather than the main financial driver. Focusing mainly on carbon revenues, instead of adopting a holistic approach to strengthen farming system resilience and reduce climate impacts, may pose financial risks and uncertainties for smallholder farmers.

- **Private sector involvement**: whether for offtake along the value chain, or early finance access (from end-buyer), private sector should be identified and involved from the project design stage to ensure project financial viability and early payments to farmers. Result-based approaches, relying on credit certification and sale to incentivize farmer would often require several years before first payment.

- **Complementary approach** of financial mechanisms should be promoted to support smallholder farmer's transition. Additional revenues from value chain (certification such as SRP, premium on production...) and valorization of transition's impact (additional incentives from outcome-based payments, carbon credits...) would ensure a long-term support and financial incentives spread in time.

2. Key indicators

Total participants in DeiMeas Event

1580
Participants
32% female

Average farmers spent on adoption of agroecology practices

91.5
US$/ha/year

20
events per year

DeiMeas organized events in Rattanak Mondoul district (upland area) and Kanghot irrigated perimeter (lowland area).

641 plots
Registered under DeiMeas Pilot

454 ha
Cover crop grown cumulated

$40,000+
Farmer rewards

33.5 ha
Under a research-pilot on Alternate Wetting and Drying (AWD)

Through all its activities, the DeiMeas pilot had a large range of measurable impacts, which are divided into 3 main pillars (Transition – Quantification – Finance) and activities around capacity building and communication:

Pillar 1 "Transition": farmer technical support to agroecology and practice-based incentive system:

- DeiMeas organized more than ~**20 events per year** in the Rattanak Mondoul district (upland area) and Kanghot irrigated perimeter (lowland area), including demand creation events during which local service providers, Agriculture Cooperatives (ACs) and farmers are pooled together to exchange on new services (machinery, seeds, inputs), farmers trainings, field demonstrations or focus group discussions.

- The DeiMeas team contributed and participated to an average of ~30 additional field events per year, organized by partner projects and organizations (BUAC, TA-AGRI/WAT4CAM, FWUC…).

- In 2024 alone, DeiMeas organized 24 field events in Battambang's two intervention areas, gathering a total of **526 participants (36% female),** and contributed to 39 partner events, reaching more than 1580 participants in total (32% female).

- Over the 3 years pilot, **193 farmers** registered 641 plots under the DeiMeas initiative and implemented agroecology practices on **~290ha annually**. Farmers implemented agroecological scenario including several practices integrated in their cropping system. Cumulatively, **No-till planter (NTP)** was used on 461ha, **cover crops** were established on 454ha, and **pulse crops** were integrated in cropping systems on 461ha. DeiMeas also supported the production of 52ha of cover crop seed in upland regions.

- **US$ 40,000+** were allocated to farmers for their successful practice implementation over the 3 years, US$ 26,643 and US$ 14,219 in lowland and upland, respectively. ~60% of the incentives were given for diversification of farmer's cropping system (cover crop, pulse crop…).

- 42 farmers (~22%) were acknowledged as "**Early adopters**", for being part of the DeiMeas pilot and implementing agroecology practices across the three years of the initiative (2022 – 2024; 32 farmers in the lowland and 10 in the upland).

- Through a research-pilot on synchronized agriculture and Alternate Wetting and Drying (**AWD**), **33.5 ha** (~58% of the study area) successfully conducted a collectively coordinated single drainage event during the second rice cycle of 2024.

Pillar 2 "Quantification": quantifying transition impacts and calibrating innovative MRV technologies:

- The DeiMeas team participated in the **annual agroeconomic assessment** (AEA), interviewing ~140 farmers (~60 in upland, ~80 in lowland) on their practices, costs, and profits at the end of each crop cycle. For the Kanghot area, the AEA was conducted in partnership with the R4D sub-component of WAT4CAM.

- A **soil baseline** was conducted, analyzing **484 soil samples** (carbon and nitrogen concentrations), supporting the calibration of 3 MRV technologies (Model, MIR spectrometer, Remote sensing). **Soil fertility index** of 68 plots was assessed using the Biofunctool® approach targeting 3 main soil functions (Carbon transformation, nutrient cycling and soil structure maintenance).

- **53 pani pipes** were installed to manually monitor the water level of the paddy field across the 5 blocks of the MC2-Kanghot irrigated perimeter. Despite 31 farmers participating in the data collection of the water level alongside the DeiMeas team, the data collection remains labor-intensive. These data showed a heterogenous access and management of the water resource and "natural AWD periods" occurring in all blocks.

- A **water sensor** prototype was engineered and tested by a team from the Institute of Technology of Cambodia (ITC), allowing automatic data collection of the water level, with a locally manufactured device. The prototype is in its final phase of tests in the Block A of Kanghot.

- A **Mid infra-red spectrometer (MIR)** was calibrated using the soil analyses of DeiMeas plots, included as part of a pool of over 4,700 georeferenced soil samples from the Department of Agricultural Land Resources Management (DALRM/GDA). The estimation of the soil organic carbon concentration, through the MIR, allows to reduce drastically the cost of soil analysis.

- **Modelling of rice growth, soil organic carbon and greenhouse gases (GHGs)** has been initiated, mainly for rice cropping systems (Mathilde Dionisi, PhD, and field assessment under the R4D of WAT4CAM), and for cassava-based cropping systems (Leng Vira, PhD study, Bos Khnor, ASSET). Two main models are being compared: DSSAT and DNDC. For rice-based systems, additional contextualized datasets are needed to reduce the uncertainty in predicting carbon and nitrogen stocks and GHG emissions. For rainfed annual crops such as cassava, predictions of soil organic C and N stocks are acceptable, but GHG emissions still show large discrepancies between measured and estimated data, requiring additional calibration and validation processes.

- **Satellite remote-sensing** calibration and monitoring with CarbonFarm. After ground-proofed tests and calibration, the remote sensing company was able to produce conclusive and context-specific results on:
    - o **Water management**: ~52% of all plots were identified with "strong or some evidence" of drainage during the rice cycle, without project intervention (what is referred in this report as "natural AWD"),
    - o **Burning monitoring**, showing a significant decrease of rice crop residues burning practice in MC2-Kanghot between 2019 and 2024 (from 49% to 3% of monitored plots),
    - o **Plot delimitation**: created precise polygon boundaries of farmer plots, removing trees, ponds and bunds for more precise surface estimation,
    - o **Crop diversity detection** was tested, opening possibilities for practice adoption verification through remote sensing.

Pillar 3 "Finance": exploring financial mechanisms that could support Cambodian smallholder farmers in their transition:

- The main **types of financial mechanisms** highlighted during the study were: certification (of the product or impact), results-based (often carbon market related), outcome and practice-based payment (broader indicators, including co-benefits), financial institutions (insurance and finance access) and hybrid or complementary approaches.
- Non-disclosure agreements (NDA) were signed with three private sector actors to assess their business models and to share information supporting the development of financial mechanisms for Cambodian farmers' transition toward agroecology:
    - o **ShambaCenter**: outcome-based payment model, aiming to de-risk the transition for farmer and field partners, providing incentives to farmers based on produced outcomes, and financed through sustainable impact bond. Indicators and measuring tools of the targeted outcome must be defined in advance.
    - o **AgriG8**: project developer with "Hybrid" mechanism though lower-interest loans (transition finance), and providing MRV data collection tools, supporting low-carbon value-chains. AgriG8 is also a partner of BUAC and NILEDA (input supplier) aiming at developing a 'tracking' system of SRP (and non-SRP) farmers regarding the inputs used with a pro-active role to limit the use of highly toxic and non-relevant pesticides.
    - o **CarbonFarm:** carbon project developer, focusing on rice system and AWD promotion, aiming to generate carbon credits (VCM or Article 6) and providing ground proofed remote sensing MRV.

- An **"eco-credit"** methodology was developed with **RegenNetwork** and is currently under review through a 3rd-party audit. This methodology could then be used in future practice-based projects in Cambodia, incentivizing farmers for their AE practice adoption. Its implementation will still need to be piloted, involving private sector and impact/outcome buyers.

Pillar 0 "Coordination and Communication": Communication and capacity building of field and institutional partners:

- Alongside the activities of the 3 pillars, the DeiMeas pilot conducted several capacity-building workshops and skills training with field teams and partners:
  - **Biannual training sessions for field partners** were organized on digitalization of data collection and use of geolocation software for plot monitoring. These trainings gathered participants from PDAFF, BUAC, CAO, TA-AGRI/WAT4CAM or CARDEC teams from Battambang and neighboring provinces, and were conducted on the use of Google My Maps, Kobo toolbox, Microsoft Excel and QGIS. Some trainings, focusing on SRP certification, on data collection and GIS data management, were provided to BUAC team members.
  - DeiMeas organized the first Cambodian **Soil Collage** ("La Fresque du Sol" in French) as an educational and collaborative workshop designed to raise awareness about soil health and its critical role in ecosystems. Through collective learning, it encouraged individuals to understand the importance of soil conservation for agriculture, biodiversity, and climate regulation.
- Under the lead of DALRM, the DeiMeas team has contributed to the **Global Soil Partnership (GSP)** of Food and Agriculture Organization (FAO) on:
  - The first Soil Doctor Program training of trainers (To5), led by DALRM, gathering 91 participants, including 32 official trainees (DALRM, PDAFF,CAO representatives, 30 farmers, 19 certified trainers from the Thailand Land Development Department (LDD).
  - 6 Soil Doctor trainings were then organized by DeiMeas teams, gathering 100+ farmers in Battambang province, in partnership with CAO, CARDEC/DALRM and PDAFF.
  - DeiMeas was recognized as part of the **RECSOIL** research network (FAO/GSP), opening opportunities to exchange experience and feedback with similar pilot projects around the word, using comprehensive tool to scale up sustainable soil management practices based on SOC sequestration.

- The DeiMeas pilot was presented and discussed at **national and international conferences** and workshops, such as TARASA23, Sustainable Rice forum, Cambodian Climate Change Forum (CCCF), or the ASEAN Workshop on Carbon Neutrality, allowing many discussions and debates around transition finance, and increasing visibility of the pilot.
- Through the policy dialogue of CASIC and with the collaboration of DALRM/CARDEC, CIRAD and Swisscontact under the ASSET project, **15 species of cover crops were officially registered in Cambodia** by the Crop Seed Department of GDA/MAFF. This certification represents a significant milestone for Cambodia's agricultural sector, particularly for sustainable farming practices and value chains.
- A training course was developed on **"Carbon finance and Agriculture**" and conducted during the final phase of the project with the aim of providing stakeholders (development partners, government stakeholders, and policymakers) with essential knowledge to engage in carbon finance and support climate-related decision-making. The training covered the history of international climate negotiations and carbon markets, highlighting the Article 6 of Paris Agreement, carbon farming practices, and the limitations associated with the implementation. The first training was held at Swisscontact office and gathered teams from more than 10 partner institutions.

DeiMeas Short Description

Pilot name	DeiMeas - ដីមាស (Golden Soil)
Project	Agroecology and Safe food System Transitions (ASSET) in Southeast Asia
Founder	French Facility for Global Environment (FFEM)
Co-funding/ additional funding	Agence Française de Développement (AFD) European Union (EU) Quantedge Advancement Initiative LIEN Foundation Innovation for Sustainable Agriculture (ISA) CIRAD SEQANA
Lead executive agency	Cambodian Department of Agricultural Land Resources Management (DALRM/GDA)
Partners project devel-oper	CIRAD, Swisscontact and SmartAgro,
Locations	Two districts of Battambang province, Cambodia • 3 villages in the Kanghot irrigation scheme, Sangkae district • 2 villages in the upland area of Rottanak Mondoul district
Duration	Mid-2022 – Mid- 2025 (3 years)

1. The 3 DeiMeas pillars

Agroecology (AE) practices (i.e., for annual crops based on no-tillage, crop diversification, permanent soil cover and agroecological crop protection) represent a significant potential to restore degraded lands, optimize nutrient availability, reduce the use of hazardous pesticides, combat climate change and directly improve food security and farmers' livelihoods. By shifting their practices toward agroecology, smallholder farmers can contribute to soil carbon sequestration and GHG emissions reduction, while enhancing a broad set of ecosystem services and co-benefits. However, when adopting these practices, smallholder farmers face various short-term agronomic and economic uncertainties. Their full transition toward sustainable farming practices can take several years and thus, farmers might not risk a transition without **incentives** (i.e., financial, technical, organizational support).

Within the framework of the project "Agroecology and Safe Food System Transitions in South-East Asia" (ASSET/AFD-EU-FFEM), the Department of Agricultural Land Resources Management (DALRM) is leading a pilot initiative, called **DeiMeas (Golden Soil)**, through the support of SmartAgro, CIRAD, and Swisscontact. DeiMeas is a 3-year, research-based initiative, aiming to explore financial mechanisms for a sustainable transition of smallholder farmers toward agroecology (AE) practices (Figure 1). The pilot was conducted in two districts of Battambang province (Figure 2), and based on 3 pillars:

- **The 1st Pillar "Transition"** technically supports farmers in their transition and tests a practice-based incentive system by rewarding smallholder farmers annually for their successful implementation of Agroecology practices. At each intervention location, and every year, 4 main steps are followed:
    - i. Farmer registration and data collection (surveys),
    - ii. Practice transition,
    - iii. Monitoring of practice implementation, and
    - iv. Farmers rewarding. The pilot has reached 193 farmers from 2022 to 2024, registering 622 hectares across the two pilot locations in Battambang. More than US$ 40,000 were allocated to farmers over the 3 years for their successful implementation of the AE practices.

- **The 2nd Pillar "Quantification"** aims to measure agroecology transition impacts (i.e., SOC dynamics, agro-economic assessment, soil ecosystel services, pesticide usage ...) and support the calibration of innovative "monitoring, reporting, and verification" (MRV) technologies. These innovative technologies (model, remote-sensing, MIR spectrometer) could cost-effectively quantify impacts and co-benefits of farmers' transition contributing to financial mechanisms. 484 soil samples were collected and analyzed during the pilot, and 140 farmers' plots were monitored through an agro-economic assessment, supporting the testing procedures of several models and the calibration of the MIR spectrometer. Two satellite remote sensing companies are also involved in model calibration using ground-proofed data.

- **The 3rd pillar "Finance"** aimed to explore financial mechanisms that could support Cambodian smallholder farmers in their transition. From certifications schemes and carbon markets to outcome-based payments and microfinance Institutes, each model was analyzed for its feasibility in financing farmers' transition. Some of the identified business models are being tested (i.e., carbon developer on AWD project, insetting in SRP certification), others are implemented and aim to scale (SRP), while others are still at the designing phase but expected to launch in 2025 (ShambaCenter, RegenAgri, AgriG8). Some were not adapted to Cambodian conditions or faced difficulties to be implemented (the PREVOIR micro-insurance, ACORN-Rabobank).

2. DeiMeas results graphics and timeline

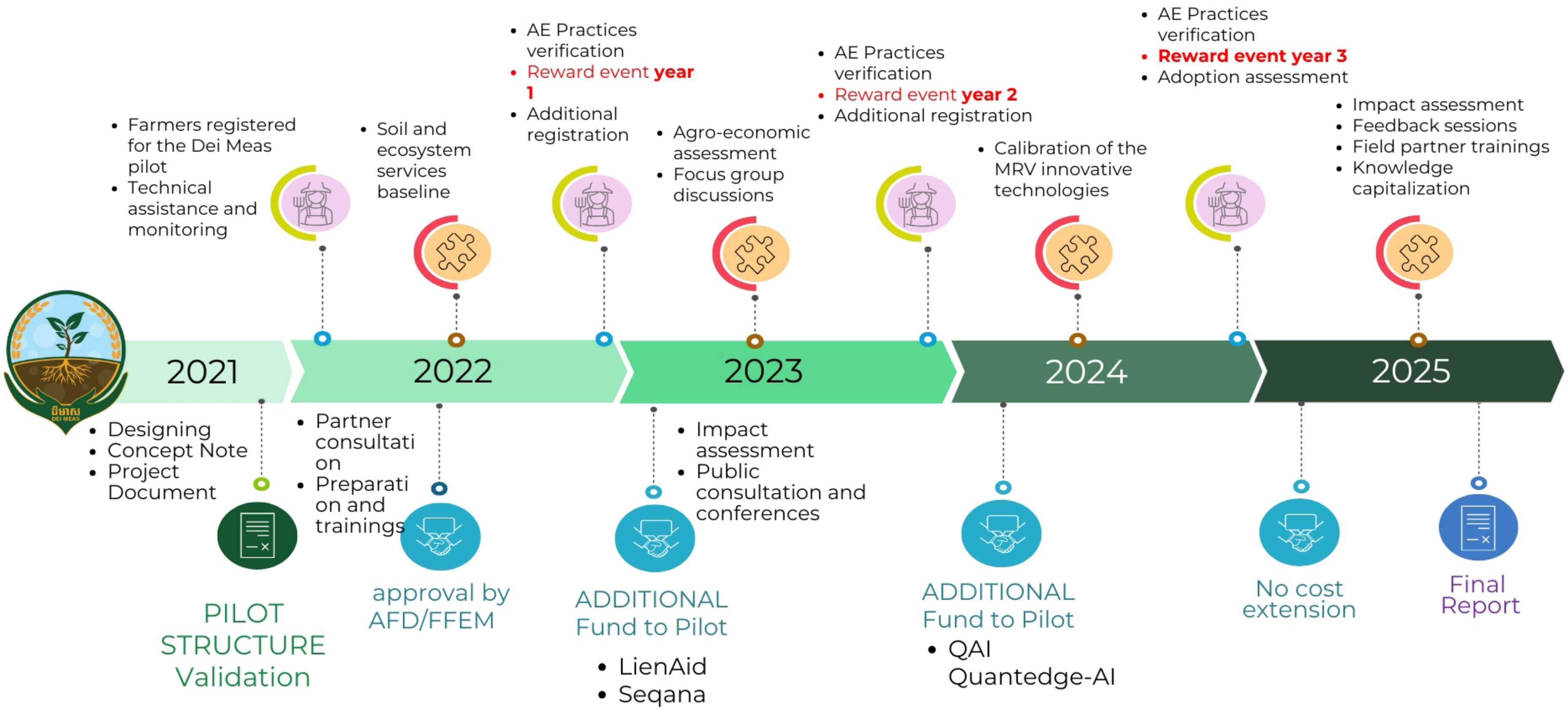

Figure 1: Timeline of the DeiMeas pilot

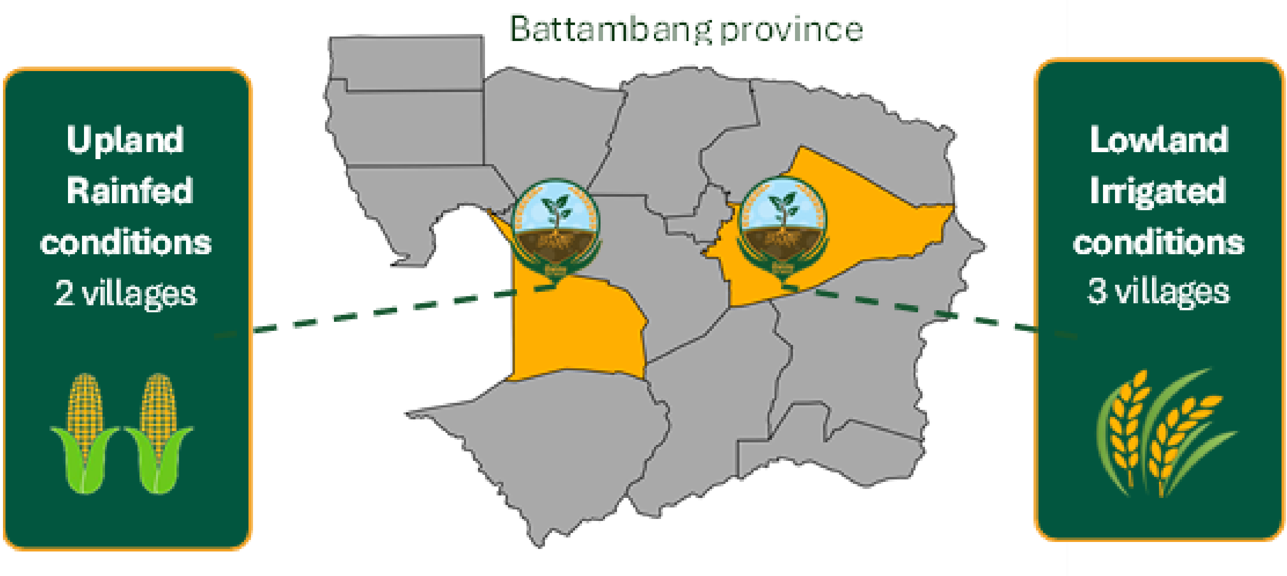

Figure 2: Simplified map of the two DeiMeas study locations

Village Upland	# of farmers	Plot registered	Surface (ha)	Incentive 2022-24 ($)
Sangha	32	53	111.4	8622
Pichangvar	31	44	79.5	5598
Total	**63**	**97**	**191**	**14219**

Village Lowland	# of farmers	Plot registered	Surface (ha)	Incentive 2022-24 ($)
Domnak Dangkor	25	147	93.6	6226
Reang Kessei	41	190	144.2	9890
Wat Kandal	60	197	189.0	10067
Svay Cheat	4	10	4.6	461
Total	**130**	**544**	**431**	**26643**

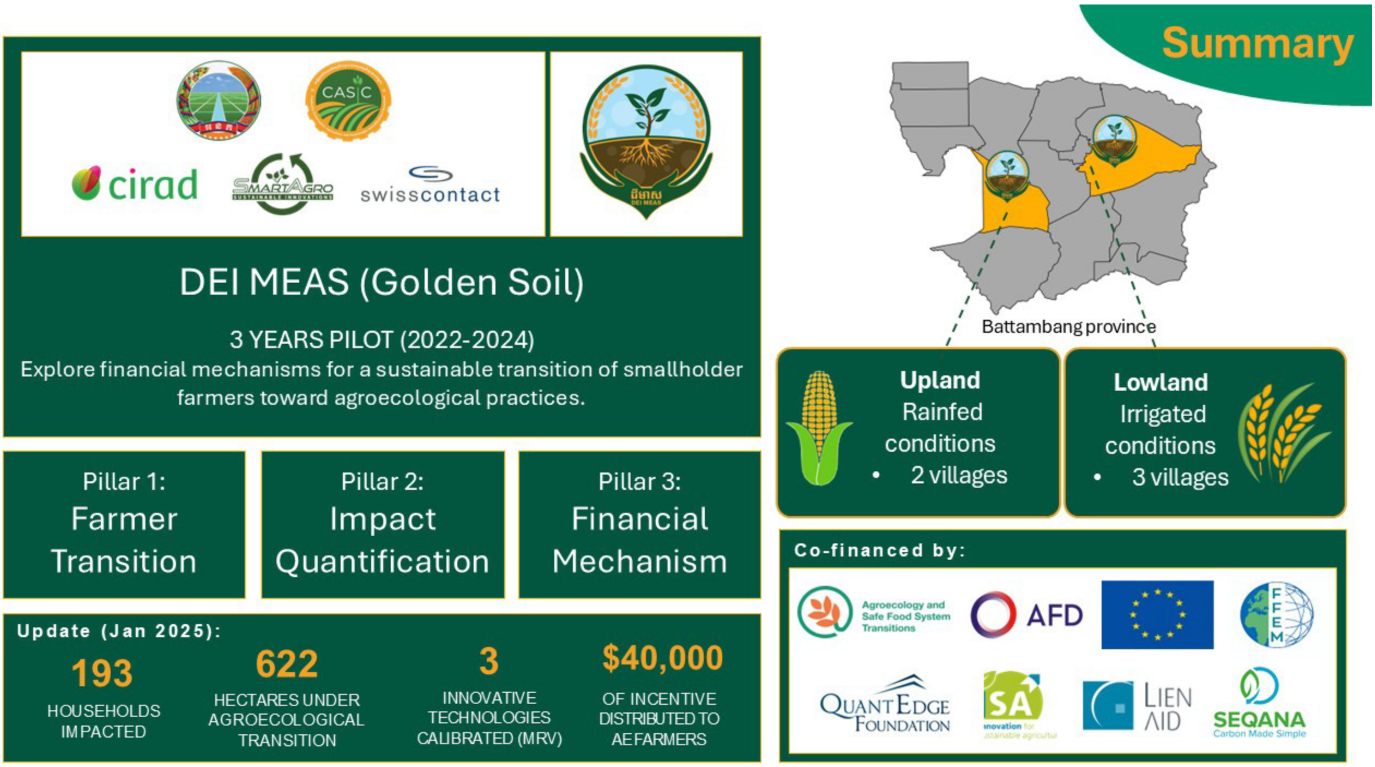

Figure 3: Summary Agroecology of the DeiMeas pilot

Pillar 1: Transition

1. Agroecology Practices

Through photosynthesis, plants remove CO_2 from the atmosphere, transformed it into sugars and other carbon-based compounds which can be sequestered in the soil as soil organic carbon (SOC), a process known as SOC sequestration, depending on practices and systems (i.e., agroforestry, conservation agriculture for annual crops, crop – livestock integration ...). Soil represents the largest terrestrial reservoir of carbon and has significant potential to store atmospheric carbon, making it a crucial ally in global efforts to mitigate climate change (Lal et al. 2004)[1]. According to the 4p1000 initiative[2], an annual increase of 0.4% of the SOC stocks in the first 40 cm of soil would significantly reduce the CO_2 concentration in the atmosphere related to human activities. Additionally, soil management is even proven to directly impact 13 of the 17 sustainable development goals (SDGs), according to Keesstra et al. 2016[3].

The adoption of Conservation Agriculture (CA)/ Agroecology (AE) practices for annual crops has direct impacts on soil health and climate change mitigation. In some countries, the approach of sequestering atmospheric carbon and reducing GHG emissions through sustainable practices adoption is called "**Carbon Farming**"[4] or regenerative practices.

"Conservation agriculture is the integrated management of the available natural resources such as soil, water, flora, and fauna with partial outside inputs which increases the efficiency of natural resource use." (Bisht et al. 2016[5]).

The main pillars of CA are:

i. **Minimal soil disturbance**: practicing no-till or reduced tillage to maintain soil structure and health,
ii. **Permanent soil cover**: Using cover crops and crop residues to protect soil from erosion and enhance soil organic matter and soil biodiversity,
iii. **Crop, plant species diversity**: Diversification of the cropping system through rotations, intercropping or crops succession to improve soil fertility and disrupt pest cycles.[6]

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1 https://www.researchgate.net/publication/8515631_Soil_Carbon_Sequestration_Impacts_on_Global_Climate_Change_and_Food_Security

2 4p1000 initiative

3 Keesstra et al. 2016

4 https://ec.europa.eu/clima/eu-action/forests-and-agriculture/sustainable-carbon-cycles/carbon-farming_en

5 https://doi.org/10.1007/978-981-10-2558-7

6 Séguy L, Bouzinac S, Husson O. 2006. Direct-seeded tropical soil systems with permanent soil cover: Learning from Brazilian experience. In: Uphoff N, Ball AS, Fernandes E et al. (eds) Biological approach to sustainable soil systems, pp 323-342. CRC Press, Taylor and Francis.

https://agritrop.cirad.fr/533071/
https://www.fao.org/conservation-agriculture/en/

Conservation Agriculture is part of the practices being identified within the frameworks of Sustainable Intensification and Climate-smart agriculture. Based on its biophysical principles, Conservation Agriculture is the foundation of a range of **agroecological practices**. Agroecology (AE) combines five main principles with:

1. Efficiency of agricultural systems,
2. Substituting the use of external inputs minimizing dependency of farmers,
3. Redesigning the landscape investing into watershed management (biodiversity, corridors ...),
4. Reconnect consumers and producers,
5. Build a new global food system.

Agroecology is also linked to the 13 principles identified by the High-Level Panel of Experts on Food Security and Nutrition making the links between the two main scales with (i) agroecosystems and (ii) food systems (Figure 4).

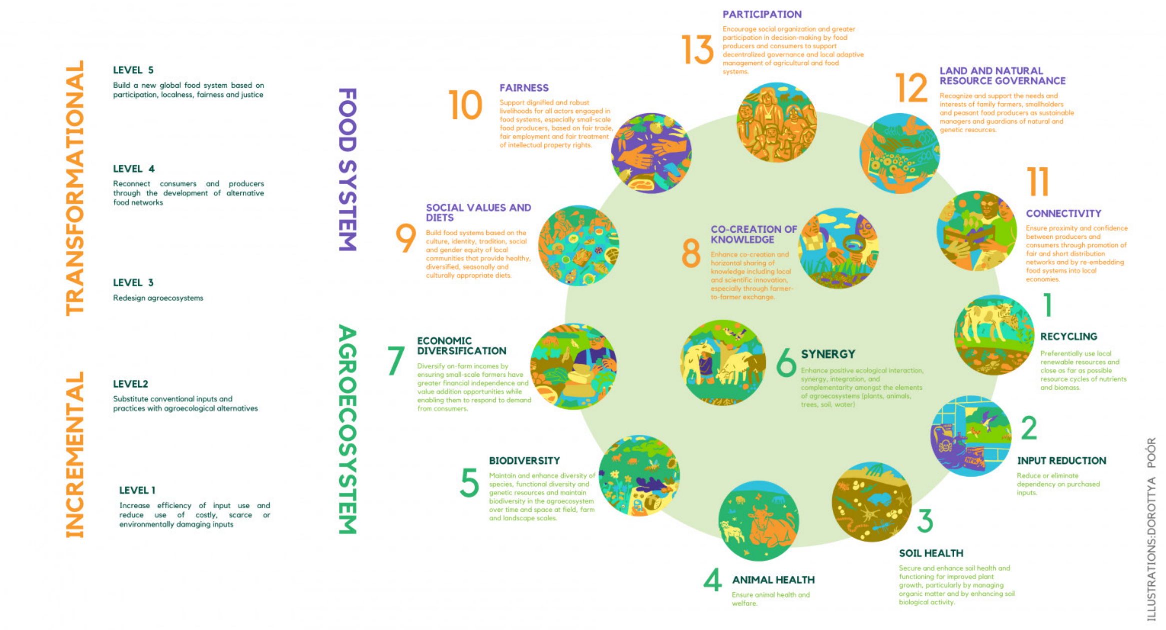


Figure 4: Description of the 13 agroecology principles, and the 5 levels of transition (Source: gliessman .2007 and hlpe .2019)[7]

7 https://www.agroecology-europe.org/the-13-principles-of-agroecology/

DeiMeas focuses mainly on the two first principles: (i) improving the efficiency of agricultural systems, and (ii) substituting the use of external inputs minimizing dependency of farmers. In addition, and by seeking out new financial mechanisms, DeiMeas contributes partially to the principle 4 of agroecology.

By adopting carbon farming practices, carbon credits can be generated from the climate mitigation impact of these practices (each credit representing a reduction or removal of one metric ton of carbon dioxide). Farmers can earn additional income through the sale of carbon credits to companies or organizations seeking to offset their emissions (e.g., Soil Capital[8] in Europe, IndigoAg[9] in USA, AgriProve[10] in Australia…). Although carbon farming often focuses on climate mitigation, it can also generate important co-benefits (increased soil health, biodiversity, farm resilience, reduced input costs…), but those are often not measured or valorized.

Only a few carbon farming pilots can be found in developing countries so far, as the technical knowledge, assets (seeds and machines) and financial mechanisms for carbon farming businesses need to be adapted to each country's context (smallholder farmers, tropical conditions, access to MRV tools…). This topic will be more detailed in the chapter "Pillar 3 – Finance" on this report.

8 https://www.soilcapital.com/fr
9 https://www.indigoag.com/
10 https://agriprove.io/

Figure 5: Pictures of some of the agroecology practices promoted in Kanghot and Rattanak Mondoul

2. DeiMeas Transition System

a. Practices Promoted During DeiMeas Pilot

Through the DeiMeas pilot, agroecology practices were promoted to farmers according to their cropping systems (irrigated rice in the lowland, and rainfed corn in the upland). The approach aims to increase the efficiency of the current cropping systems substituting current practices such as ploughing and use of synthetic fertilizers by the use of plant diversity focusing mainly on legumes for grain production and biomass (cover crops). This cropping system approach comprises a range of technical objects related to soil (minimum to no-till system, land levelling ...), crop (rotation, successions, mix of species, seed density, sowing date ...) and thematic adjustments (inputs: nature and quantity). The main promoted agroecology practices were:

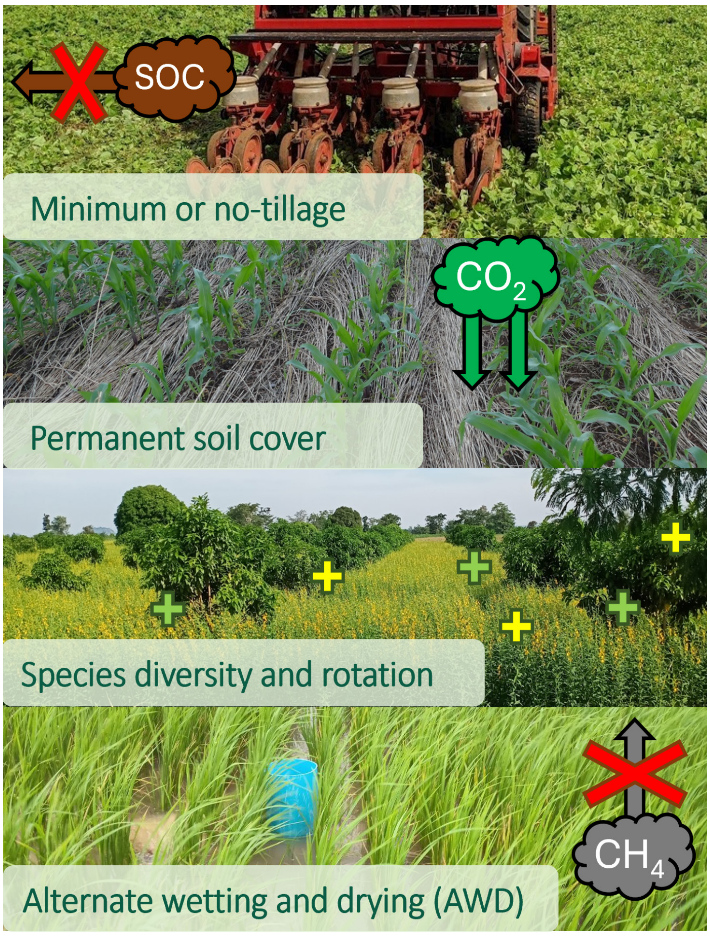


Figure 6: Main practices promoted through the DeiMeas pilot

i. Implementation of cover crops:
   - Single specie of cover crop
   - Multi-species of cover crops
   - Seed production of cover crops
ii. Diversification of the cropping cycle with pulse crop (mungbean, cowpea...)
iii. Appropriate scale mechanization
   - Land leveling (pre-transition practice)
   - No-till planter (NTP)
   - NTP & green sowing (sowing the main crop on living cover)
   - Reduce soil disturbance using stubble roller between rice cycles (lowland)
iv. CH_4 mitigation with Mid-season drainage (AWD in lowland)

The cover crops promoted to farmers were divided in two categories: i) Short-cycle cover crops (ShortCC) generally used before the cash crop during a 45 to 60 days cycle (*C. juncea, Sesbania sesban* ...), and ii) Long-cycle cover crops (LongCC), generally used after cash crop and kept on the field during the dry season up to the next season (*C. ochroleuca*...).

These agroecology practices were presented to farmers during focus group discussions before the DeiMeas pilot implementation, to collectively build the agroecology cropping systems that will be promoted to farmers in both target area. These cropping systems were then adapted annually, according to each year's climate conditions.

These agroecology practices were promoted together during DeiMeas field events, organized directly in the villages or on farmer's plots, in partnership with TA-Agri/WAT-4CAM, MetKasekor (PDAFF), BUAC, SmartAgro (and more recently the CAO). A graphical representation of the promoted agroecological practices in rice cropping system (lowland area) can be found Figure 7. All training sessions and group discussions are conducted in Khmer language, as well as the training material and posters used. Training and technical support to farmers were conducted throughout the year through:

- Individual monitoring (on-farm survey, phone call),
- Focus group discussions and feedback sessions (~10 farmers),
- Demand creation events (events involving private sector, showing agroecology assets and services to farmers available in the target area), field demonstration and farmer training (~30 farmers).

DeiMeas organized more than ~**20 field events per year**, including demand creations, farmers trainings, field demonstrations or focus group discussions, between the Rattanak Mondoul district (upland) and Kanghot irrigated perimeter (lowland). Additionally, the team contributed and participated in an average of ~30 additional field events every year, organized by partner projects and organizations (BUAC, Metkasekor, TA-AGRI, FWUC...), supporting the **SRP certification** process and scaling up of the AE practices in Battambang province. In 2024 alone, DeiMeas organized 24 field events in the two intervention areas of Battambang province, gathering a total of **526 participants (36% female)**, and contributed to 39 partners' events, reaching more than 1,580 participants in total (32% female).

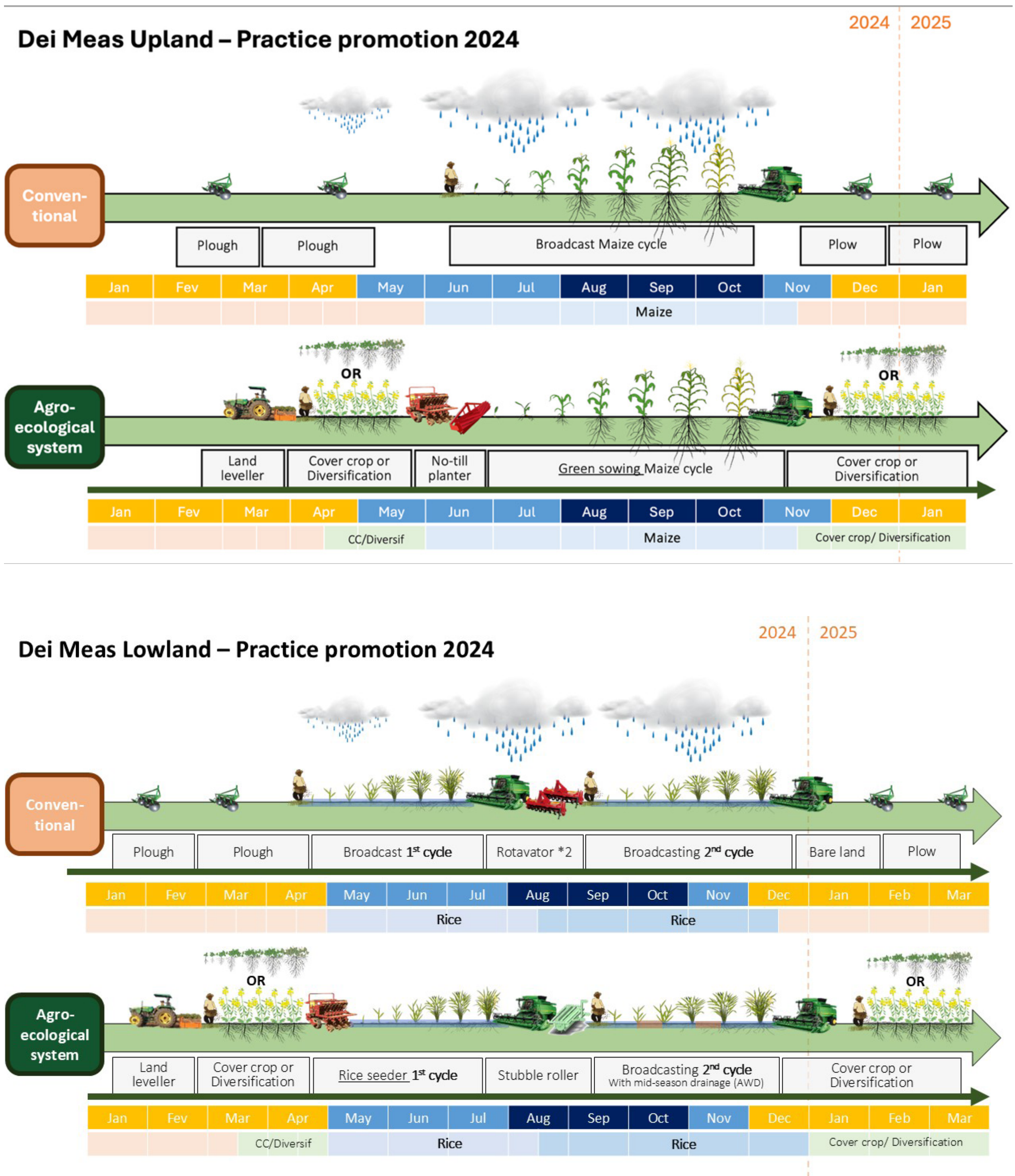


Figure 7: Graphical representation of the practices promoted during the DeiMeas pilot, compared to more conventional cropping system

b. Field Partners During the 3-year Pilot

Most activities organized in both target locations involved important field partners:

- CARDEC (DALRM/GDA), leading DeiMeas, providing technical assistance to farmers during their transition and in data collection and farmer monitoring processes
- Battambang Union of cooperatives (BUAC), directly involved in DeiMeas pilot (1 permanent BUAC staff member in the DeiMeas team) supporting the practice promotion, the data collection and linking the pilot with the SRP certification
- AC Reang Kessei officers involved in agroecological practice promotion and data collection for SRP certification
- PDAFF of Battambang leading the MetKasekor activities (promotion of appropriate scale machinery in partnership with the private sector and service providers)
- TA-ISWM and TA-AGRI (WAT4CAM program), involved in the support to FWUC, in the agroecology practice promotion, the SRP certification and the overall coordination of activities in MC2-Kanghot
- SmartAgro involved in the promotion and technical assistance on cover crops, polling additional resources and partners (Seqana, remote sensing), leading the development of the Regen Network methodology
- Farmer Water User Community (FWUC) supporting the water management and irrigation schedule in Kanghot and leading the AWD pilot at the sub-hydraulic level
- Commune Agriculture Officers (CAO), supporting agroecological practice promotion and data collection
- Key farmers in each village, supporting the promotion of agroecology practices as early adopters

c. Practice-Based Reward System

DeiMeas pilot developed a “practice-based” incentive system that rewarded annually smallholder farmers for their successful implementation of agroecological farming practices. At each intervention location (lowland/upland) and every year, 4 main steps were followed: i) Farmer registration and data collection (individual survey), ii) Technical assistance and practice implementation, iii) Monitoring and evaluation of practice implementation, and iv) Farmers rewarding at the end of the season. Even once registered in the pilot, farmers always had the choice to implement or not the agroecological practices promoted. DeiMeas team was ensuring that farmers were able to purchase the necessary assets (i.e., cover crop seeds) and/or were in contact with the local service providers (NTP, LL, roller…).

Two types of reward system were tested during the 3-year pilot:

i. **Scenario-based system**: farmers were proposed a set of agroecological practices, grouped as “scenarios”, co-designed with CARDEC and CIRAD team, each fitting farmer’s specific cropping system. The more “complex” the scenario, the higher the impact on soil and environment was expected, and thus the higher the reward would be. Farmers were then free to select the scenario they preferred to implement or test. Different scenarios could be implemented on different plot by the same farmer.
ii. **Entry and Top-up system**: in this system, farmers were proposed an “entry practice” (i.e., cover crop or crop diversification with legume) to “unlock” the main reward at the end of the season for successful implementation. All other practices promoted (i.e., NTP, LL, green sowing…) were incentivized through “top-up” to the main reward. This method was considered easier to explain by the team, and to understand by farmers, but also removed the uncertainty of machinery interest or access in some villages.

The two systems used during DeiMeas pilot are detailed on Table 1.

The reward was calculated by the CARDEC and CIRAD team, using:

i. the costs of each agroecology practice and machinery service promoted and
ii. the soil health and environmental impact of the practice or scenario.

Reward amounts also had to be close enough to what potential future financial mechanisms could support after the pilot (i.e., PES, carbon credits, sustainable certification…). Reward systems and amounts were discussed and modified accordingly with field teams and key farmers at each targeted location. Once set, these reward system and amounts were detailed to farmers every year during field events (and individual contact), before the start of the cropping season, so they could start planning accordingly.

After practice verification, individually and during the reward events, organized once a year in each village at the end of the season, the reward was sent to the farmers through their phone number, using the direct money transfer of WING Bank. This option was discussed with the DeiMeas team and the farmers themselves and was selected as the easiest and safest to ensure incentive transfer, knowing that most farmers did not have a bank account. Transfer confirmation was then given by farmers to the team once money collected at any of the numerous WING shop available in the villages. The WING pay slips were kept for transparency and audit reporting (example of WING pay slips in the annex, Figure 56). The transfer fees were covered by the pilot. Due to administrative constraints, the DeiMeas pilot couldn't open a bank account, leading to farmers' transfer made one by one, a time-consuming process. A future incentive mechanism should include an intermediary (BUAC…) and a private actor (Wing or AMK bank…) to support the incentive distribution and verification.

Table 1: DeiMeas "Scenario-based" (top) and "Entry and Top-up" (bottom table) incentive systems

	Category	Practices promoted	Incentive ($/ha)
Scenario 1	Cover crop or Diversification, before or after the cash crop	·Single species cover crops ·Multi-species cover crops ·Seed production cover crops *(upland specific)* ·Cash crop diversification	**35$**
Scenario 2	Cover crop or Diversification, before or after the cash crop	·Same as Scenario 1	**65$**
	Appropriate-scale machinery	· Pre-transition practices: Land leveling ·No-till planter (NTP) ·Roller between rice cycles *(lowland specific)*	
Scenario 3	Cover crop or Diversification, before or after the cash crop	·Same as Scenario 1 and 2	**85$**
	Appropriate-scale machinery	·Same as Scenario 2	
	<u>Additional</u> cover crop or diversification cycle, before or after the cash crop	·Single species cover crops ·Multi-species cover crops ·Seed production cover crops *(upland specific)* ·Cash crop diversification	

	Category	Practices promoted	Incentive ($/ha)
Entry practice	(i) Cover crop:	·Single species cover crops ·Multi-species cover crops ·Seed production cover crops *(upland specific)*	**40$**
	(ii) Diversification:	·Cash crop diversification	
	(iii) CH4 mitigation	·Mid-season drainage (AWD) *(lowland specific, in the SG17, in 2024)*	**20$**
Top-up	(a) Top up **added cycle**	·More than one diversified cycle per year	**20$**
	(b) Pre-transition practices:	·Land leveling	**20$**
	(c) No-till sowing/ planting	·No-till planter (NTP)	**10$**
	(d) Residue management:	·NTP + Green sowing (on living cover)	**20$**
	(e) Reduce soil disturbance	·Roller between rice cycles *(lowland specific)*	**10$**

d. Practice Adoption and Reward: Pillar 1 Results

Over the 3-year pilot, **193 farmers** registered 641 plots under DeiMeas, representing a total of 622 hectares under agroecological transition (Table 2). Starting with 107 farmers in 2022 between the two study locations, the number of farmers participating in the pilot grew ~30% every year. The number of farmers registered was higher in the lowland (~ 66%), as 3 villages were selected there (plus a few farmers from a fourth one), compared to 2 villages in upland.

Table 2: Synthesized result table of the DeiMeas Pillar 1

Village	# of farmers registered	# of plots registered	Total Surface (ha)	Reward ($)
Domnak Dangkor	25	147	93.6	6226
Reang Kessei	41	190	144.2	9890
Wat Kandal	60	197	189.0	10067
Svay Cheat	4	10	4.6	461
Sangha	32	53	111.4	8622
Pichangvar	31	44	79.5	5598
Total	**193**	**641**	**622.2**	**US$ 40,862**

Once registered, farmers still had the choice to implement the agroecological practices promoted during the field events. It was on average 66% of all registered farmers who implemented at least one AE practice each year. The rest of the registered farmers had different reasons for not implementing them, the main ones being i) lack of money for the practice costs (i.e., seeds or service costs), ii) time constraint (i.e., sowing the cash crop as early as possible) or iii) service access (i.e., not enough service providers for NTP or LL). More specifically in the upland, some farmers implemented a bi-annual rotation with cassava, which was not eligible in DeiMeas system. Most of these farmers did not receive a reward that year but came back the following year when sowing corn and implementing one of the scenario or entry practice.

We can note that 42 farmers implemented agroecological practices each year during the 3-year pilot (32 farmers in the lowland and 10 in the upland), representing 39% of all farmers registered since 2022. These farmers were acknowledged as "**Early adopters**" and given a certificate during the last reward event in their village (Figure 10).

On average, DeiMeas farmers implemented agroecological practices on **~290ha annually** in Battambang province. In cumulative over the 3-year pilot, No-till planter (NTP) was used on 461ha, cover crops were established on 454ha, and pulse crops were integrated in cropping systems on 461ha. While the surface of cover crops and pulse crops were mainly located in the lowland (72%), we can note that the no-till planter was widely adopted in the upland (77% of the surface).

During the 3-year DeiMeas pilot, **US$ 40,000+** was allocated to farmers for their successful agroecological practice implementation, US$ 26,643 and US$ 14,219 in lowland and upland, respectively. The detailed results of the pillar 1 of the DeiMeas pilot can be found in the Table 3, Figure 8 and Figure 9. The cover crops are separated into i) Short cycle cover crops (ShortCC), and ii) Long cycle cover crops (LongCC).

Table 3: Detail on agroecology practices implemented between 2022 and 2024 (top table) and detail of the registration and reward given to farmers between study locations during the DeiMeas pilot (bottom table)

Year	Diversification (ha)				Machinery (ha)		
	ShortCC	LongCC	Pulse crop	Seed production	NTP	Green sowing	Land leveler
2022	90	40	160	26	101	12	21
2023	48	23	189	9	172	28	40
2024	105	148	112	18	188	27	20
Overall/ Cumulative	**243**	**211**	**461**	**52**	**461**	**67**	**81**

Year	Village	Total Registered			Implementation			Reward total ($)
		N° of farmers	N° of plots	Surface (ha)	N° of farmers	N° of plots	Surface (ha)	
2022	Upland	26	33	82	24	30	73	3720
	Lowland	81	357	252	75	334	217	8097
	Total 2022	**107**	**390**	**334**	**99**	**364**	**290**	**11817**
2023	Upland	53	75	149	32	43	81	4095
	Lowland	108	458	360	64	275	207	8113
	Total 2023	**161**	**533**	**509**	**96**	**318**	**288**	**12208**
2024	Upland	63	97	191	33	43	86	6404
	Lowland	130	544	431	75	275	225	10433
	Total 2024	**193**	**641**	**622**	**108**	**318**	**311**	**16837**
Overall/ Cumulative		**461**	**1564**	**1466**	**303**	**1000**	**888**	**40862**

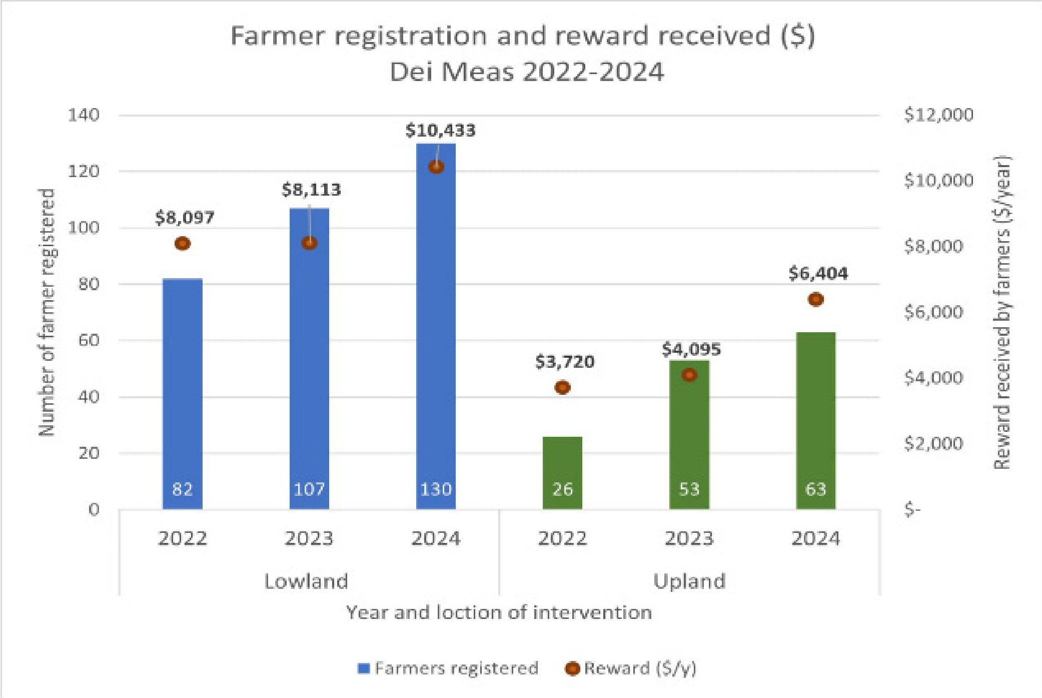


Figure 8: Number of farmers registered, and total rewards received (USD/year) from 2022 to 2024

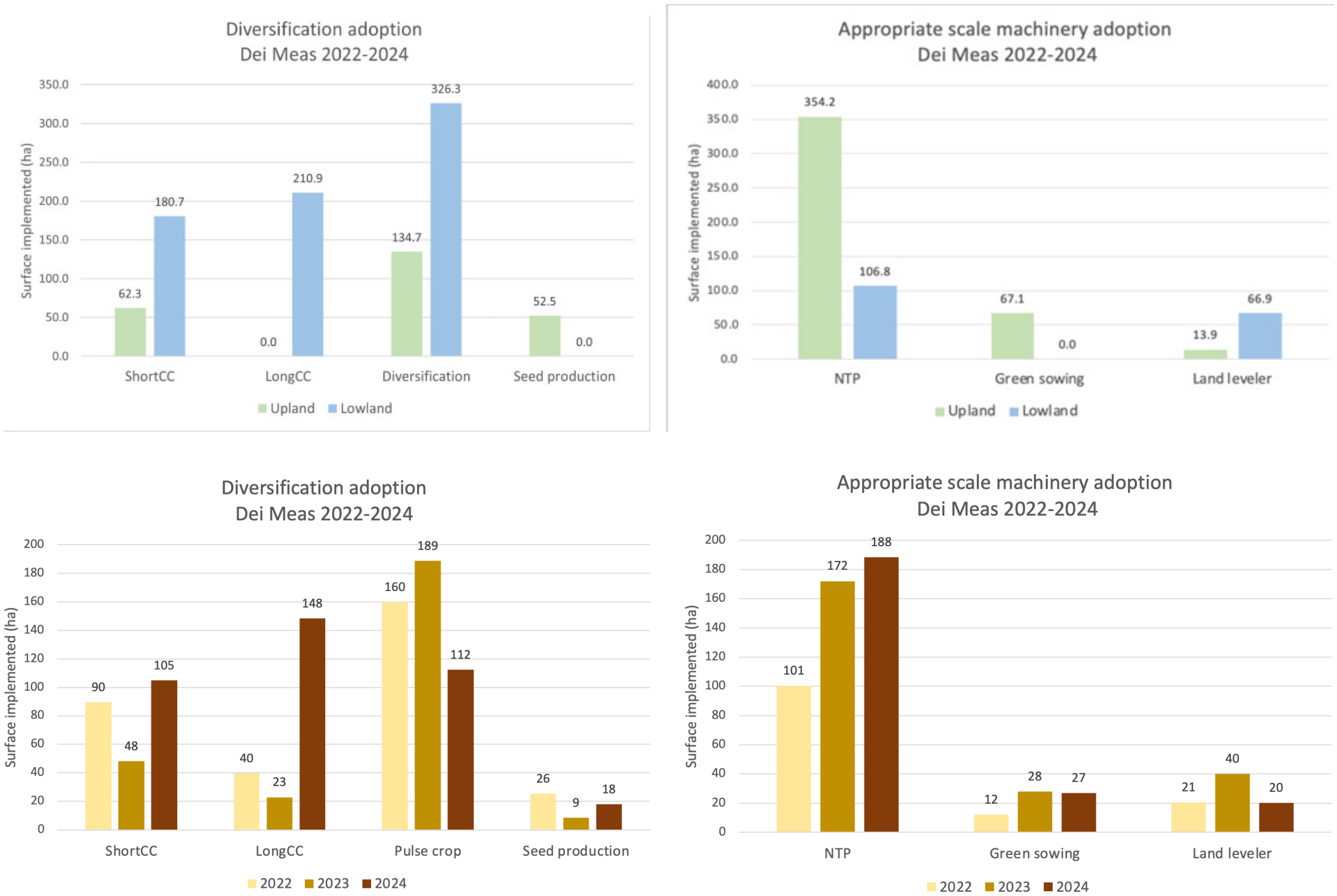


Figure 9: Surface area (in hectares) of diversification practices adopted in upland and lowland areas from 2022 to 2024

Figure 10: Final DeiMeas reward events in Battambang province

e. DeiMeas Reward Impact

To better understand the leverage effect that DeiMeas reward system (promotion – assistance – reward) had on agroecology practice adoption in Battambang province, an impact assessment is being conducted in both pilot locations. This impact assessment study, focusing on Pillar 1 of the pilot, is being conducted by Ms. Lou Zaytouni, a Master student from University of Dijon (France).

The main objectives of this study are to:

- Assess the general understanding regarding agroecological practices and DeiMeas incentive system
- Identify the benefits and challenges encountered by farmers through their transition, in both targeted locations
- Understand the main participation and drop-out reasons (for those who stopped)
- Assess their potential long-term transition (future implementation with or without incentive or premium) and the resulting behavioral changes among farmers

Benefiting from the experience of the field team and using the large pool of data collected during the registration of each farmer, the MSc student, supported by the DeiMeas team, conducted interviews with a randomly selected pool of farmers and key partners, using semi-structured questionnaires to collect qualitative and quantitative information on farmers' agroecology transition and DeiMeas pilot. The conceptual framework used as reference is the Impact Pathway (IP). Theoretical IP models analyze how innovations are built and how actors appropriate them. The impact pathway permits the determination of cause-and-effect relationships. It allows the identification of (research and development) outputs; outcomes that correspond to an appropriation and/or transformation of outputs by actors interacting with the research for development community (CARDEC/DALRM, CIRAD), and then the impacts that affect actors interacting directly or indirectly with the R4D community and/or its partners with potentially a 2nd level impacts that concern the change of scale of the innovation. Following these surveys and assessments, focus group discussions with key farmers and feedback sessions will be organized, presenting and assessing main results. A draft SWOT analysis (highlighting strengths, weaknesses, opportunities and threats) of the 1st pillar of DeiMeas can be found on the Figure 11, detailing results by i) main actors (direct team members from different organizations), ii) influential actors (field partners supporting agroecology practices scaling up in Battambang province) and iii) influenced actors (benefiting from the pilot activities). This study is expected to be completed in September 2025.

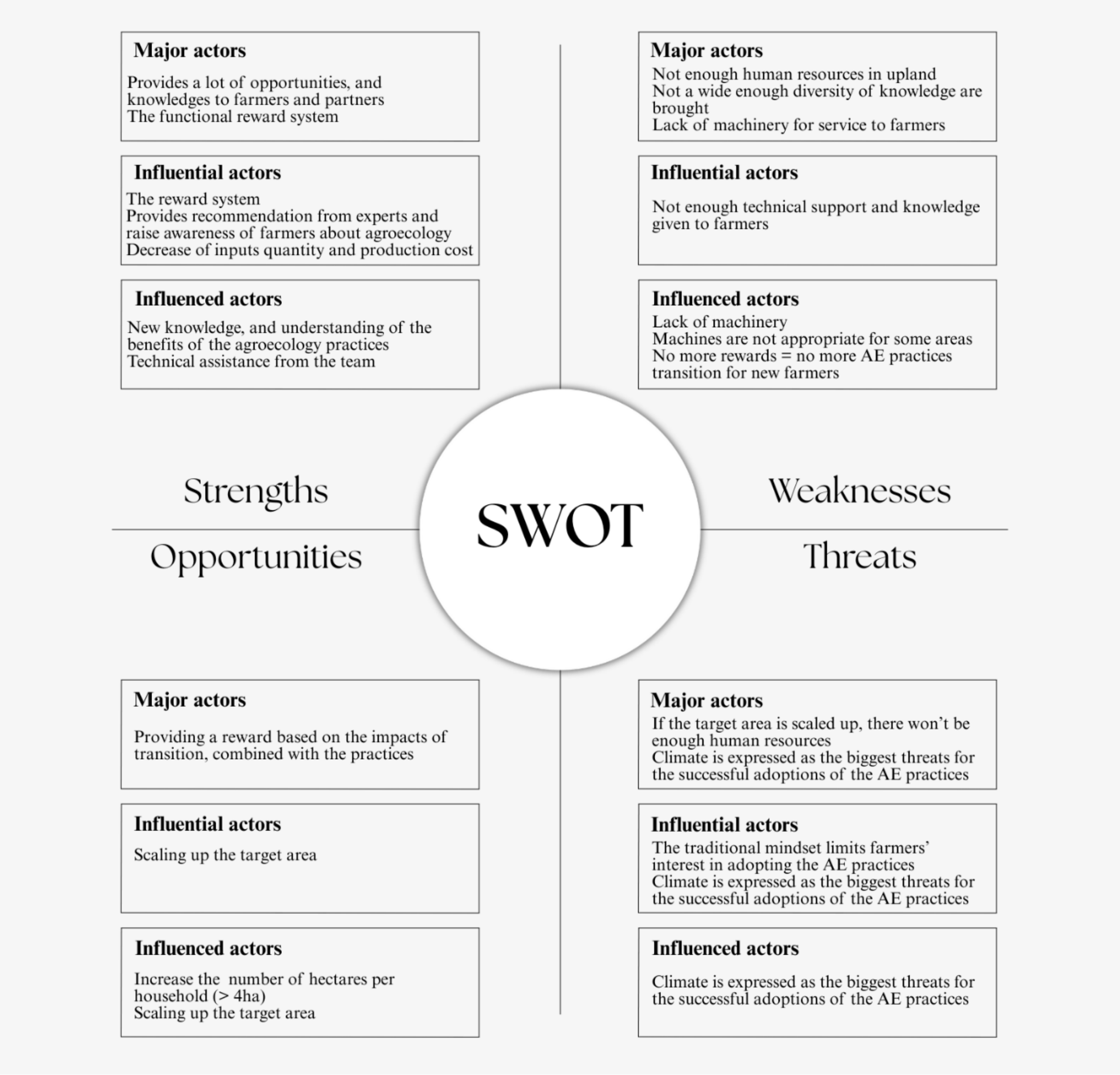


Figure 11: SWOT analysis of DeiMeas pillar 1 conducted by Lou Zaytouni during her MSc internship

3. First AWD Pilot in Kanghot Irrigated Perimeter (2024)

a. Rice Methane Emissions

Rice cultivation, while vital for global food security, is a major contributor to greenhouse gas emissions, particularly methane (CH_4). The annual CH_4 emissions from rice paddies have been estimated to contribute approximately 10% of the total anthropogenic CH_4 emission to the atmosphere. In Cambodia, more than half of emissions related to the agricultural sector are linked to the rice production (mainly due to CH_4 and N_2O emissions), representing more than 11 $MtCO_2eq$ annually[11].

More precisely, it was shown by the meta-analysis of Qian et al. (2023)[12], that the global mean annual area-scaled and yield-scaled GHG emissions are **~7,870 kg CO_2eq/ha and 0.9 kg CO_2eq/kg**, respectively, with 94% from CH_4. Among the sustainable practices promoted to reduce rice emissions, i) rice variety selection, ii) non-continuous or intermittent flooding (AWD), and iii) straw removal strategies have shown a potential GHG emission reduction of 24%, 44% and 46% on average, respectively, but other mitigation practices can also be implemented.

b. AWD Pilot in SG17, MC2-Kanghot

In response, the DeiMeas pilot (ASSET/FFEM) and WAT4CAM program (AFD-EU) initiated a trial of **Alternate Wetting and Drying (AWD)** with synchronized agriculture among smallholder farmers in the Kanghot irrigated perimeter, Battambang. The pilot aimed to assess both the feasibility and the challenges of AWD adoption in a real-world collective farming setting.

11 https://unfccc.int/sites/default/files/resource/National_GHG_Inventory_Cambodia.pdf

12 https://www.researchgate.net/publication/374204042_Greenhouse_gas_emissions_and_mitigation_in_rice_agriculture

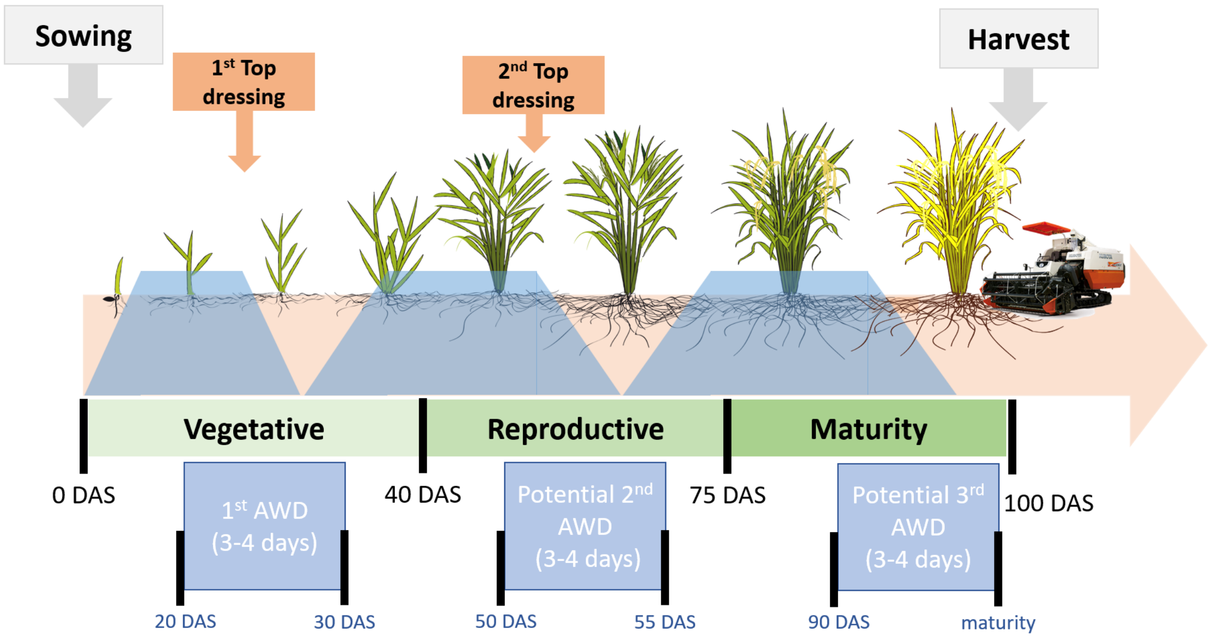


Figure 12: Graphic used during focus group discussion (before translation in Khmer language)

The trial engaged 20 farmers in the SG17 sub-group, covering 72 plots (55ha). Rice sowing of the 2nd rice cycle was synchronized in late October 2024, and a single **AWD event was successfully implemented on 33.5ha** (~58% of the area). DeiMeas provided US$ 20/ha as an incentive for AWD practice adoption during this pilot. Constraints which included water access issues, plot leveling disparities, and uncoordinated irrigation schedules, prevented further AWD cycles. Despite these challenges, the trial demonstrated promising signs of collective practice alignment (e.g., shared sowing dates, choice of rice variety, and post-harvest cover crop implementation).

Farmers reported both benefits (stronger root systems, reduced rice lodging) and challenges (drought stress, weed pressure), reflecting the heterogeneity of field conditions. Nonetheless, there was strong interest in continuing AWD trials, but they would require technical support and incentives for practice adoption.

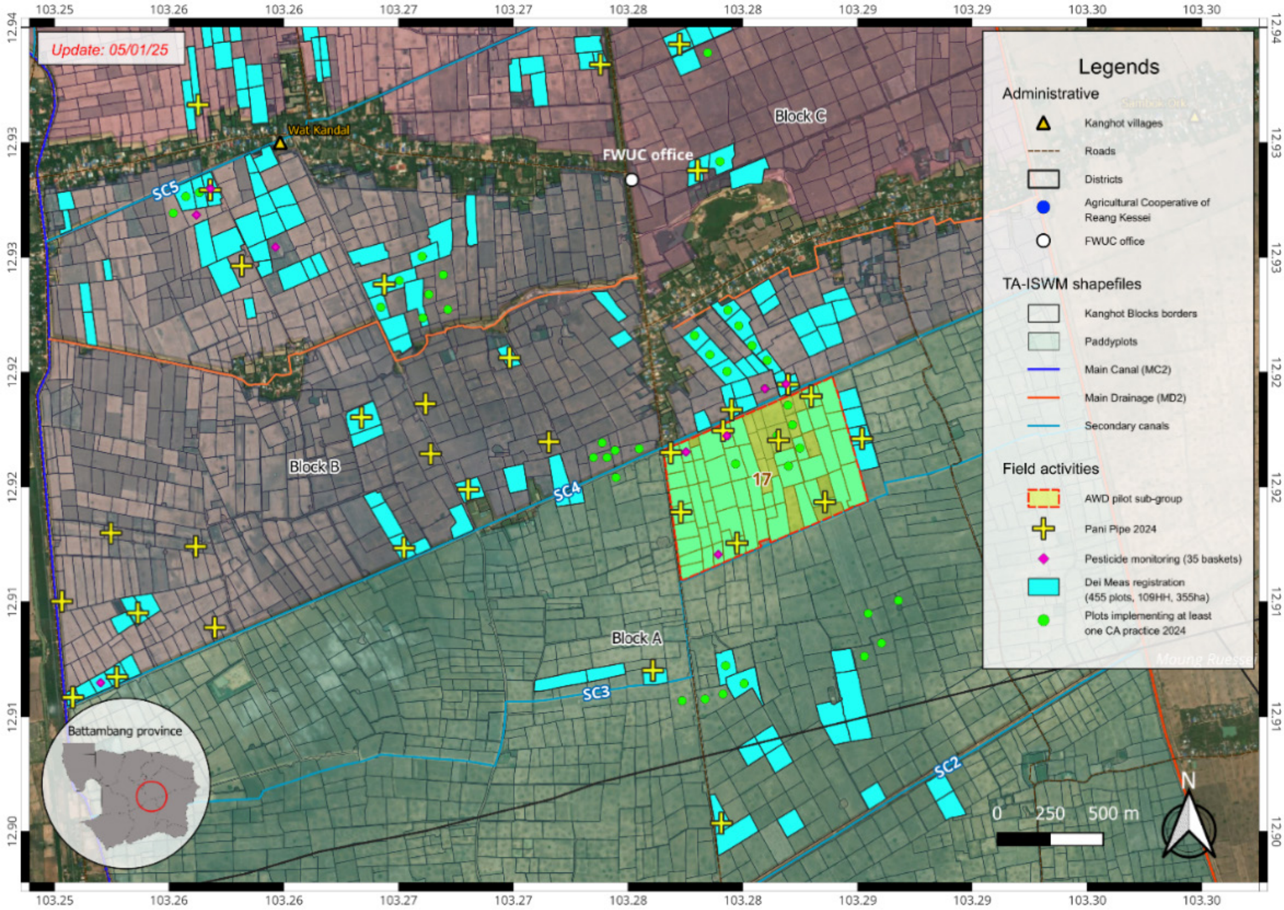


Figure 13: Map of the sub-hydraulic group selected for the pilot (green with red frame), Kanghot irrigated perimeter, Battambang province. Fields registered under DeiMeas (blue).

It is important to note that water-level monitoring via 53 pani pipes revealed that **"natural AWD"** conditions (periods below soil saturation level) already occurred between 37% and 53% of the cropping seasons, raising concerns about additionality for carbon credit generation. Future AWD projects should start with a robust baseline to validate eligibility under carbon standards. Additionally, manual data collection proved very labor-intensive, indicating a need for automation via remote sensing and water-level sensors (currently being explored in partnership with CarbonFarm).

c. Mitigation Potential of AWD

Table 4: Comparison of AWD mitigation potential according to literature

Study or standard	Study location	Continuous flooding	AWD	Mitigation potential ($tCO2eq/ha$)	Peer reviewed
Qian et al. 2023	Meta analysis of 269 study locations	7.87 tCO2eq/ha	Reduce ~44 %	~3.46 tCO_2eq/ha	Yes
Ly et al. 2013	Cambodia, Phnom Penh laboratory	Between 5.96 and 7.90 tCO2eq/ha	Reduce ~ 17–24 %	Between 1.01 to 1.74 tCO_2eq/ha	Yes
Thanks Carbon	GHG chambers installed in Kanghot, Battambang province	~7.83 tCO2eq/ha	~4.4 tCO2eq/ha	~3.43 tCO_2eq/ha	No
Regrow	NA	-	Reduce up to 50% emissions	1.5 to 5 $tCO_2eq/ha/$ season	No
IPCC 2019	NA	3.64 tCO2eq/ha/ cycle	2.00 tCO2eq/ha/ cycle	1.64 tCO2eq/ha/ cycle	Yes

When referring to the Tiers 1 model proposed by Verra-VCS (VM0051[13]) and GoldStandard[14], we found the following calculation:

- Baseline emission factor (Tier 1 IPCC): 1.3 kg CH_4/ha/day
- Multiple drainage scaling factor: 0.55
- Global warming potential of CH_4 ($tCO_2eq/t\ CH_4$): 28
- Rice cycle: 100 days
- Baseline emission of a rice cycle: 3.64 $tCO_2eq/ha/cycle$
- Emission with multiple drainage periods: 2.00 $tCO_2eq/ha/cycle$
- **Mitigation potential: 1.64 $tCO_2eq/ha/cycle$**

The calculations above apply a “multiple drainage scaling factor” of 0.55 to the baseline emission factor, following IPCC values (Figure 14), meaning that methane emissions are assumed to be reduced by 45% when multiple drainage events are implemented during the rice season.

13 https://verra.org/wp-content/uploads/2025/02/VM0051v1_27Feb25.pdf

14 https://globalgoals.goldstandard.org/standards/437_V1.0_LUF_AGR_Methane-emission-reduction-by-AWM-practice-in-rice-cultivation.pdf

Table 4: IPCC default values for $SF_{BL,w}$ or $SF_{P,w}$

Water regime during the cultivation period		$SF_{BL,w}$ or $SF_{P,w}$
Irrigated	Continuously flooded	1
	Single drainage period	0.71
	Multiple drainage periods	0.55

Source: IPCC 2019, Volume 4, chapter 5.5, Table 5.12

Figure 14: table extracted from the GoldStandard methodology on rice emissions reduction emission factors

Through the implementation of AWD during the rice cycle, it could be estimated a potential mitigation impact of 1.01 to 3.46 tCO_2eq/ha, leading to a potential avoidance of ~33.8 to 115.9 tCO_2eq from from the area (33.5 ha) under AWD at the SG-17. However, it is important to note that:

i. No GHG samples were taken during this experiment and thus the mitigation potential can only be estimated

ii. The mitigation impact of water management can strongly vary according to specific context (i.e., soil type, pH, organic matter, rice residue management, number of drainage events during the cycle…), and thus the adapted "emission factors" presented in Table 4 and Figure 14

iii. There is no baseline available for 2023 water management in the SG17. If "natural AWD" was already implemented, the pilot's impact would be considered non-additional

iv. A 1st GHG assessment (using static chambers) of conventional practices and AWD will be launched during the 2nd rice cycle of the cropping season 2025 through a partnership between DALRM - AgriG8 - CIRAD/WAT4CAM.

Overall, AWD shows high potential as a methane-reduction strategy in Cambodian rice systems. Yet, scaling efforts must be embedded in a broader agroecological transition. Practices such as crop diversification, cover cropping, integrated pest management, and reduced pesticide use are crucial to ensure resilience, environmental integrity, and access to high-value markets. Agroecology not only enhances climate mitigation but delivers co-benefits (biodiversity, food safety, and sustainable resource use) that strengthen Cambodia's agricultural systems for the long term.

The full 40-page report "***Alternate Wetting and Drying (AWD) pilot, Kanghot irrigated perimeter, Battambang province, May 2025***"[15] can be found online on the ASSET project website or requested from the report's authors.

15 https://www.asset-project.org/news/alternate-wetting-and-drying-awd-and-its-pilot-in-cambodia

4. Detail Maps of the Intervention Areas

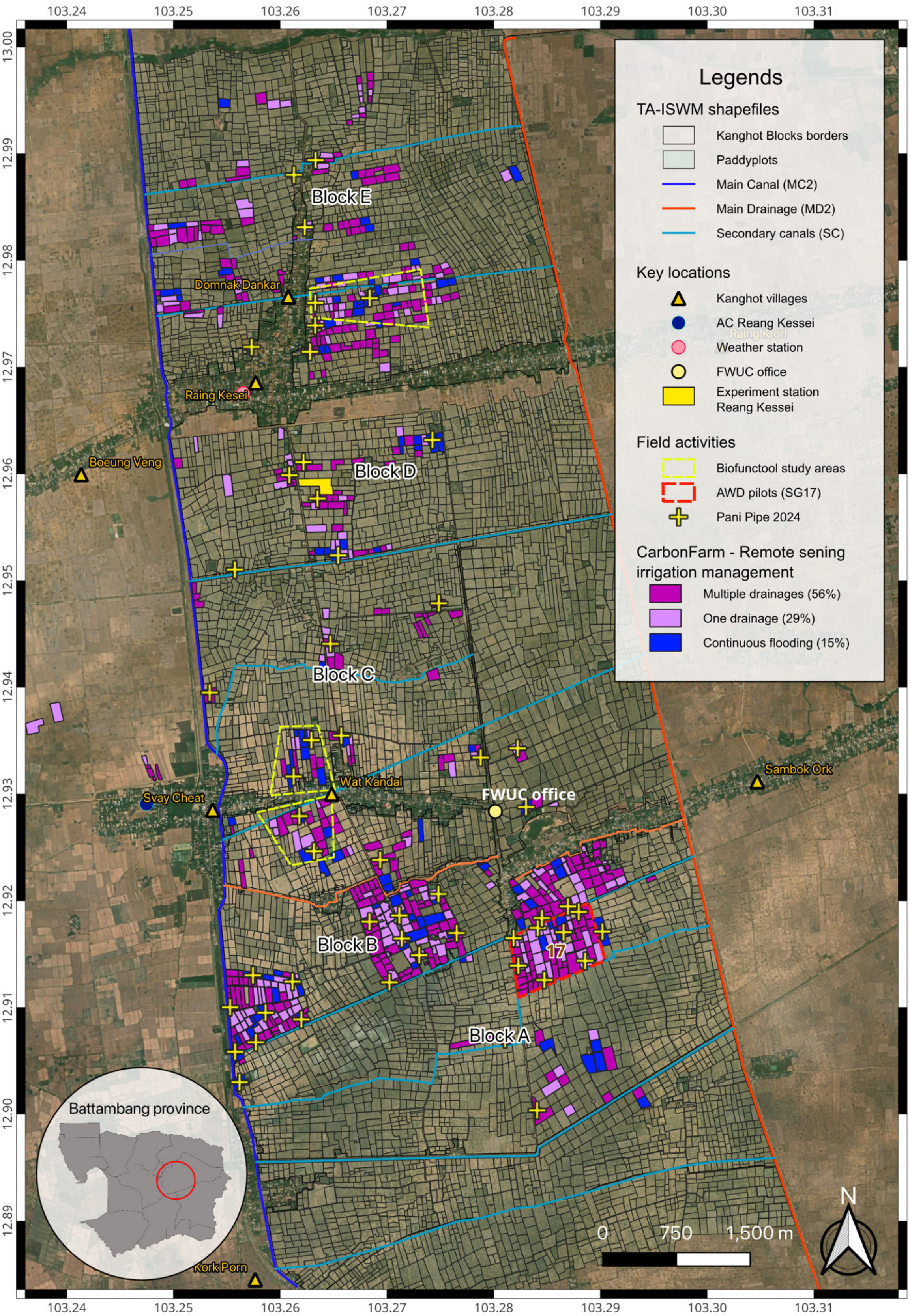
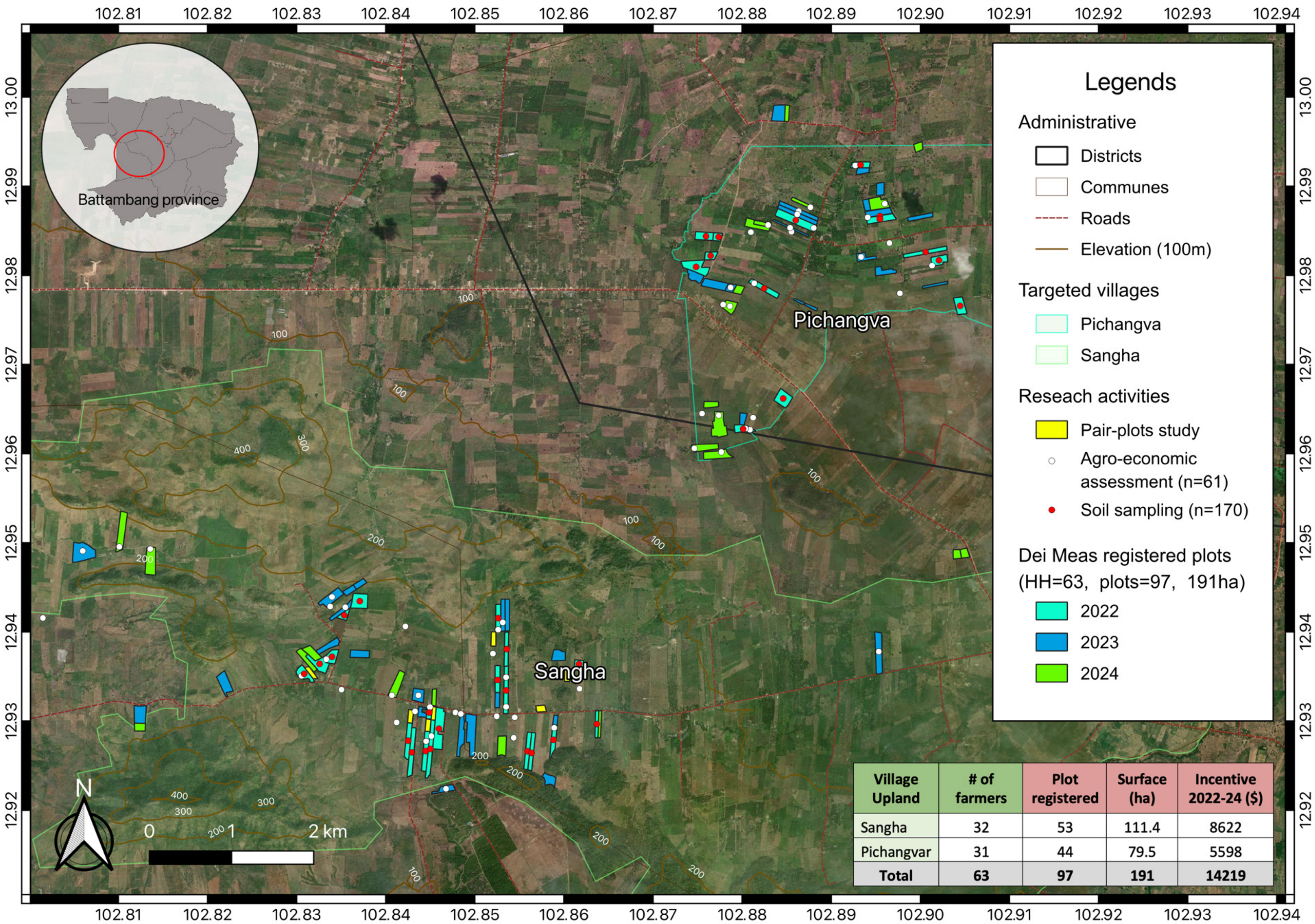


Figure 15: Map of intervention of the DeiMeas pilot in the lowland of Battambang province, MC2-Kanghot irrigated perimeter



Village Upland	# of farmers	Plot registered	Surface (ha)	Incentive 2022-24 ($)
Sangha	32	53	111.4	8622
Pichangvar	31	44	79.5	5598
Total	**63**	**97**	**191**	**14219**

Figure 16: Map of intervention of DeiMeas pilot in the Upland of Battambang province, Rattanak Mondoul district

Pillar 2: Quantification

1. Field Data Collected

Monitoring, Reporting and Verification (MRV) is crucial and defines the quality and transparency of the project's impact. Support in developing innovative low-cost technologies to reduce MRV costs will greatly improve access for smallholder farmers to carbon finance. The 2nd DeiMeas Pillar "Quantification" aimed to measure agroecological transition impacts (i.e., SOC dynamics, soil ecosystem services, pesticide usage, dynamic of rice yield, production cost and income) and support the calibration of innovative MRV technologies. These innovative technologies (modelling, remote-sensing, MIR spectrometer) could cost-effectively quantify the impacts and co-benefits of farmers' transition and be used in financial mechanisms. To support this calibration process, different ground-proofed and field data were collected along the 3-year pilot. The main measures and data collected are detailed in Table 5.

Table 5: Detail of the main measures and data collected during the DeiMeas pilot

Measures	Data collected	Regularity	# collected
Soil analysis variables:	• Soil organic carbon (SOC) concentration • Soil Nitrogen concentration • Bulk density • Coarse fraction from the sample of bulk density • Carbonates content (upland areas)	At year 0 (baseline), in 2022 Between year 3 to 5 of AE practices implementation	136 samples in the uplands 348 samples in the lowlands = 484 samples
Biofunctool® (soil health indicators)	• Carbon transformation: POXC, soil respiration, cast of earthworms. • Soil structure: water infiltration and soil aggregation • Nutrient cycling: N available, NO3, NH4 The three main soil functions are aggregated into a **Soil Quality Index (SQI)**	At year 0 (baseline) in 2022 Between year 3 to 5 of AE practices implementation	105 sampling points in the upland (Koun et al. 2023) 152 samples in the lowland (Mr, Gatignol internship report)
Agro-economic assessment	• Crop type and yield • Biomass input: manure, compost… • Synthetic inputs: N fertilizer, pesticide… • Tillage and soil disturbance • Crop residue management • Water management: Irrigation, flooding…	Data collected annually with farmers between 2022 and 2025	80 farmer plots assessment in the lowland 60 farmer plots in the upland = 140 plots
Water level	• Monitoring of the water level using pani pipes	Data collected manually weekly during growing seasons	53 pani pipes installed, 30 weeks monitored = 1590 data

a. Soil Analysis

After stratification mapping of both pilot locations, 484 soil samples were collected. The soil analysis was conducted through a partnership with ETH Zurich and supported both the soil baseline of the intervention areas, as well as the calibration of the innovative technologies (modelling using DSSAT and DNDC, MIR spectrometer, and remote-sensing imagery with SEQANA and CarbonFarm).

Soil sampling protocol and processing:

Within each farmer field an area of 1 ha was delimited (50×200m), and four to five sampling sites of 4 × 4 m were marked in the lowland and upland, respectively. . Five sub-samples and one bulk density sample were collected per sampling site at four soil depths (0-10, 10-20, 20-30, 30-40 cm). The five sub-samples were mixed to form one composite sample per sampling site. Each composite sample for a given soil depth was constituted from the five sub-samples collected at each sampling point to manage the spatial variability inside the sampling area. One soil core sample was collected in the middle of the sampling site to measure the bulk density (ρb). A small pit was dug in the center of each sampling site and bulk density samples were collected using core samplers of 5 cm in diameter and 5 cm in height, oven-dried at 105 °C for 48 h.

Each sampling point and pit position was georeferenced. All soil samples are stored at the Cambodian Conservation Agriculture Research for Development Center (CARDEC/DALRM, BosKhnor, Chamcar Leu district, Kampong Cham province, 12.179221° N, 105.323134° E) for further analysis including the physical fractionation of the soil organic matter (particulate organic carbon/POC and mineral associated organic carbon/MAOC) and infra-red spectroscopy calibration.

In total, 136 samples were collected between the two villages of the upland and 348 samples in the three blocks of the MC2-Kanghot of Battambang province (total of 484 samples).

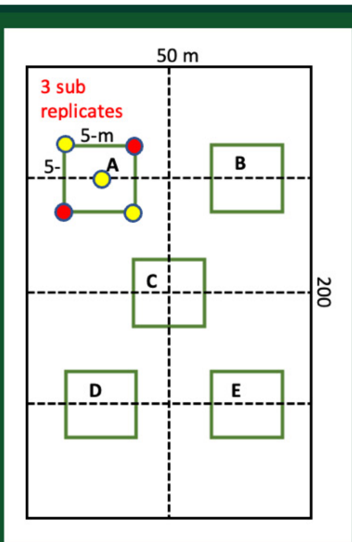
Box 2. Soil sampling

Soil sampling protocol:

> 5 replicates (W shape)
> 3 sub-replicates (composite)
> 4 depths (0-10, 10-20, 20-30 and 30-40 cm)

Bulk density:

> 5 points per field at 0-10, 10-20, 20-30 and 30-40 cm
> Dry in the oven at 105°C during 48 hours
> Sieve at 2-mm: weight the coarse fraction



Texture and Soil organic carbon and nitrogen analyses:

After the sampling campaign, the 5 composite samples per field were air-dried for 2 to 3 weeks and sieved at 2 mm. Composite soil samples were collected to measure the texture, total soil carbon and nitrogen by nitrogen concentrations, and carbonates content (upland). Soil texture was determined through the pipette method (ISO 11277, 1998). Total carbon and nitrogen concentrations were determined through the dry combustion method. Each sample was finely ground (<150 μm) before analysis for total C and N by dry combustion using the LECO® CHN628 analyzer at the Sustainable Agroecosystems Lab, ETH Zurich University, Switzerland. The coarse soil fraction (> 2mm) of bulk density samples was weighted to correct the SOC stock calculation.

The results of the soil laboratory analysis of DeiMeas pilot locations can be found in annex, and Table 7.

Soil organic C and N stocks calculation

To correct for differences in ρb, SOC and N stocks were estimated based on an equivalent soil mass-depth basis (Ellert et al., 2002; Wendt and Hauser, 2013). We defined the reference soil mass as the lowest soil mass observed at each sampling depth, regardless of cropping systems or land use. We applied these reference soil masses to compute the SOC and N stocks.

The results of the soil organic C and N analysis can be found in Table 6 and Figure 18.

Soil functions through Biofunctool®

Biofunctool® consists of a set of ten functional indicators that assess three main soil functions with (i) carbon transformation, (ii) soil structure maintenance and (iii) nutrient cycling (Thoumazeau et al., 2019). These functions aggregate several biological processes which individually allow the production of goods or ecosystem services. Biofunctool® assesses these soil functions through a range of indicators. N-mineral extraction and ion exchange membrane are linked to the nutrient cycling function. Permanganate oxidizable carbon (POXC), indicator which quantifies labile soil C, SituResp to assess basal soil respiration in-situ, Bait Lamina for soil mesofauna activity and cast density are used to assess Carbon transformation function (Culman et al. 2012; van Gestel, Kruidenier, Berg 2003; Thoumazeau et al. 2017). They represent different and complementary process stages of the soil carbon cycle (Hurisso et al. 2016). Regarding soil structure maintenance, aggregates stability with both surface aggregates (0-2cm) and soil aggregates (2-10cm) to assess aggregates resistance to immersion and slacking, Beerkan test for water infiltration rate and Visual Evaluation of Soil Structure (VESS) for soil structure are used (Bissonnais 1996; De Roo, Hazelhoff, Heuvelink 1992; Guimarães, Ball, Tormena 2011).

These indicators constitute the core set of Biofunctool® framework and are aggregated in a **Soil Quality Index (SQI)**. Biofunctool was used for the baseline in the lowland but without covering all fields that were sampled. It is expected to use Biofunctool under a synchronic approach assessing the impacts of different practices and cropping systems after several years of implementation.

In total, 105 samples were collected in Sangha village (upland) and 152 samples in the 3 blocks of the MC2-Kanghot of Battambang province (total of 257 Biofunctool samples). In the upland, two peer-reviewed articles were published (Koun et al. 2023; Pheap et al., 2025) and an assessment was conducted in Kanghot in 2022 (Gatignol, 2022).

Agroecology transition brings more than carbon or climate benefits and additional outcomes also need to be measured and valued. Innovative financial mechanisms are being developed, recognizing and incentivizing these co-benefits (outcome-based payments, practice-based certifications...) and the Biofunctool® along with biodiversity indicators could be part of functional sets of science-based indicators to measure these co-benefits.

Related PhD studies

In addition to DeiMeas pilot, two PhD studies have been conducted under the ASSET project:

- Dr Vira Leng: "Assessing the impacts of conservation agriculture-based cropping systems on: (i) soil organic and nitrogen stocks (including the fractions) under a diachronic analysis (10 years), (ii) greenhouse gas emissions for cassava-based cropping systems (assessment on 2 cropping seasons), and (iii) quantifying all inputs of biomass (quantities and qualities) coming from the main crops and cover crops used including the root systems."

- Dr. Sambo Pheap: "Multicriteria assessment of recently implemented conservation agriculture cropping systems across farmers' plots in northwestern Cambodia".

These two PhD studies along with other initiatives contribute to strengthening the MRV system of DeiMeas.

Dr Vira Leng finalized his PhD on December 2024 and published a 1st article on "*Diachronic assessment of soil organic C and N dynamics under long-term no-till cropping systems in the tropical upland of Cambodia*" (Leng et al. 2024[16]) benefiting from the long-term experiments of the Bos Khnor research station (red Oxisol) comprising 3 long-term experiments (cassava, maize; soybean) and using a diachronic soil analysis over a 10-year interval (2011 – 2021). When adopting conservation agriculture practices, the Soil Carbon stocks increased of **+ 0.65 tons** to **+ 1.47 tons of Carbon per ha and per year** across this 10 years timeline. In a carbon farming project, this carbon sequestration (or carbon removal) capacity represent between **2.40 to 3.58 tCO_2eq/ha/year (Figure 17).**

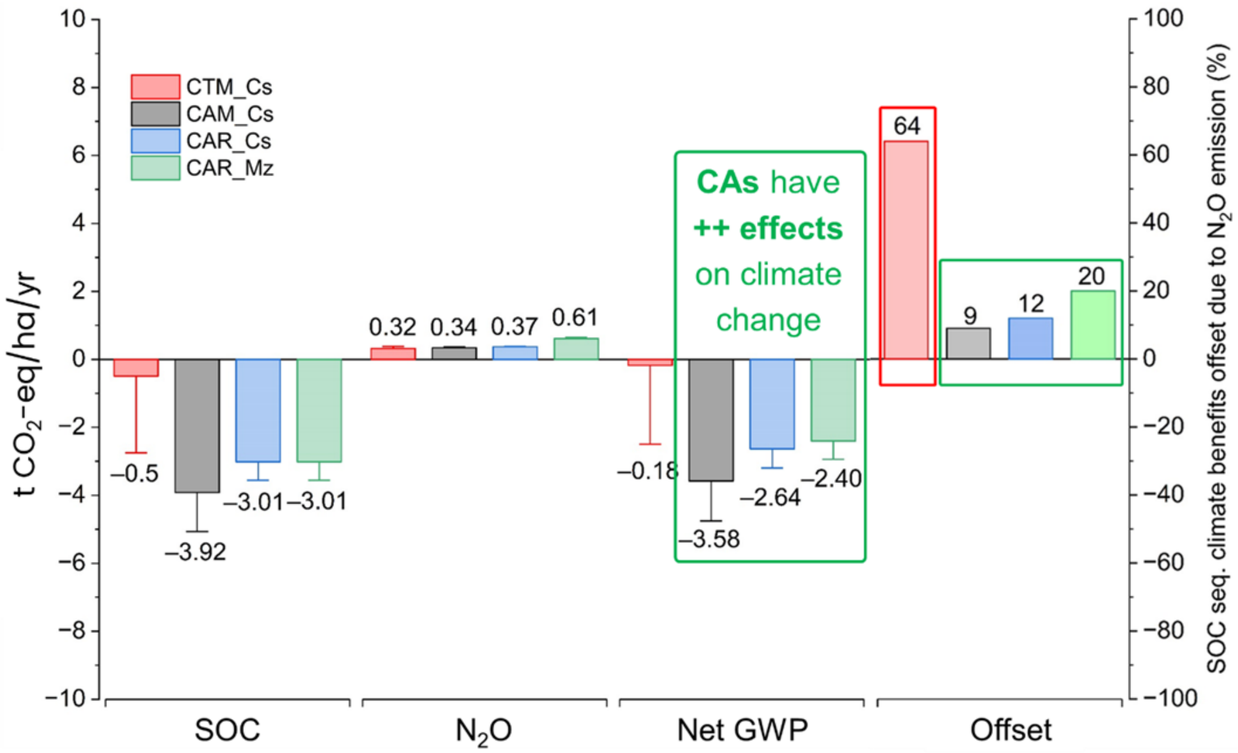
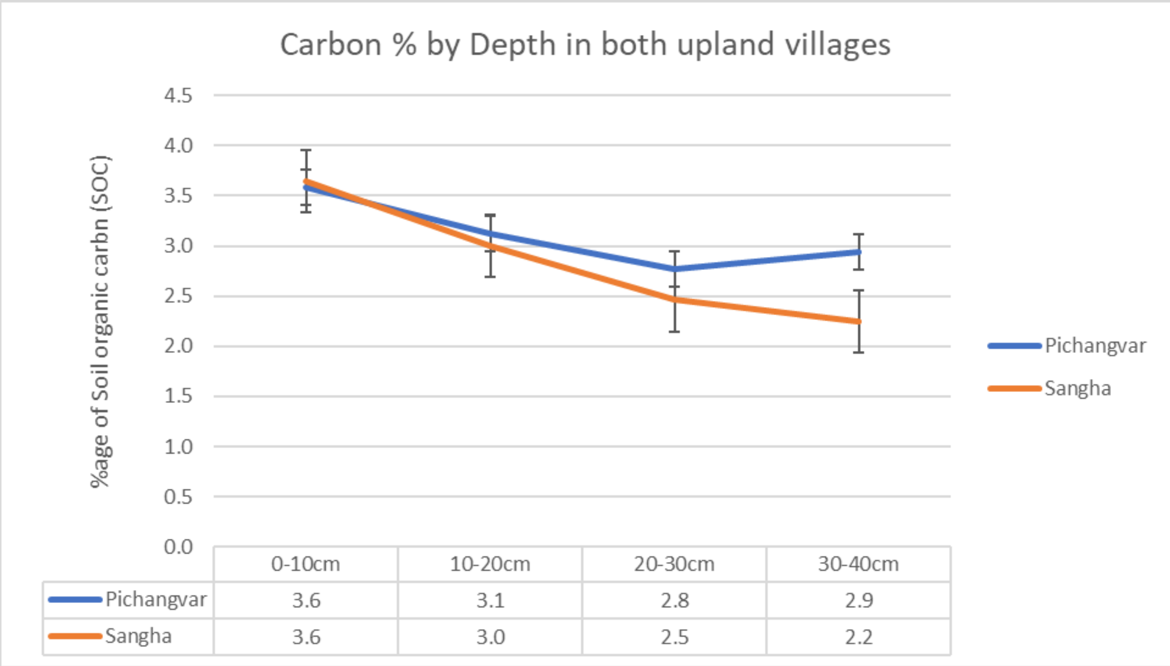
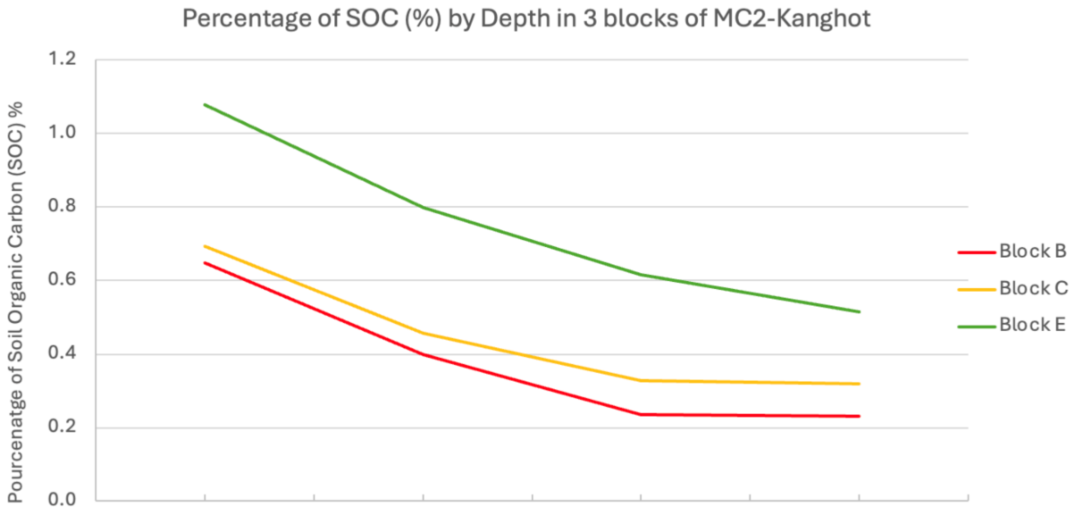


Figure 17: Effect of conservation agriculture practices on soil organic carbon (SOC) accumulation and N2O emissions compared to conventional practices. GWP: Global Warming Potential (source: Leng et al. 2024)

16 https://www.researchgate.net/publication/378806777_Diachronic_assessment_of_soil_organic_C_and_N_dynamics_under_long-term_no-till_cropping_systems_in_the_tropical_upland_of_Cambodia



	0-10cm	10-20cm	20-30cm	30-40cm
Pichangvar	3.6	3.1	2.8	2.9
Sangha	3.6	3.0	2.5	2.2



Depth (cm)	0-10	10-20	20-30	30-40
B	0.65	0.40	0.24	0.23
C	0.69	0.46	0.33	0.32
E	1.08	0.80	0.62	0.52

Figure 18: Graphical representation of soil organic carbon (SOC) in percentage (%) at 4 depths, in 2 villages of the upland (top) and 3 blocks of the MC2-Kanghot (bottom) of Battambang province

Table 6: Averaged results of the soil samples analysis in 2 villages of the upland (top) and 3 blocks of the MC2-Kanghot (bottom) of Battambang province

Village	Depth	Number of samples	Nitrogen %	SOC %	Bulk density	Coarse fraction %	SOC Stock (tC/ha)
Pichangvar	0-10cm	14	0.18	3.59	1.08	0.03	37.24
	10-20cm	14	0.17	3.12	1.15	0.03	34.77
	20-30cm	14	0.13	2.77	1.19	0.06	25.35
	30-40cm	14	0.08	2.94	1.22	0.03	16.99
Sangha	0-10cm	20	0.25	3.65	1.01	0.01	35.89
	10-20cm	20	0.22	3.00	1.08	0.01	31.11
	20-30cm	20	0.16	2.46	1.08	0.01	23.46
	30-40cm	20	0.11	2.25	1.13	0.03	19.57
Mean		**136**	**0.17**	**2.95**	**1.11**	**0.02**	**28.96**

Block/Depth	Number of samples	SOM %	SOC %	Total N %	C:N
Block B	**144**	**0.65**	**0.38**	**0.04**	**9.2**
0-10cm	36	1.12	0.65	0.06	10.6
10-20cm	36	0.69	0.40	0.04	9.9
20-30cm	36	0.41	0.24	0.03	8.8
30-40cm	36	0.40	0.23	0.04	7.5
Block C	**60**	**0.79**	**0.46**	**0.03**	**16.5**
0-10cm	16	1.20	0.69	0.04	16.8
10-20cm	16	0.79	0.46	0.03	22.5
20-30cm	14	0.57	0.33	0.03	13.7
30-40cm	14	0.55	0.32	0.03	12.1
Block E	**144**	**1.30**	**0.75**	**0.07**	**11.7**
0-10cm	36	1.86	1.08	0.09	12.2
10-20cm	36	1.38	0.80	0.07	12.0
20-30cm	36	1.06	0.62	0.06	11.5
30-40cm	36	0.89	0.52	0.05	11.0
Mean	**348**	**0.94**	**0.55**	**0.05**	**11.5**

b. Introduction to the Agroeconomic Assessment (AEA)

DeiMeas team participated in the **annual agroeconomic assessment** (**AEA**), interviewing ~140 farmers on their practices, costs and profits at the end of each crop cycle. In Kanghot, the AEA is conducted in partnership with WAT4CAM program phase 1. Yield assessment was conducted through both farmers' interviews and yield assessment, before each rice cycle's harvest (Figure 19). This assessment monitored a total of 188 plots, across the two study areas, each year between 2022 and 2024. The map of the spatial repartition of the selected plots in both areas can be found in DeiMeas intervention maps, Figure 15 and Figure 16.

Figure 19: Pictures of the manual yield assessment of a rice plot in Kanghot irrigated perimeter

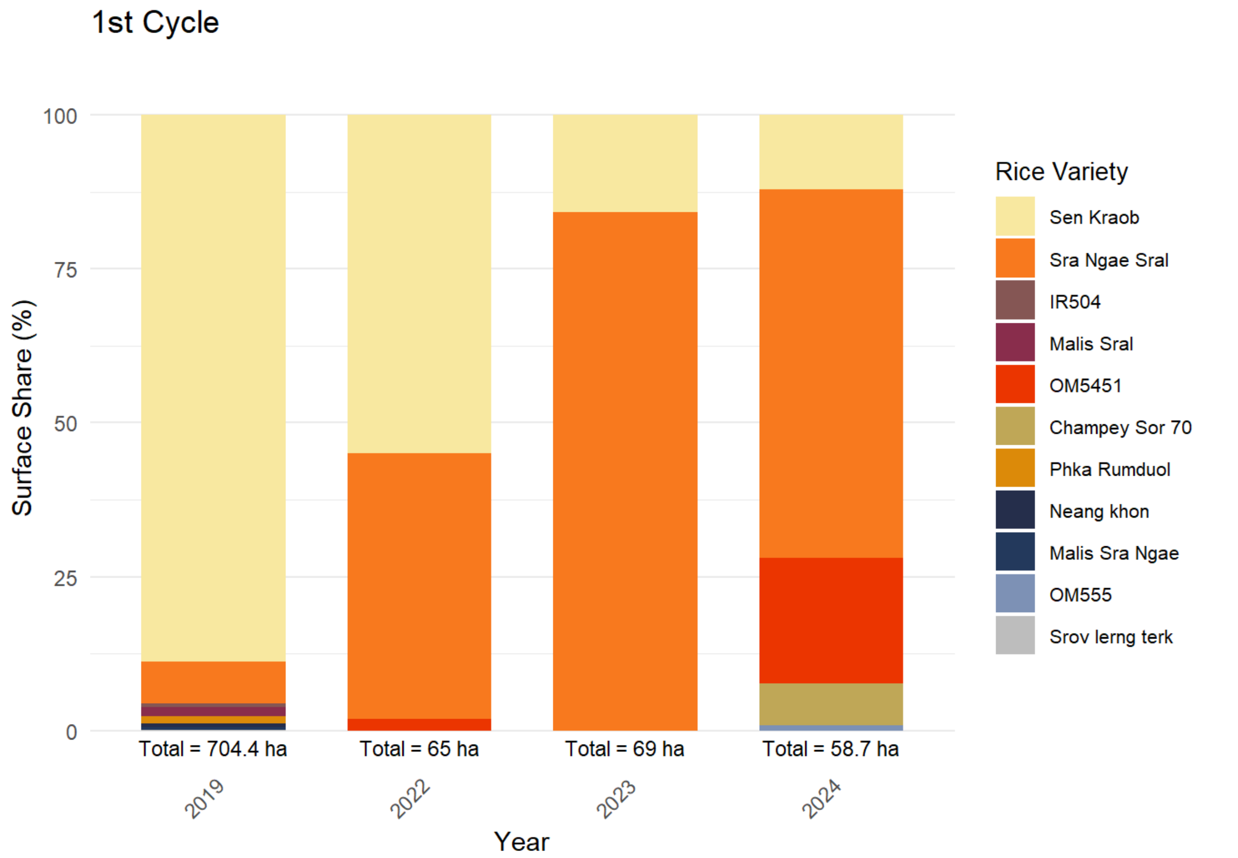
In the lowland, the two rice cycles monitored during the AEA 2022 were analyzed by Ms. Jade Boucher, MSc student from Montpellier SupAgro[17]. The report presents a preliminary analysis of the effects of one year of agroecological practices promotion in Battambang lowland's Kanghot irrigation scheme.

Ms. Sophal Koun, field coordinator of the activities of R4D WAT4CAM, along with a Msc student, Ms. Zoé Behiels, are currently capitalizing on this AEA study, analyzing the three years of data collected, and creating an aggregated database with the data from the three consecutive years. This database, "Consolidated data - AEA 2022-2024", is the foundation of the analysis. Some preliminary results can be found below, and the final report will be available in Q3 2025.

17 https://www.asset-project.org/content/download/5305/38976/version/1/file/AE+Report+Battambang+Jade+Boucher+2022_2023.pdf

The figures below are draft results of main components studied during the AEA in the Kanghot irrigation scheme:

- The change in rice varieties used by farmers between 2019 and 2024, show a decrease in the number of varieties over time (Figure 20)
- A continuous increase in pesticide and fertilizer use (Figure 21)
- An increase in the average declared yield per cycle over the years, from 2+ tons per hectare (t/ha) in 2019 to 5+ t/ha in 2024 (Figure 22)
- A continuous increase in rice yield over time, of ~9%/year (Figure 23)
- And highlighted that the costs of adoption of the agreological practices in Kanghot were on average **US$ 91.5/ha/year**, representing on average an increase of +17% of the 1st rice cycle production costs (Figure 23). In comparison, the AEA study conducted in the upland of Battambang in 2024 found an agroecology cost adoption of on average US$ 76/ha/year



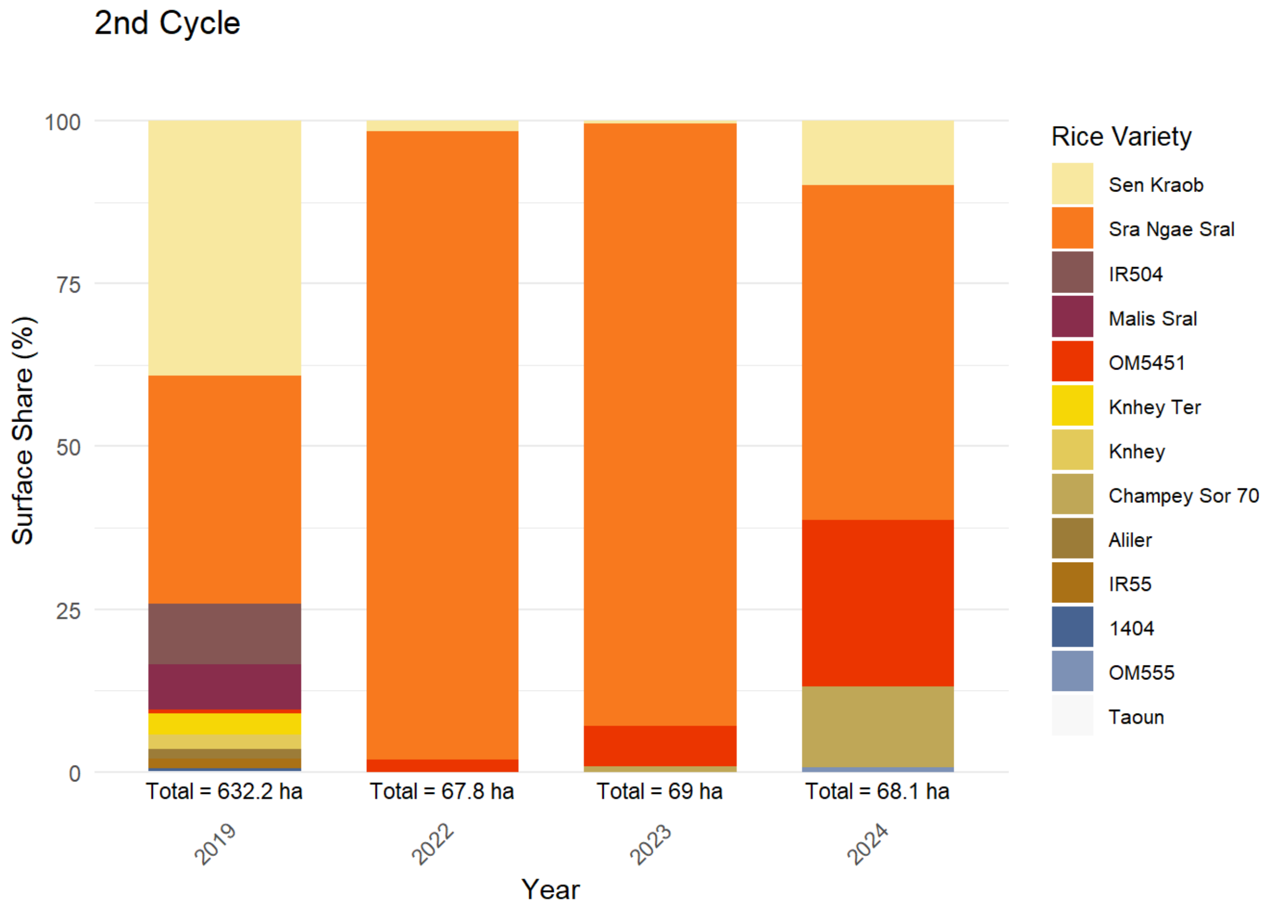


Figure 20: Rice varieties used by farmers during the agroeconomic assessment study (2022-2024)

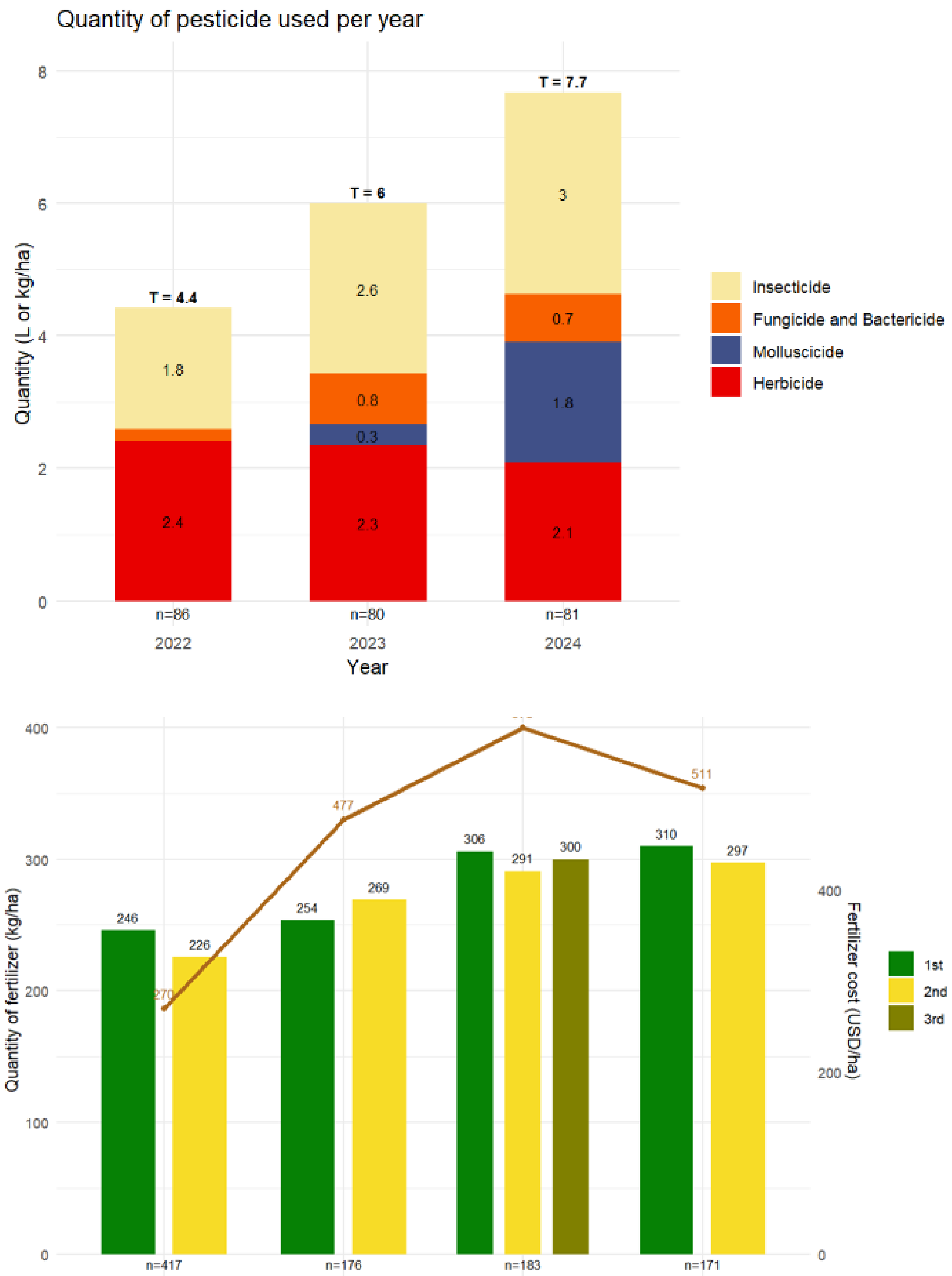
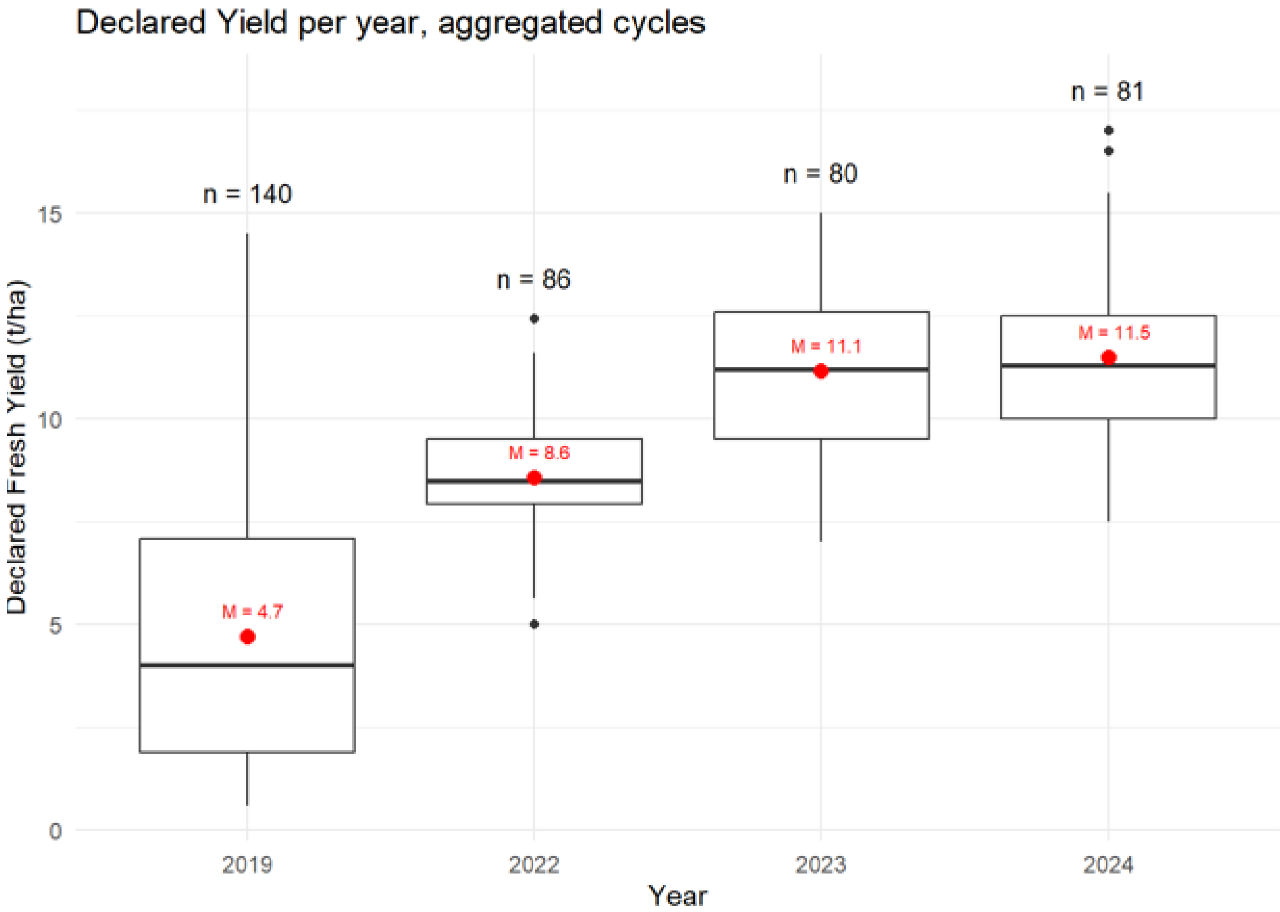


Figure 21: Pesticide (above) and fertilizer use (below) evolution during the AEA study



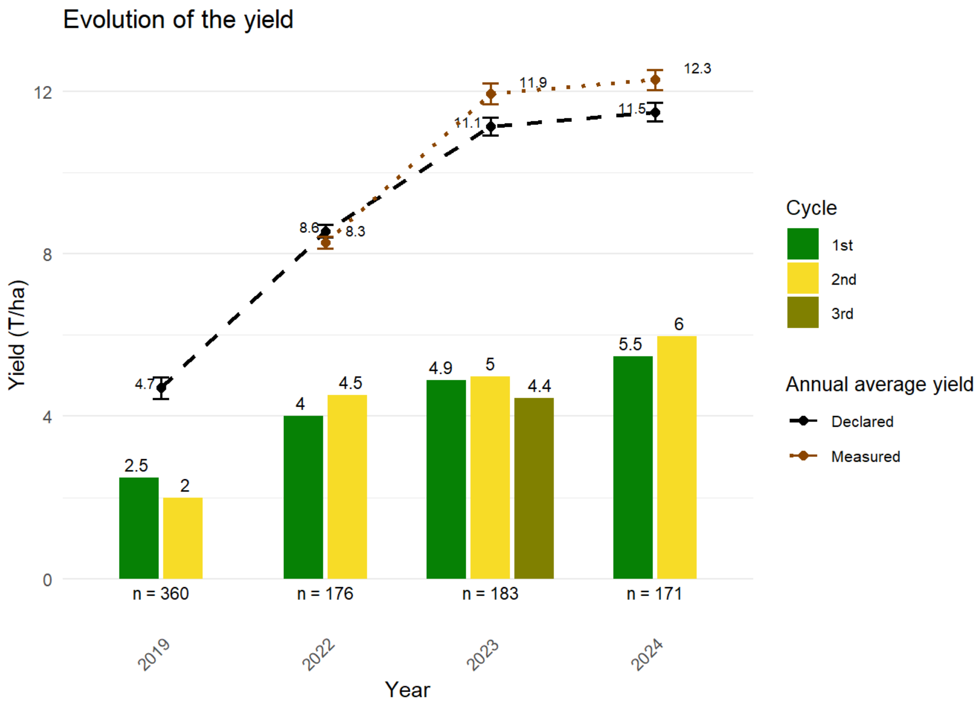
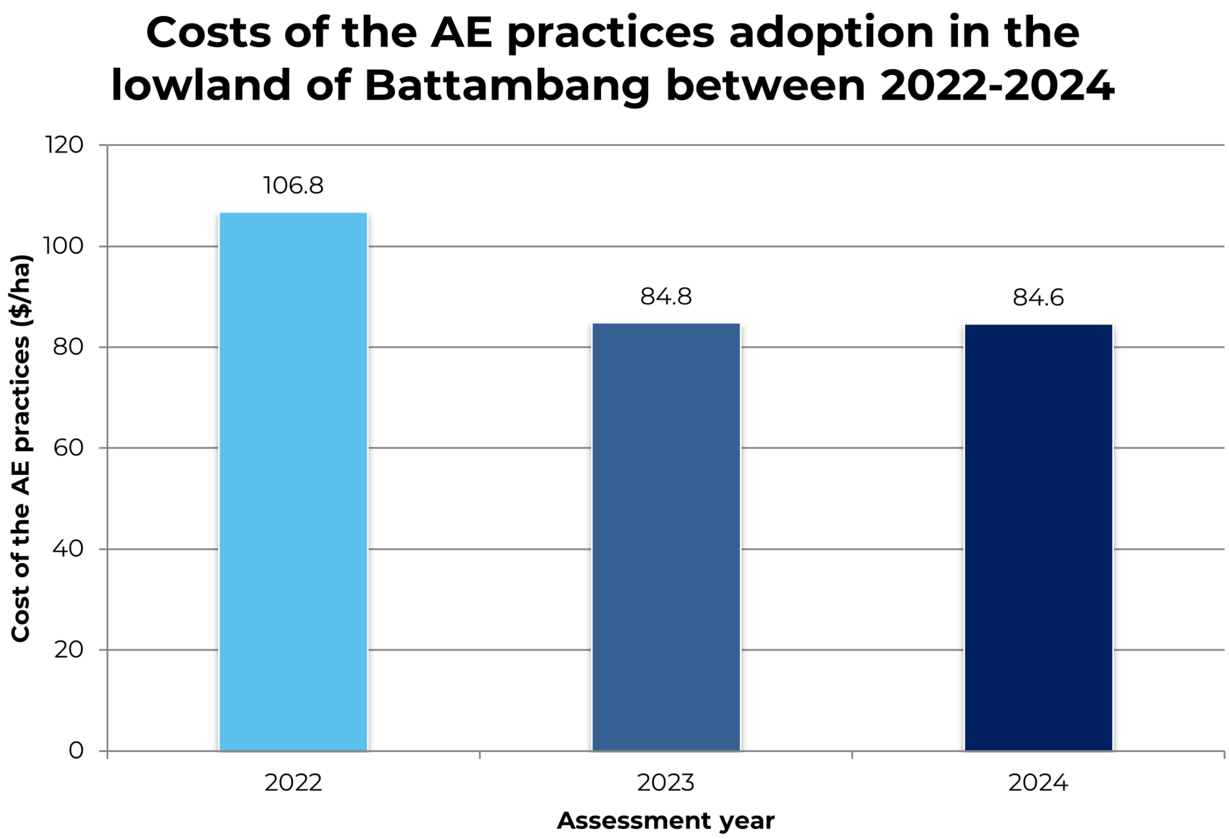


Figure 22: Declared farmer's yield during the agroeconomic assessment, aggregating yield from both rice cycle (above) and separated (below), between 2019 and 2024



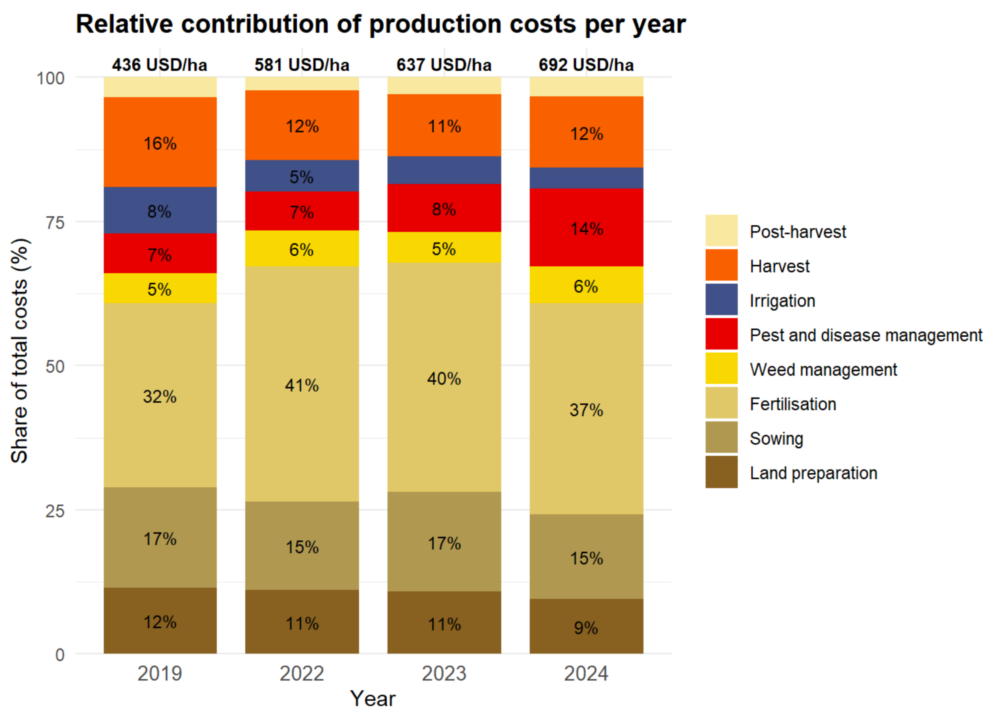


Figure 23: Cost detail of the agroecological practices implemented (above) and of rice production per cycle (below) during the AEA study

Table 7: Main results of the agroeconomic assessment conducted in the lowland between 2022 and 2024

Year	Cycle	AET/CT	# of plot	Measured Fresh Yield 14%(t/ha)	Declared Fresh Yield (t/ha)	Production cost Rice only ($/ha)	Total cost ($/ha)	Income declared ($/ha)	Net profit declared ($/ha)
2022	1st	CT	41	2.8	4.0	599	599	1,053	454
		AET	45	3.2	4.1	560	599	1,199	600
	1st Total		86	3.0	4.0	578	599	1,129	531
	2nd	CT	44	4.0	4.4	618	618	1,140	522
		AET	46	4.0	4.7	556	556	1,215	659
	2nd Total		90	4.0	4.5	586	586	1,178	592
2023	1st	CT	23	4.7	4.7	602	602	1,414	812
		AET	57	4.9	5.0	622	665	1,430	765
	1st Total		80	4.9	4.9	616	647	1,426	779
	2nd	CT	23	4.4	5.0	634	634	1,557	923
		AET	57	4.6	5.0	677	677	1,586	909
	2nd Total		80	4.5	5.0	664	664	1,578	913
2024	1st	CT	45	4.6	5.5	710	710	1,430	720
		AET	37	4.7	5.5	678	717	1,482	764
	1st Total		82	4.7	5.5	695	713	1,453	740
	2nd	CT	51	5.8	6.0	696	696	1,401	705
		AET	38	5.5	6.0	707	707	1,536	829
	2nd Total		89	5.7	6.0	701	701	1,459	758
Grand Average/Total			**507**	**4.6**	**5.0**	**640**	**651**	**1,366**	**715**

Year	CA/CT	# of plot	Measured Yield 14% (t/ha)	Declared Fresh Yield (t/ha)	Production cost Rice only ($/ha)	Total cost ($/ha)	Income declared ($/ha)	Net profit declared ($/ha)
2022	CT	85	3.4	4.2	609	609	1,098	489
	AE transition	91	3.6	4.4	558	577	1,207	630
2022 Total		**176**	**3.5**	**4.3**	**582**	**592**	**1,154**	**562**
2023	CT	46	4.5	4.8	618	618	1,486	868
	AE transition	114	4.7	5.0	649	671	1,508	837
2023 Total		**160**	**4.7**	**4.9**	**640**	**655**	**1,502**	**846**
2024	CT	96	5.3	5.7	703	703	1,415	712
	AE transition	75	5.1	5.7	693	712	1,509	797
2024 Total		**171**	**5.2**	**5.7**	**698**	**707**	**1,456**	**749**
Grand Total		**507**	**4.6**	**5.0**	**640**	**651**	**1,366**	**715**

c. Pani pipes and water level monitoring

Monitoring water level data is important to understand water access and control in the irrigated perimeter, to evaluate the water-use efficiency (when compared with data of the agroeconomic assessment) and to follow the potential drainage periods along the rice cycle (AWD periods). The water-level data collected can also be used in the calculation of the methane emissions of the rice cycle.

To monitor the water level on paddy plots, a PVC tube is used, also called **pani pipe**, measuring 30 cm long and ~15cm in diameter with drilled holes as shown in Figure 24. The tube is embedded 20 cm deep into the rice field, leaving 10 cm above the soil level. These pipes were installed in 2023 and 2024 in Kanghot to manually monitor the water level of selected DeiMeas plots.

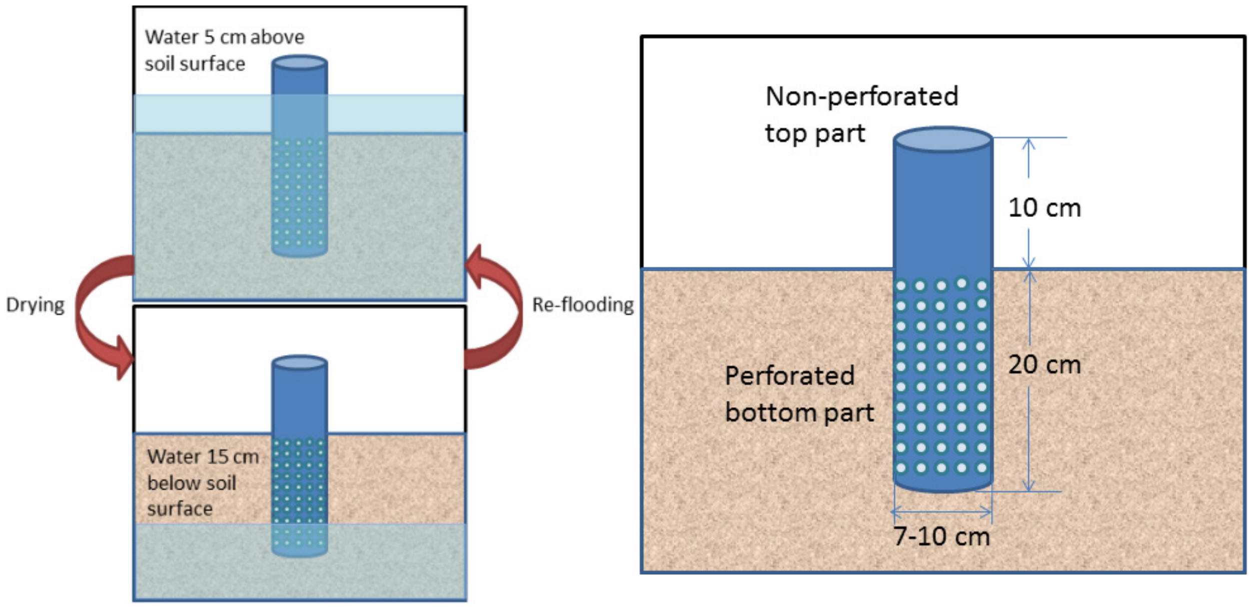


Figure 24: Pani pipes made of PVC used in Battambang province

In 2023, 17 pani pipes were installed on DeiMeas farmers' plots and data were collected manually every week, for 35 weeks, covering the 3 rice cycles of the year. Results of the manual water level monitoring can be found in Figure 25 below, highlighting the high difference of water access between the irrigation blocks of Kanghot.

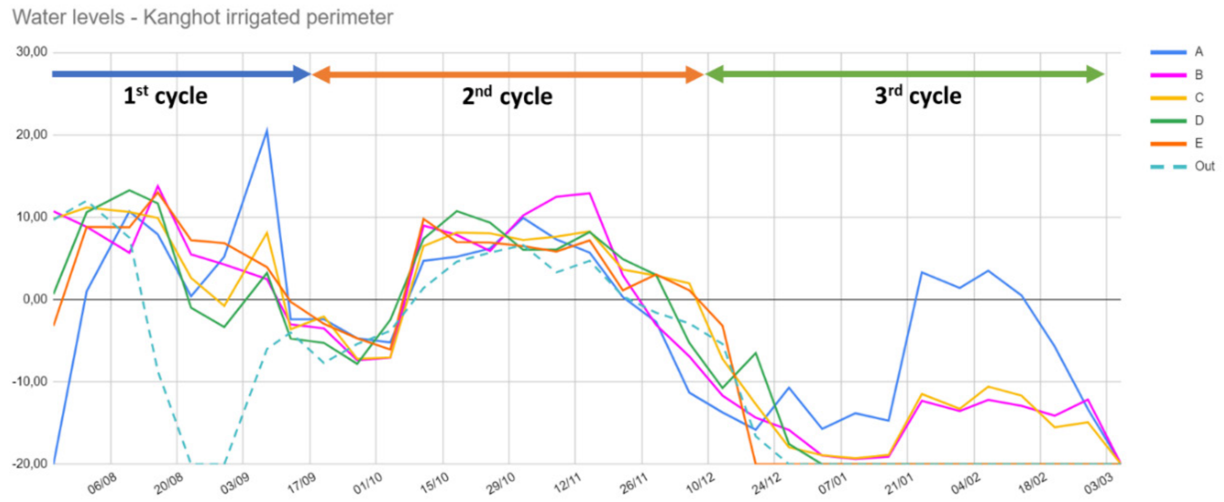


Figure 25: Average of the water level per block, collected manually on the 17 pani pine in Kanghot in 2023

In 2024, through all the 5 Blocks of the MC2-Kanghot, 53 pani pipes were installed on DeiMeas farmers' plots. The level was collected manually every week, during 30 weeks in a row, covering the 2 rice cycles of 2024. More intensive data collection was conducted in the SG17 during the AWD pilot data collected daily or every 2 days). A higher density of pani pipes was installed in the selected sub-hydraulic group SG17. Results of the manual water level monitoring can be found in Figure 26 below.

The analysis of these data has shown heterogenous management of the water resource but also highlighting the numerous drainage periods occurring across all blocks of the MC2-Kanghot during both rice cycles. These drying periods, related to a lack of water access and control, were named "**natural AWD periods**". Between 37% and 52% of all data collected in 2023 and 2024, respectively, were below the soil level (Figure 28).

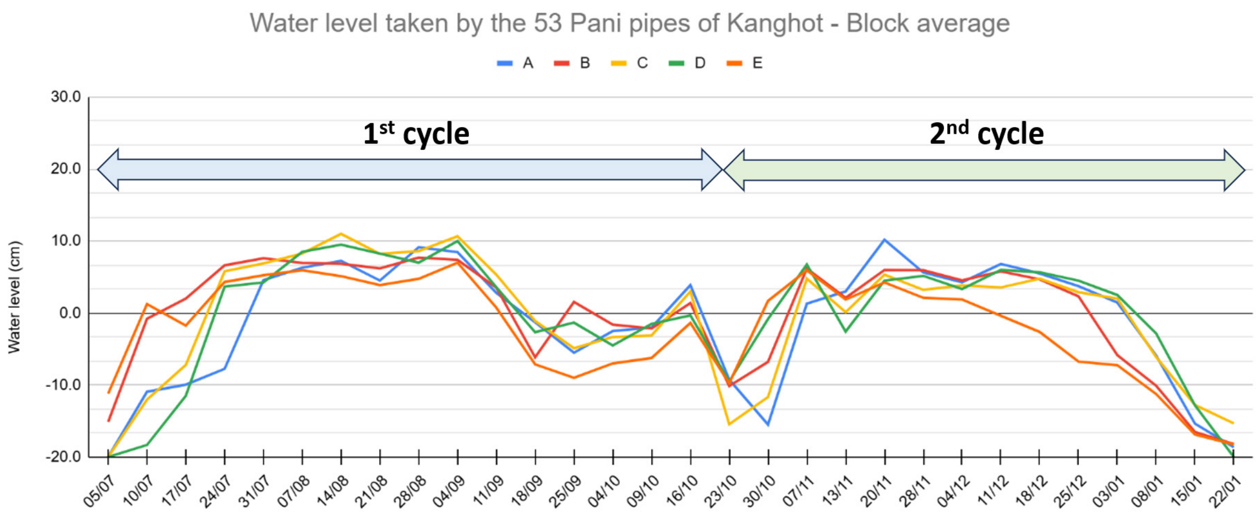
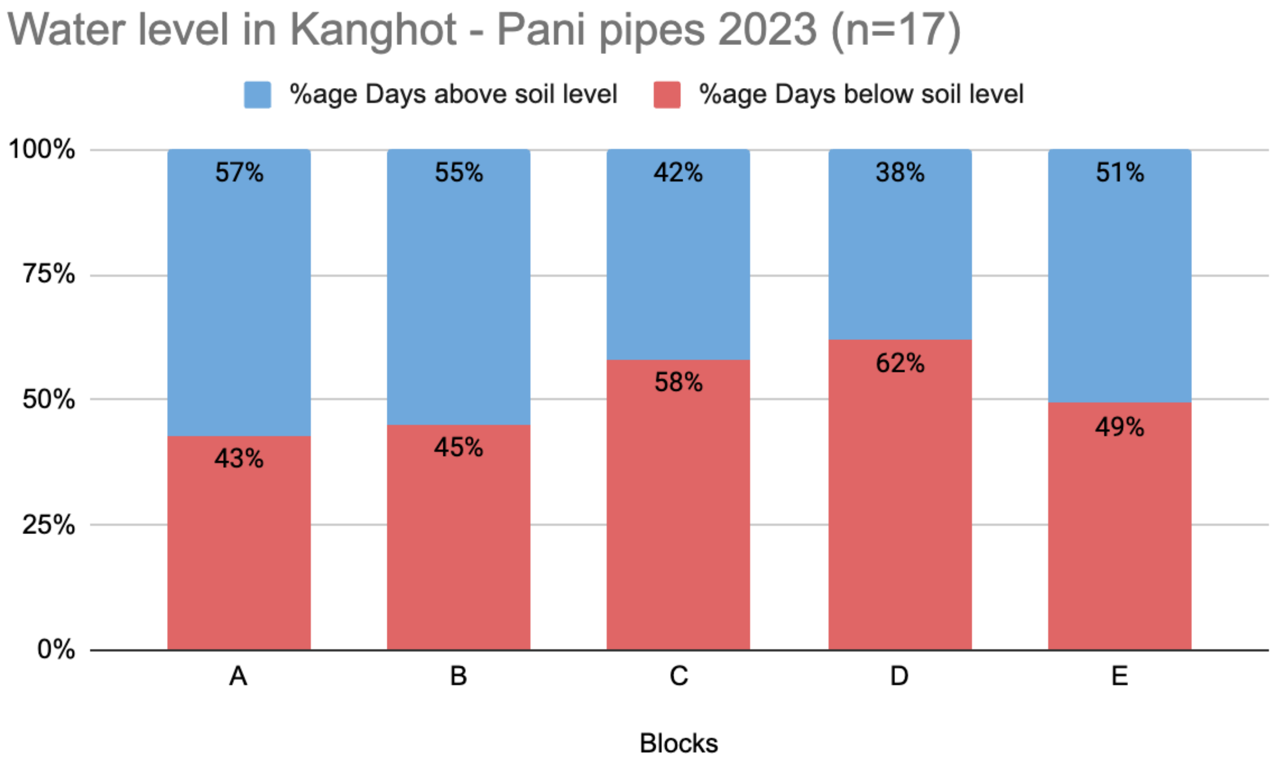


Figure 26: Average of the water level per block, collected manually on the 53 pani pine in Kanghot in 2024

Despite the participating of 31 farmers in the data collection of the water level alongside DeiMeas team in 2024, the data collection remains **labor-intensive and time consuming** (Figure 27). Innovative technologies were also being tested to digitalize this data collection such as water sensor or satellite-based imagery for water monitoring (these technologies are further developed in the following sections).

Figure 27: Manual collection of water level using pani pipes



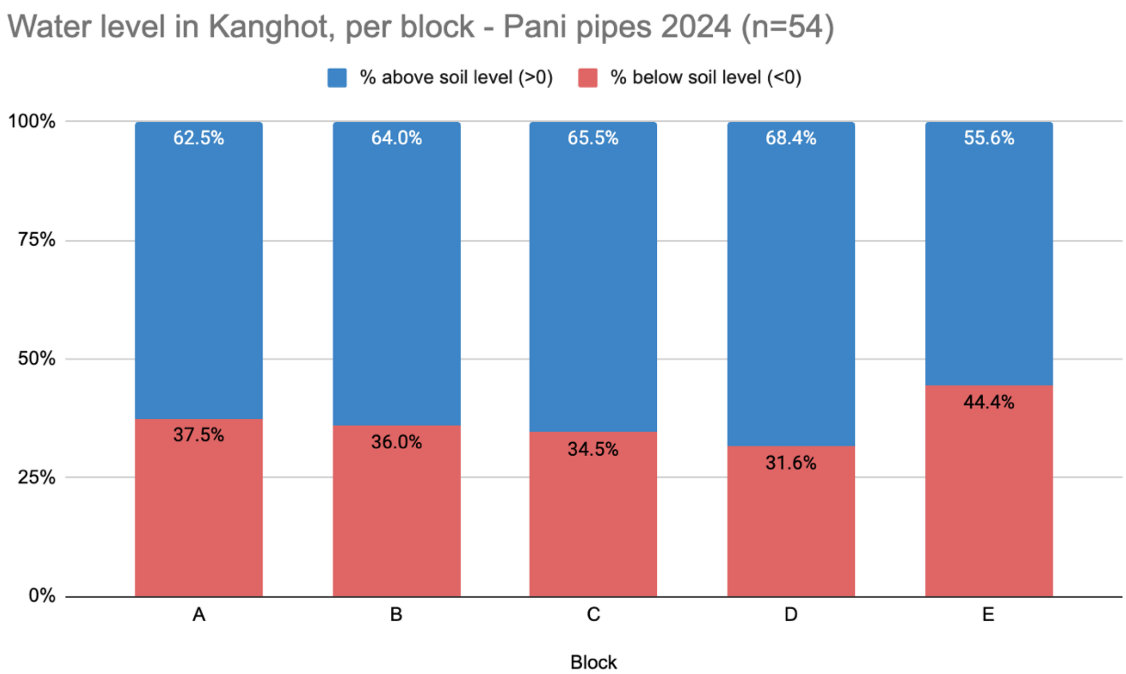


Figure 28: Percentage of days with water level below soil level in business-as-usual scenario (no project intervention) during the annual cropping system of 2023 and 2024

2. Innovative Technologies

a. ITC Prototype

To reduce the labor-intensive data collection of the water level data, **water sensors** could be installed on farmer plots to digitally collect accurate and regular data. These water-level data collection devices can be found on the market, provided by international companies, but are often costly. The DeiMeas team decided to work with **students from the Institut technologique du Cambodge (ITC)** to build and test a locally made water sensor prototype. The three versions of this prototype were tested at the research station of Wat4Cam project in Reang Kessei, MC2-Kanghot (Figure 29).

Figure 29: Field Test of Automatic Water Monitoring Device (2nd Prototype)

A "station" device was installed in a shed next to the rice fields, while the "nod" devices (water-level data collection devices) were installed on farmer's plots. The second version of the prototype showed some issues in terms of battery (short duration) and data transfer (connection between nods and station, and maximum length). Solar batteries and additional disc card for manual data collection were installed on the 3rd prototype. The device was installed in mid-May 2025 at BlockA-SG17 field in Wat Kandal village (location of the AWD pilot in 2024). The test is still on-going. At this stage, the costs of a "station" and a "nod" are estimated at US$ 150 each. Several nods can be linked to one station.

Accessing locally made water sensors would greatly improve the quality and quantity of the water-level data collected, and support more accessible and affordable MRV technologies for potential rice mitigation projects in the future. The ITC team will continue to improve their prototype during the 2nd trial of AWD in MC2-Kanghot in 2025.

b. Medium infra-red (MIR) spectroscopy

The MIR (**Medium infra-red spectroscopy**) is a rapid and cost-effective SOC quantification tool. The principle of spectroscopy is the measurement of the interaction between electromagnetic radiation and matter at different frequencies. The studied material is submitted to radiation at different wavelengths, and the absorbance (or reflectance) of the material is recorded through a spectrum. The spectrum can provide information about chemical constituents of the material through spectral peaks analysis.

Spectroscopy can be used for many different purposes related to agronomy (biomass, geology, soil...) and it is quick, simple and non-destructive. A portable infra-red apparatus has been purchased by CIRAD (Reflectance spectroscopy, FTIR and Medium Infrared) to strengthen the analytical capacities of CARDEC/DALRM and to develop models aiming to predict soil indicators (SOC, N, pH, soil texture, CEC...) for different soil types.

Figure 30: Pictures of the portable mid-infra-red (MIR) spectrometer

All the soil samples collected during the DeiMeas pilot, along others from different projects and provinces in Cambodia, are used to calibrate and validate the MIR spectrometer. This activity refers to an activity of the Department of Agricultural Land Resources Management (DALRM) in partnership with CIRAD and aiming at calibrating the MIR for the main soil types of Cambodia. Several soil databases are used, representing a total of > 4,700 georeferenced soil samples. The MIR is currently located at Bos Khnor research station of CARDEC in Kampong Cham province.

The soil analysis cost often represents one of the major costs of carbon farming projects. It is expected that following calibration, the cost of soil analysis to be brought down from US$ 52/ sample (excluding the soil sampling itself) to less than US$ 5/sample (including soil sampling).

A high level of prediction is generally obtained for soil organic carbon concentration while accuracy can vary depending of the soil type for other soil parameters (Table 8). This activity is still on-going to maximize the predictive capacity of the MIR.

Table 8: Coefficient of determination of the validation process between soil analysis conducted on the lab and prediction of soil parameters using the mid infra-red spectroscopy

Soil database	Province	Soil parameters - Results of the validation process R^2 - Coefficient of determination										
		Total C	Total N	Clay	Sand	Silt	CEC	Ca	Mg	K	P	pH H2O
Veal Kropeu (Veng's Bsc)	Battambang	0.94	0.78	0.71	0.34	0.51		0.82	0.79	0.57	0.57	0.26
Borun_2020 2021 2022 (385 Samples)	Battambang	0.81	0.69	0.75	0.99	0.99	0.58	0.79	0.26	0.49	0.39	0.61
Sangha Pair-plot 2021 (450 samples)	Battambang	0.93	0.84									
Dei Meas_Baseline_Upland BTB (136 samples)	Battambang	0.96	0.92									
Dei Meas_Baseline_Lowland BTB (204 samples)	Battambang	0.94										
Rovieng Land Use change (172 samples)	Preah Vihear	0.93	0.48	0.92	0.92	0.93	0.96	0.94	0.92	0.89	0.69	0.96
Sangha land use changes (148 samples)	Battambang	0.95	0.77	0.38	0.75	0.7	0.26					

c. Quick review of the models and calculators

Many different tools were developed to calculate GHG emission reductions and soil carbon sequestration associated with projects enhancing the adoption of agroecology practices. Regardless of the tool, the principles remain the same:

i. A baseline scenario and a chosen intervention scenario are developed,

ii. Related information/data for each scenario are collected (ground-proofed), measured, obtained (satellite imagery) or estimated, and,

iii. These data are then used as inputs in the chosen tool (calculator, model software...) which will then create as outputs the information of interest (**ΔGHG emission**, **ΔSOC...)**

These tools need a diversity of data (amount and type), ranging from simple calculators based on regional data (e.g., Ex-ACT, CoolFarmTool...) to models based on local daily climatic data (e.g. DSSAT, DNDC...). The range of knowledge, efforts and time to collect the inputs and use the tools, and the range of outputs accuracy are thus wide.

In addition to SOC stocks and soil properties (texture, structure...), data on agricultural management practices are required, and collected from the field (interviews, agronomic assessment).

Four different tools were tested during the DeiMeas pilot and are still tested, two calculators: Ex-ACT[18] and CoolFarmTool[19], and two models for which the outputs (SOC and GHG) were compared (DNDC[20] and DSSAT[21]). Each tool was tested using Tier 1 and Tier 2 data from national and regional datasets available, and Tier 3 data, specific to intervention areas (CARDEC field work, WAT4CAM experiments...). These tools required a large set of data about the study location (elevation, precipitation...), soil type, cropping system.

18 Developed by FAO: https://www.fao.org/in-action/epic/ex-act-tool/suite-of-tools/ex-act/en/

19 https://app.coolfarmtool.org/account/login/?next=/

20 Developed by University of New Hampshire: https://www.dndc.sr.unh.edu/

21 Developed by University of Florida: https://dssat.net/

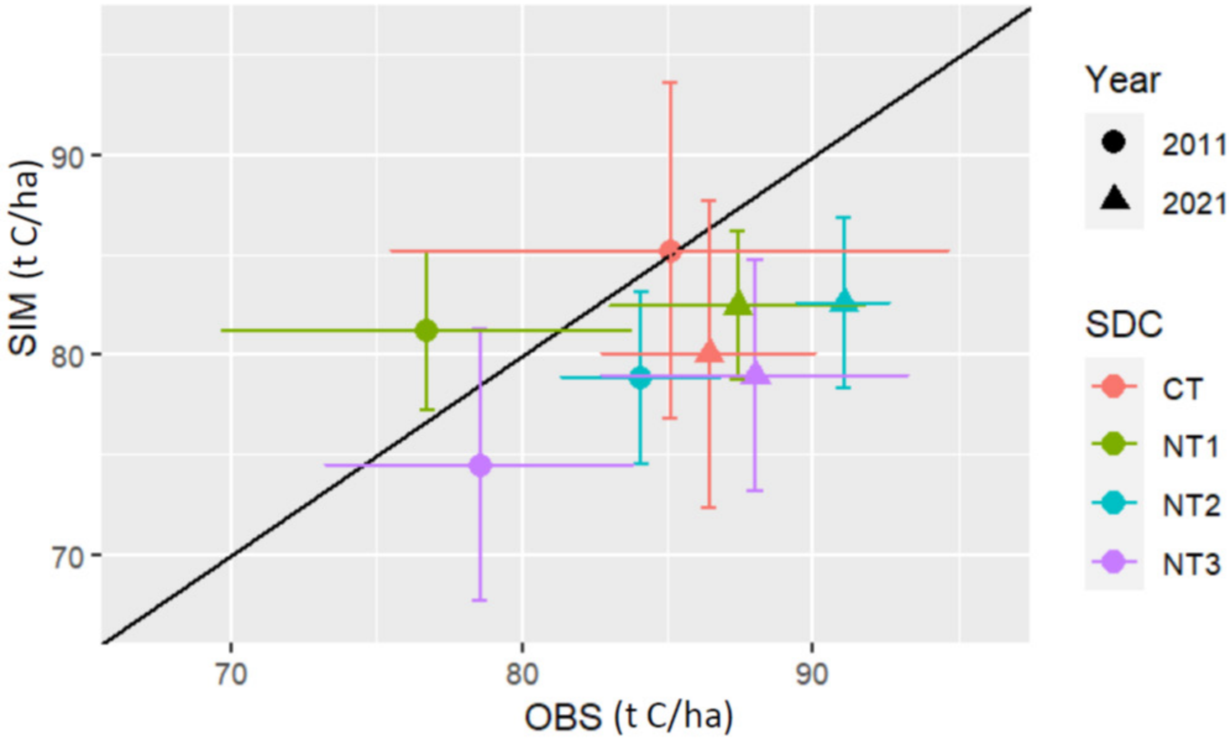


Figure 31. Predicted (SIM) vs. measured (OBS) stock of soil organic carbon for cassava-based cropping systems using the database produced during the PhD of Lyda Hok (2011) and Vira Leng (2021) assessing the impacts of conventional (CT) and conservation agriculture-based cropping systems (NT1- NT2 - NT3).

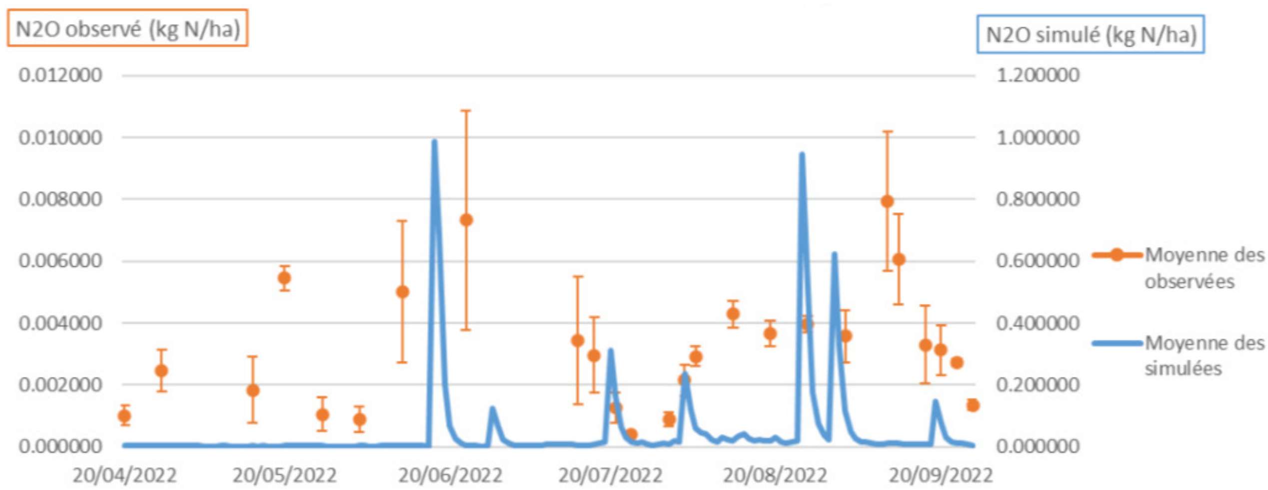


Figure 32. Example of the comparison between predicted and measured value for the gas N2O. Predicted values (orange) vs. measured N2O (blue line) over the cropping season 2022 and 2023 for cassava-based cropping system. Database from Vira Leng (PhD, ASSET/FFEM).

d. Remote Sensing: CarbonFarm

Satellite remote-sensing imagery is an innovative technology that can strongly support the development of context-based precise and cost-effective MRV systems. In 2024, the DeiMeas team engaged in a partnership with CarbonFarm, a carbon project developer and remote sensing MRV service provider, to calibrate their tools to MC2-Kanghot. In Kanghot, CarbonFarm and AMRU rice miller have initiated a calibration phase by installing ~25 sensors on farmer's plot, on SG17 (AWD pilot area) and in Os Tuk village. A Non-Disclosure Agreement (NDA) was signed to share information and data among all parties.

After several tests and ground proofed calibration using some data provided by the DeiMeas field team, the CarbonFarm team was able to produce conclusive and context-specific results on:

i. **Plot delimitation**: CarbonFarm was able to create precise polygon boundaries of farmer plots, removing trees, ponds and bunds for more precise surface estimation. This tool is particularly useful as the capacity of GIS software use by the field partners is often very limited. Moreover, precisely verified plot boundaries are often a requirement for any carbon credit certification/verification process.

ii. **Crop diversity detection** was successfully tested, opening possibilities for practice adoption verification through remote sensing. This practice verification could be very useful in the MRV system of a practice-based financial mechanism (i.e., SRP certification, outcome-based payment…).

iii. **Water management monitoring and AWD detection**: ~52% of all plots were identified with "strong or some evidence" of drainage during the rice cycle, without project intervention (referred in this report as "natural AWD"), as we can see in Figure 34. This high percentage can be explained by a lack of water access and control in the irrigated perimeter, leading to regular unplanned drying periods during the rice cycle.

iv. **Burning monitoring**: their results are showing a strong decrease of crop residues burning practice in the MC2-Kanghot between 2019 and 2024, from 49% to 3% of monitored plots, respectively (Figure 35 and Figure 36). This could be explained by increased enforcement of the regulation against straw burning, or by the alternative usages of the straw such as being collected for livestock feed, or even additional income source with the introduction of the straw baling in Kanghot. A complementary survey has been conducted with farmers and service providers to understand the main reasons behind this change in burning frequency and the main management strategy of the rice straw.

Following this successful tests and calibration, additional activities will be planned between DeiMeas partners and CarbonFarm in the future.

Water regime on-season	Strong evidence of AWD *ie fields for which 2 or more drainages were observed during the season*	**34%**	129
	Some evidence of AWD *ie fields for which 1 drainage event was observed during the season*	**18%**	67
	No evidence of AWD *ie fields for which no drainages were observed during the season*	**48%**	183

Figure 32: CarbonFarm water regime monitoring results for the 2nd rice cycle of 2024

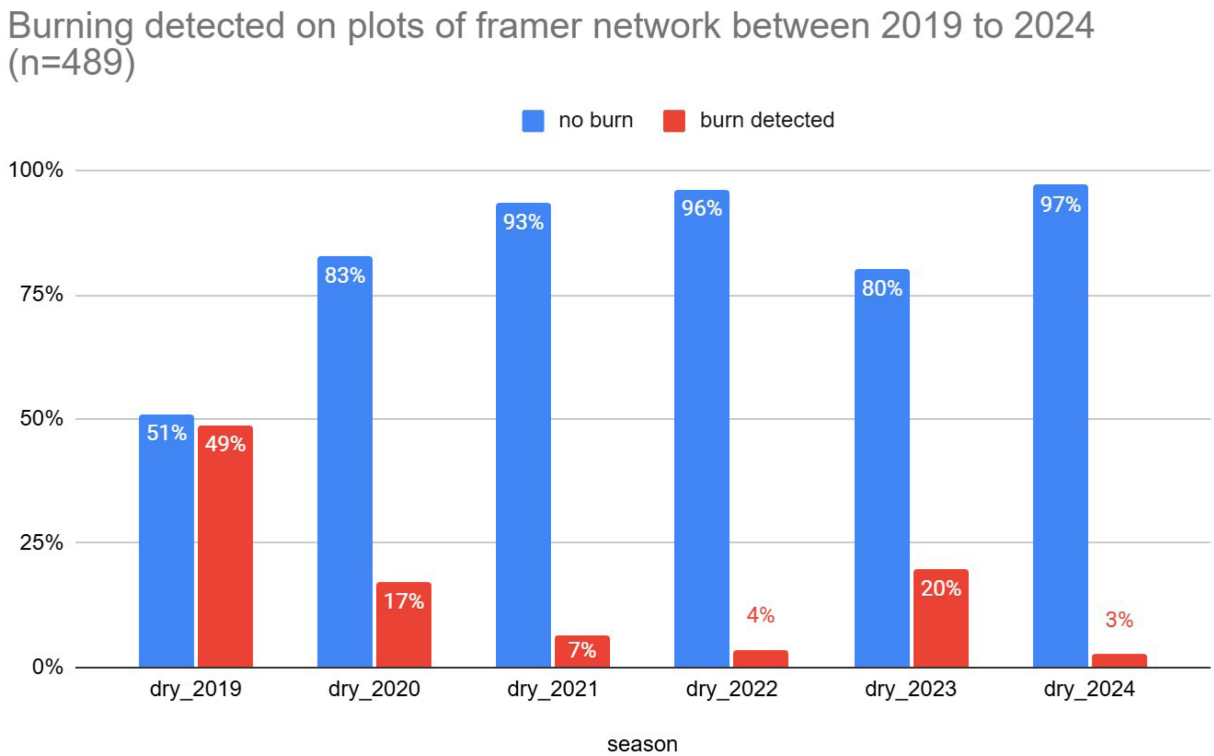


Figure 33: Graphical representation of the burning evolution in percentage of plots monitored, between 2019 and 2024 in MC2-Kanghot (source: CarbonFarm)

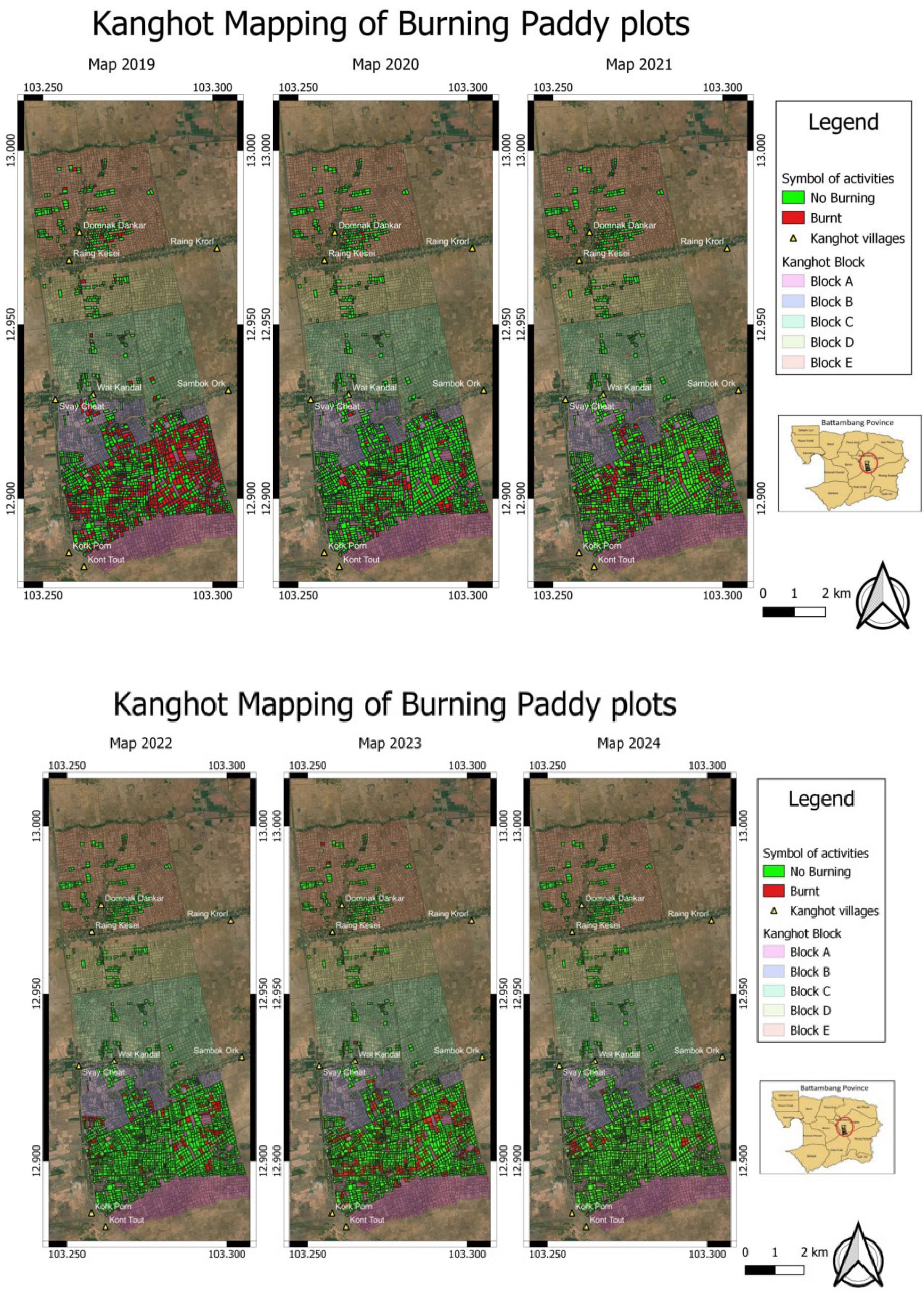


Figure 34: Map representation of the burning evolution between 2019 and 2024 in MC2-Kanghot (source: CarbonFarm)

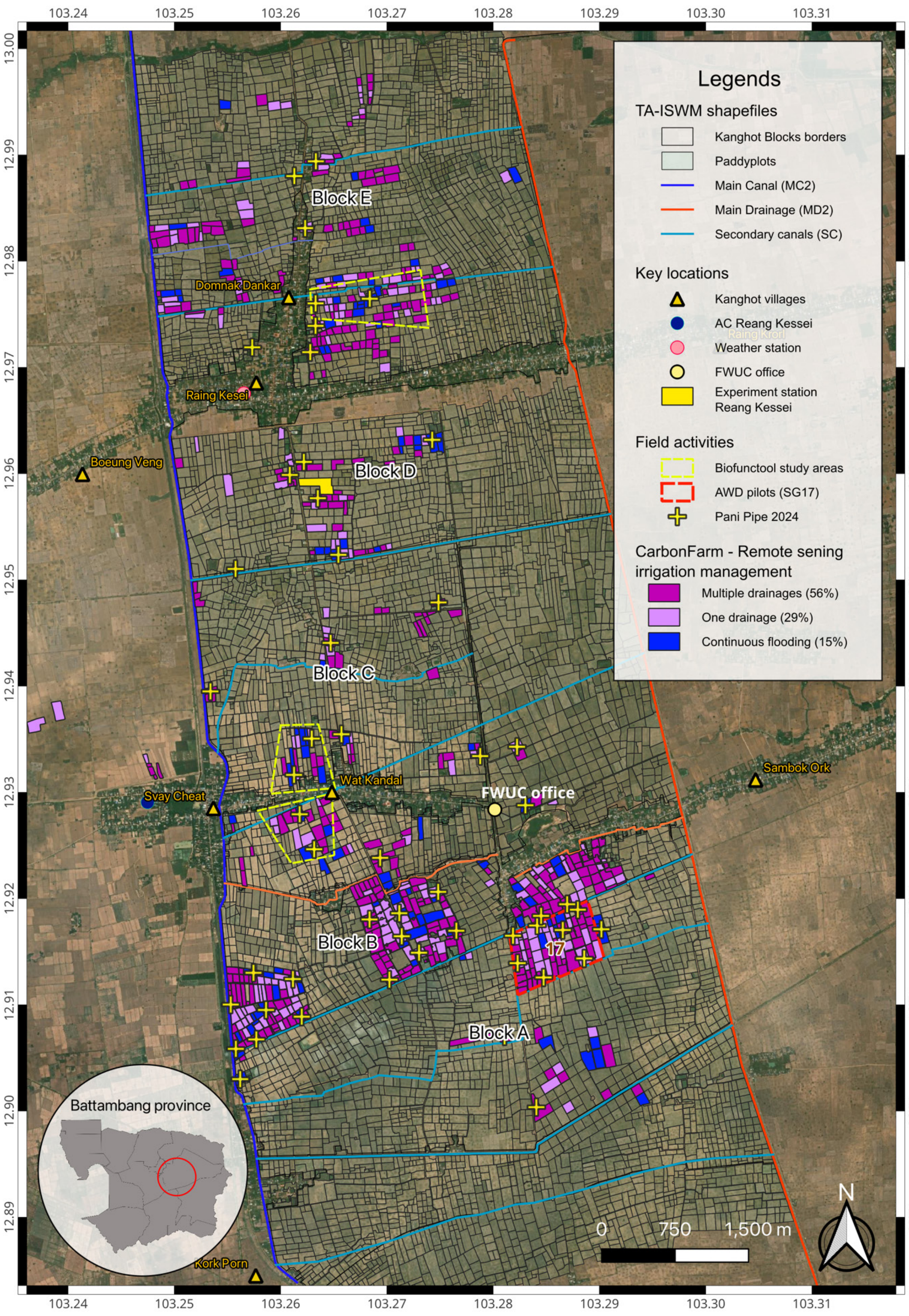


Figure 35: Map from the CarbonFarm Dashboard showing the results of the water management monitoring and AWD evidence during the second rice cycle 2024 in MC2-Kanghot (source: CarbonFarm)

Pillar 3: Finance

The 3rd pillar of the DeiMeas pilot on “Finance” aimed to explore financial mechanisms that could support Cambodian smallholder farmers in their transition. From certifications and carbon markets to outcome-based payments and Microfinance Institutes, each model was analyzed for its feasibility in financing farmers’ transition.

During the 3-year pilot, 23 private actors, national and international, with “transition-related” financial mechanisms, directly reached the DeiMeas team or were contacted. We categorized a selection of these business models and assessed their applicability to Cambodian context, more particularly to smallholder farmers in Battambang province.

In this chapter, we give a brief introduction to carbon markets and carbon farming project, before detailing the main financial mechanisms assessed by the DeiMeas team.

1. Carbon Markets

a. Compliance vs. Voluntary

Carbon markets are trading systems in which carbon credits are bought and sold, with each credit representing a reduction or removal of one metric ton of carbon dioxide or its equivalent in other greenhouse gases (tCO_2eq). Once measured through a MRV system and verified by a third-party verifier, the carbon sequestered, and/or the emissions avoided during an “additional” change of practices, are converted into tons of CO_2 equivalent (tCO_2eq). Each tCO_2eq generates one carbon credit unit, issued by an international registry, and can be sold to offset on a carbon market. The sale of these credits generates funds shared between the stakeholders involved in the project (project developer, farmers, public sector...).

Figure 39: simple representation of a carbon crediting mechanism

There are two main types of carbon markets (Figure 39):

i. **The compliance carbon market** involves mandatory participation by entities, regulated by government policies, to meet clear emissions reduction targets (such as NDCs). Participants must adhere to legally binding limits and can trade carbon credits to comply with these regulations (Examples: EU Emissions Trading System (EU ETS), CORSIA or Article 6 of the Paris Agreement).

ii. **The voluntary carbon market (VCM),** on the other hand, operates outside of regulatory frameworks (for now, until further implementation of the article 6.4 of Paris Agreement). Private sector, individuals, and organizations participate voluntarily to offset their carbon footprint by purchasing carbon credits from projects that implemented carbon removal or avoidance activities. This market allows buyers to demonstrate Corporate Social Responsibility (CSR), reach Environmental, Social and Governance (ESG) targets, or other commitments, or simply to support climate mitigation projects (individuals, philanthropy...).

The "Operations Manual for the Implementation of Article 6 of the Paris Agreement on Climate Change in Cambodia"[22] was signed and published early 2024 and should support a more transparent and structured carbon market in Cambodia, allowing the generation of "Internationally Transferred Mitigation Outcome" (ITMO) by future carbon projects. Procedures for project registration and validation have been clarified but remain to be tested.

Additional information on Cambodia's NDC targets and on-going project related to carbon markets can be found on different platforms and websites such as:

- Climate focus Dashboard (focusing on VCM projects)
- United Nations Carbon Offset Platform (focusing on CDM projects)
- Abatable website (Article 6, VCM projects and carbon pricing)
- Verra/VCS Standard website (focusing on VCM projects)
- UNEP website (focusing on Article 6 bilateral agreements)

22 https://www.moe.gov.kh/wp-content/uploads/2024/01/Article-6-OM_EN.pdf

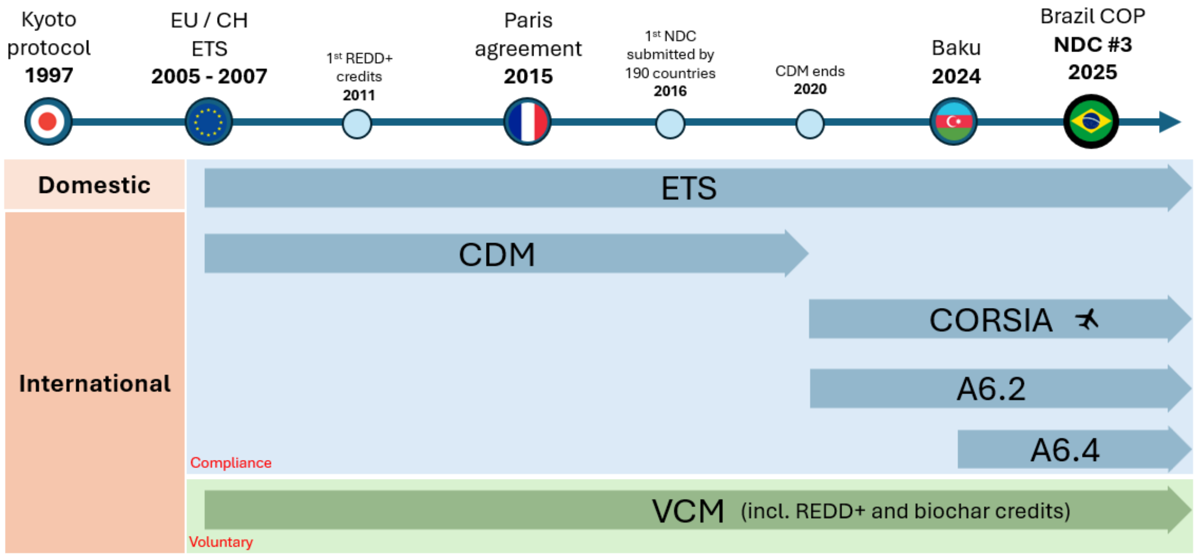


Figure 40: Graphical representation of the main carbon markets (source: authors)

b. Article 6 of the Paris Agreement

The Article 6 of the Paris Agreement plays a crucial role in both compliance and voluntary carbon markets. It provides the framework for international cooperation on carbon markets, supporting countries to meet their Nationally Determined Contributions (NDCs), using internationally transferred mitigation outcomes (ITMOs) and Biennial Transparency Reports (BTR) to avoid double counting. There are 3 main sub-articles:

- Article 6.2, active since 2020, which allows countries to voluntarily transfer ITMOs through bilateral agreements, enhancing flexibility and cost-effectiveness in achieving countries' mutual NDCs. In January 2024, Switzerland and Thailand completed the first ever transfer of Article 6.2 carbon credits.

- Article 6.4, active since 2024, aims to replace the UN's Clean Development Mechanism (CDM), by establishing a new mechanism to transfer "mitigation contributions" and governed by a Supervisory Body to ensure environmental integrity (and avoid double counting). The text isn't yet definitive.

- Article 6.8 focuses on non-market approaches, promoting mitigation and adaptation cooperation through finance, technology transfer, and capacity-building without involving tradable credits. There is little clarity on how the mechanism would work or be framed yet.

The differences between the 3 main sub-articles of the Article 6 are clearly explained on the document of The Nature Conservancy[23] (updated with COP29 decisions), and more details/clarity will be brought on 6.4 and 6.8 during the next Conferences of the Parties (COP).

23 https://www.nature.org/content/dam/tnc/nature/en/documents/c/m/CM-TNC-Article-6-Explainer.pdf

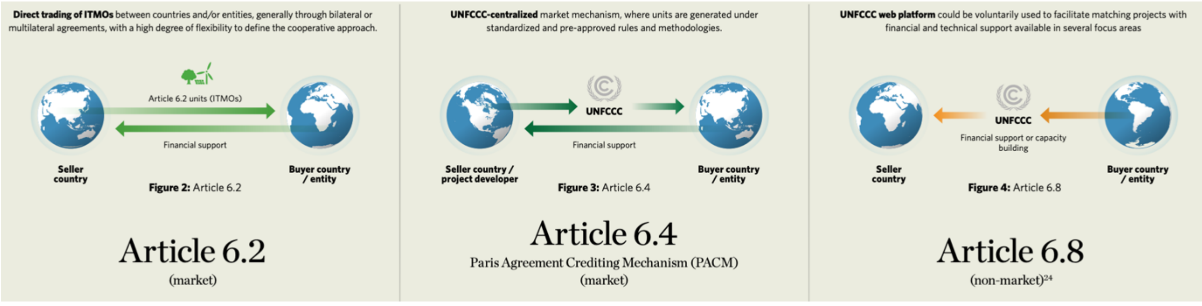


Figure 41: Details on the 3 main sub-articles of Article 6 of the Paris agreement (source: The Nature Conservancy)

c. Latest Status of the VCM

According to the State of the Voluntary Carbon Market 2025 report[24] by Ecosystem Marketplace, the voluntary carbon market (VCM) continued its contraction between 2023 and 2024. As we can see in Figure 42 and Figure 43, the total volume of carbon credits transacted declined by 25%, dropping from 112 million to 84 million tCO_2eq, while the overall market value decreased by 29%, from US$754 million to US$535 million. The average credit price also saw a small decrease of 6%, falling to US$6.34 per tCO_2eq in 2024. This decrease specifically affects certain credit types, particularly REDD+ with a 52% drop in transaction volume, reflecting credibility and additionality concerns since the publication of The Guardian article in early 2023[25].

Despite this decrease, the report highlights 2 interesting points:

i. A growing interest in carbon removal credits, from "nature-based solutions" such as Afforestation, Reforestation, and Revegetation (ARR), or more "engineered"-based solutions like biochar and direct air capture. In 2024, removal credits traded at prices almost 5 times higher than reduction credits (US$19.50 against US$4.05), signaling a significant premium associated with their perceived quality and long-term climate benefit.

ii. There is a continuously increasing demand for credits with strong environmental and social co-benefits, with buyers shifting toward credits that meet higher standards of integrity (ICVCM[26] or SBTi[27]) and contribute to broader SDGs.

24 https://www.ecosystemmarketplace.com/publications/2025-state-of-the-voluntary-carbon-market-sovcm/
25 TheGuardian article
26 https://icvcm.org/
27 https://sciencebasedtargets.org/

Table 3. VCM Transaction Volumes, Values, and Prices by Project Category, 2023-2024

	2023			2024			Percent Change		
CATEGORY	Volume ($MtCO_2e$)	Value (USD)	Price (USD)	Volume ($MtCO_2e$)	Value (USD)	Price (USD)	Volume	Value	Price
Forestry and Land Use	37.1	$372.3M	10.04	37.0	$342.5M	9.27	0%	-8%	-8%
Renewable Energy	29.0	$113.5M	3.92	22.3	$59.5M	2.67	-23%	-48%	-32%
Chemical Processes / Industrial Manufacturing	12.2	$50.2M	4.10	5.7	$20.8M	3.66	-53%	-58%	-11%
Household / Community Devices	10.2	$78.3M	7.71	5.1	$37.4M	7.30	-50%	-52%	-5%
Waste Disposal	1.5	$10.9M	7.46	4.8	$32.0M	6.72	226%	193%	-10%
Agriculture	4.7	$30.7M	6.51	0.6	$4.7M	7.66	-87%	-85%	18%
Energy Efficiency / Fuel Switching	9.4	$34.4M	3.65	0.6	$1.9M	3.05	-93%	-95%	-16%
Transportation	-	-	-	0.2	$0.6M	3.24	-	-	-

Note: EM cannot report an average price for Transportation credits in 2023 because of the confidentiality of individual EM Respondent data.

Figure 42: Volumes, Values and Prices of VCM markets between 2023 and 2024

Figure 2. Voluntary Carbon Market Size by Value of Traded Carbon Credits, pre-2005 to 2024

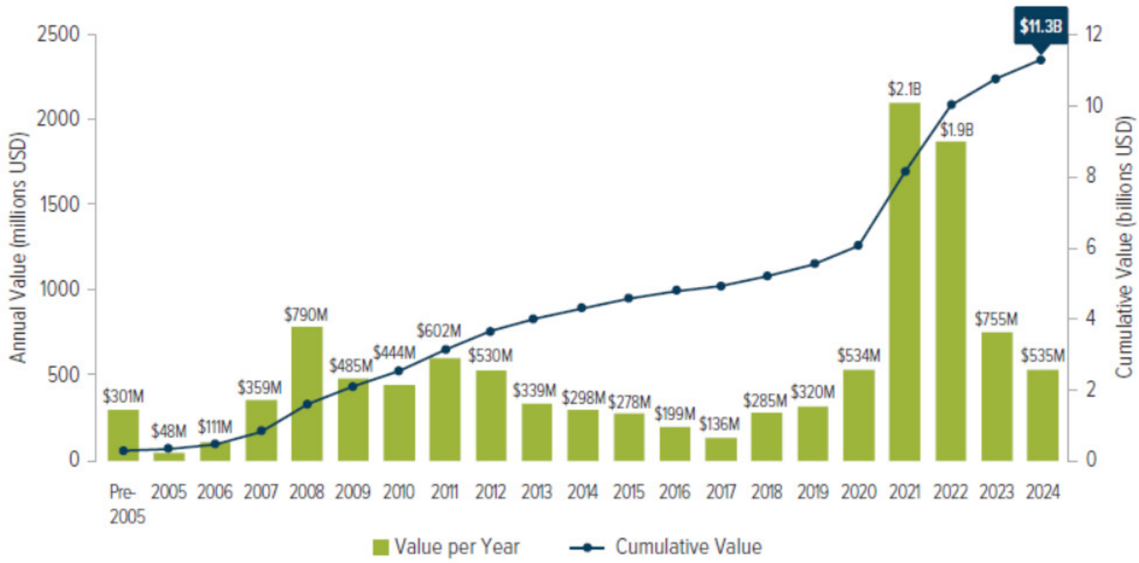


Figure 43: Value of the VCM market between 2005 and 2024 (source: Ecosystem Market place)

d. Agriculture and Carbon market: Carbon Farming

Carbon mitigation projects are often identified as "removal" or "avoidance" (Figure 44). As defined previously, "Carbon farming" is an agricultural approach that optimize carbon capture, or "carbon removal", by implementing practices that are known to improve the rate at which CO_2 is removed from the atmosphere and stored in plant material and/or soil organic matter. The main farming practices promoted in carbon farming projects are i) cover cropping and diversification, ii) reduction of tillage and other soil disturbance practices, iii) crop residues management (mulching, exportation, burning...) iv) transition toward agroforestry and crop-livestock models, and to some other extent, or v) the use of biochar.

In some definitions, the reduction of the GHG emissions through agricultural practices (carbon avoidance) such as AWD in irrigated rice production (CH_4 reduction) or reduction of chemical-based fertilization (N_2O reduction), are also included in the term carbon farming.

As an aside, it is worth noting that (except for iv), these are technical elements that do not make sense when considered in isolation. It is unlikely that a smallholder farmer can generate carbon credits by applying these practices in isolation (i.e. crop residue management, reduced tillage, cover cropping and crop diversification). It is well documented that it is only through the combination of these technical terms that significant C accumulation can be achieved, thereby improving the overall resilience of cropping and farming systems.

Figure 44: Simple graphical representation of a different types of climate mitigation

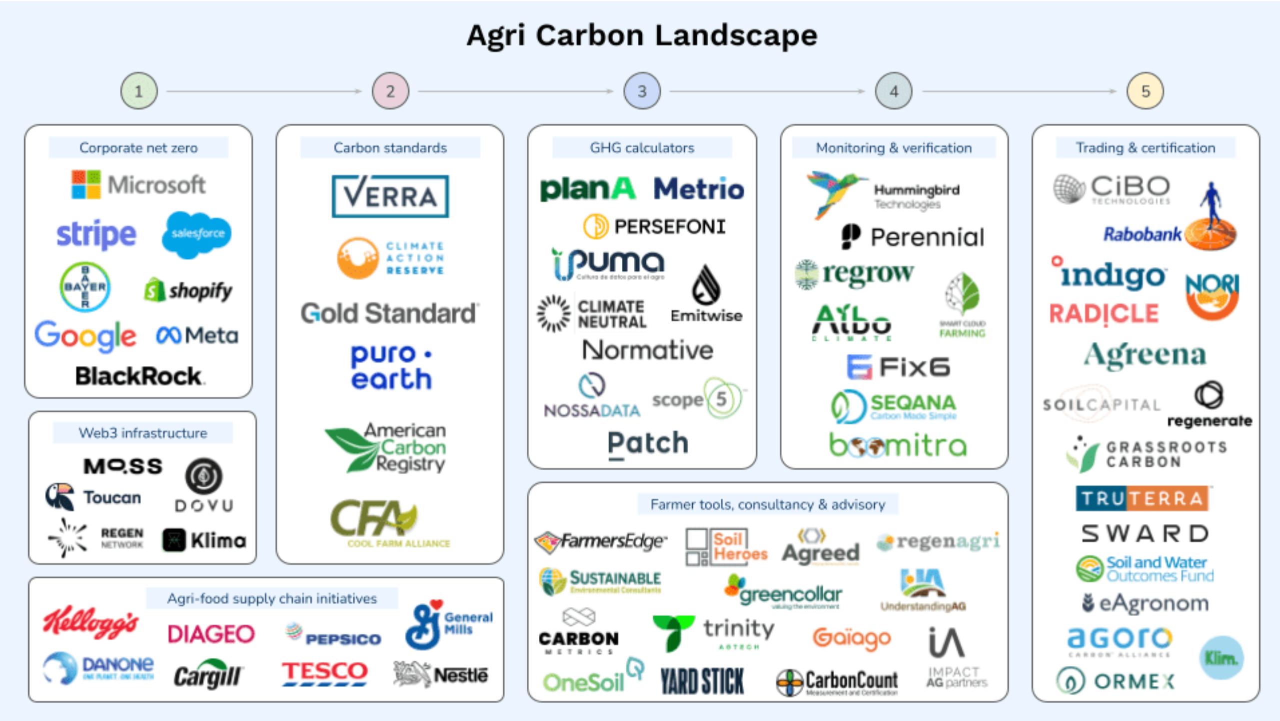


Figure 45: Private sector involvement in the carbon farming landscape internationally

The CO_2 captured (or avoided) through these farming practices can be quantified and certified to generate carbon credits. These credits are sold on carbon markets and revenues serve to finance farmer's transition. However, measuring SOC changes, GHG emissions reduction and associated co-benefits is not easy nor cheap. Precise measures and low uncertainty are linked to high MRV costs. Carbon farming is an approach implemented internationally, with an active private sector involved in all different parts of the carbon credit chain, as shown on Figure 44. Farmers, mainly from US, EU, and Australia can already benefit from incentives, subsidies and/or premium for adoption of agroecology/regenerative practices.

There is a clear knowledge gap related to carbon farming and carbon credit certification processes in Southeast Asia. Methodologies and protocols are often adapted to western countries' conditions and difficult to implement in least developed countries (LDC) contexts (tropical climate conditions, smallholder farmers (<2ha), little to no policies to support farmers...). High MRV costs, added to the complexity and lack of clarity of soil organic carbon certification standards (Demenois et al. 2021), often lead to an exclusion of smallholder farmers (who cannot benefit from economies of scale) from carbon markets.

Furthermore, we can differentiate 2 main financing strategies when referring to climate mitigation activities: **Insetting and Offsetting**.

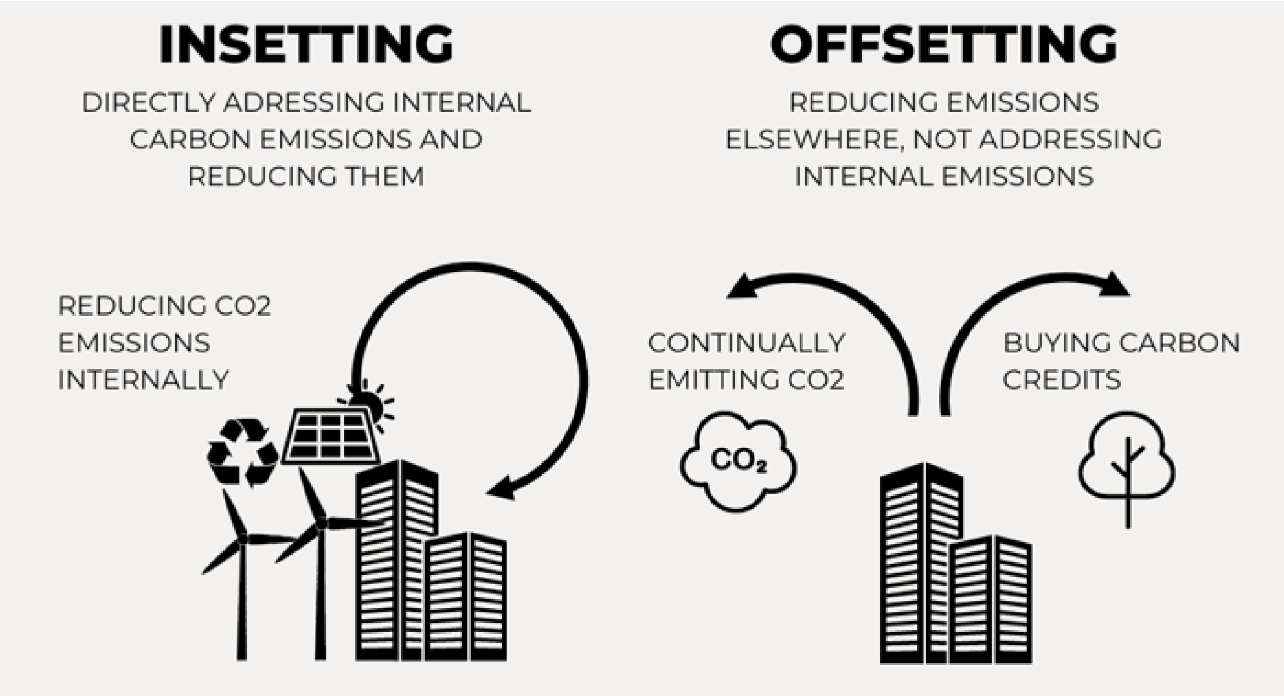


Figure 46: Graphical representation of the difference between Insetting and Offsetting (source: Tunley Environmental)

Offsetting involves purchasing carbon credits from external projects, to compensate for a company's own emissions. These carbon credits were generated through the whole certification process (standard, methodology, MRV, 3rd party verifier...) and often come from different regions or sectors than the buyer's company. In comparison, Insetting refers to the implementation (or financing) of emissions reduction activities within a company's own value chain. For instance, a food and beverage company would work with its suppliers or farmers to adopt climate mitigation practices, and the mitigation quantified would be accounted in the company's Scope 3 emissions. The MRV system in insetting process is often lighter as the mitigation impact (in CO_2eq) is directly integrated in the company GHG accounting, and no carbon credit is generated or sold.

In summary, while offsetting often focuses on external compensation, insetting emphasizes internal transformation of a value chain.

2. Exploring Different Mechanisms in Cambodia

During the 3-year pilot, 23 private actors, national and international, related to transition financial mechanisms directly reached the DeiMeas team or were contacted. We categorized a selection of these business models and assessed their applicability to Cambodian context, and more particularly to smallholder farmers in Battambang province (Figure 47). Following Raina et al. 2024[28], we categorized the selected businesses per model type:

- **Result-based model:** A financing approach in which payments are made only after measurable outcomes or impacts are verified. Common in carbon markets, this model often requires robust MRV systems to prove the impact before issuing payments or credits (ex: climate mitigation results in tCO_2eq). In this model, payments tend to be received longer after practice adoption, thus considered more risky or uncertain for smallholder farmers.

- **Practice-based model:** An approach that provides financial support or incentives based on the adoption of specific sustainable practices, regardless of more science-based quantified results. Farmers may receive payments for implementing agroecological practices, with the assumption (often based on scientific published evidence) that these practices contribute to long-term environmental benefits. This model often requires a less intensive data collection and simpler MRV system, but also less profitable, according to Raina et al. (2024). The DeiMeas reward system was considered a practice-based incentive model.

- **Hybrid Model:** A combination of both result-based and practice-based approaches, where partial payments or incentives are provided as "early payment" or upon adoption of targeted practices, and additional rewards can be given when measurable outcomes are achieved. This model balances the need for farmer's early financial support, while connecting them to new sources of financing such as carbon markets.

Additionally, these business models were categorized by their implementation stages (Design phase - Pilot phase - Implementation and scale-up), and by the type and "timeline" of the financial support brought to farmers (early finance access (MFIs) - cost reduction – premium (income increase) – incentive for adoption – share of the credit sale). The following section details some of the selected business models assessed during the pilot period.

28 https://www.sciencedirect.com/science/article/pii/S0301479724001129

Mechanism	Model	Main actors	Remark	Incentive type	Current phase	Main crop	Avoidance	Removal	Social & Bio-diversity
Certification standard	**Hybrid**	**RegenAgri**	Value-chain Insetting/Offsetting	Premium/ Share of credit sale	Design	All	●	●	●
	Practice-based	**SRP**	Value-chain (Insetting model soon)	Premium	Scaling-up	Rice	◍		●
Carbon project developer	**Result-based**	**CarbonFarm**	AWD-focus, Satellite-based MRV	Share of credit sale	Piloting	Rice	●		
	Result-based	**GreenCarbon**	AWD-focus, Strong JCM link	Share of credit sale	Piloting	Rice	●		
	Result-based	**ACORN**	Agroforestry-Focus	Share of credit sale	Stopped	Agro-forestry		●	◍
	Hybrid	**Husk Venture**	Biochar-focus, bio-fertilizer seller	Cheaper bio-fertilizer	Scaling-up	Rice		●	
Outcome based payment	**Practice-based**	**Regen Network**	Practice-based certification	Share of "Eco-credit" sale	Design	All			●
	Hybrid	**Shamba Center**	Outcome-based payment	Reward for outcome verified	Design	All			●
Micro-finance	**Hybrid**	**Agrig8**	Reduced-interest loan for AE farmers	Lower loan interest rate	Piloting	Rice, Mungbean	●		●

Figure 47: List of the assessed main private actors of farmer's transition and their financial mechanisms

a. Result-Based Models

ACORN[29] is a carbon project developer from Netherland, linked to Rabobank, focusing on agroforestry carbon removals under the Plan Vivo standard, operating mainly in Asia, Africa, and Latin America. Through farmers adoption of agroforestry practices, they will generate and sell carbon credits (named Carbon Removal Units in their programs), from which farmers receive ~80 % of carbon revenues (Figure 48). ACORN only works on agroforestry projects and calculates only above and below ground biomass (no interest on soil carbon pool).

To be adopted in Cambodia, the main challenges to their model are:

- Their strong dependency on field partners owns financial capacity, as only 10% of credit revenues are redistributed to them (not sufficient to cover all "boots on the ground" activities").
- Their minimum requirement of 2000ha to initiate a project, which requires a high aggregation capacity by partners.

ACORN has not initiated any project in Cambodia to this day.

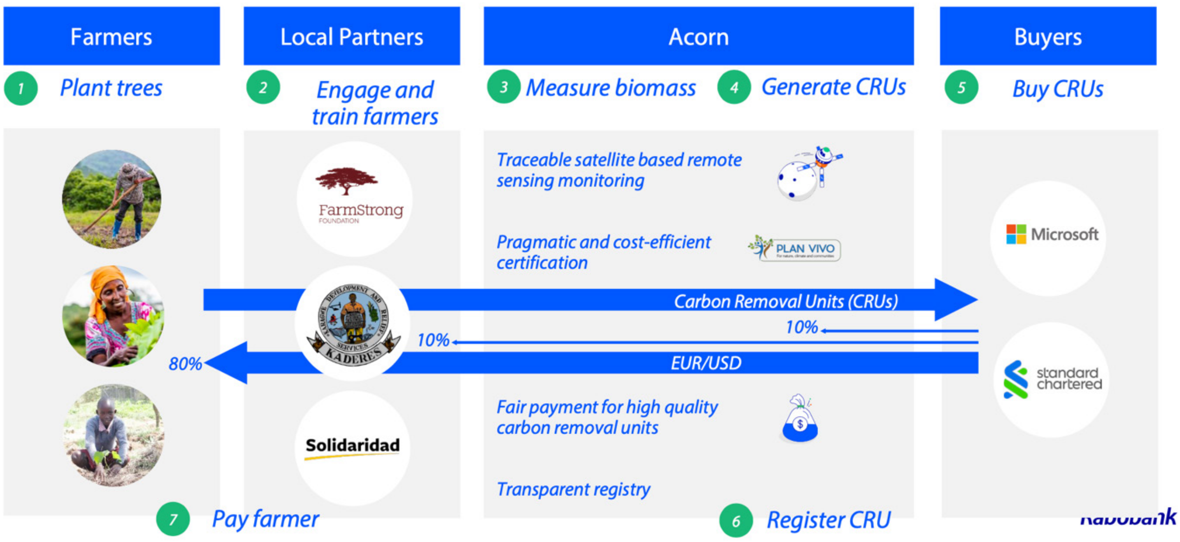


Figure 48: ACORN-Rabobank business model

29 https://acorn.rabobank.com/en/

CarbonFarm[30] is a carbon project developer and MRV remote sensing service provider, focusing on AWD promotion in irrigated rice cropping system, aiming to generate carbon credits (VCM or Article 6). As detailed in the chapter on Pillar 2, the DeiMeas team engaged in a partnership with CarbonFarm, to calibrate their tools to MC2-Kanghot. Their business model depends on their field partners (currently AMRU rice), for all boots on the ground activities, from farmers training on AWD practices to data collection for registration. AMRU rice works in partnership with BUAC through the SRP value chain, to collect these data and assist farmers during AWD practice adoption. Water-level sensors were provided by CarbonFarm installed by AMRU in Battambang province to support ground proofing and calibration of the MRV system. The revenue share between different actors (farmers, field partners, cooperatives, developer) of future carbon credit sale was not shared to the DeiMeas team. An extensive pilot in Kanghot irrigated perimeter should be conducted in 2025.

Several other carbon project developers such as ThanksCarbon (Korea), GreenCarbon (Japan), VNV Advisory (India), KosherClimate (India), or Sagri (Japan), have also shown interest in the promotion of AWD to farmers in similar area, some having already pilots initiated in Battambang, Pursat and Prey Veng provinces. Most of these private companies are working with the same field actors (RUA, CIRD, AMRU, PDAFF), but with very low communication between them, which could lead to conflicting situations or double counting of credits in the future.

30 https://carbonfarm.tech/

b. Practice-Based Model

ShambaCenter[31] is a Swiss-based international non-profit developing blended finance and outcome-based payment models aiming to support sustainable transition of smallholder farmers. Their outcome-based payment mechanism is funded via an impact bond and tied to measurable outcomes such as soil health, biodiversity, or employment (Figure 49).

This model aims to de-risk farmers transition by unlocking early-incentives for farmers and extension actors through concessional loan (taken by ShambaCenter), before selling outcomes to buyers, only once measured and verified. These outcomes are pre-defined during the project design phase by a set of measurable indicators and baselines.

In partnership with **Shamba Center**, DeiMeas team initiated a list of indicators that were generated by the DeiMeas pilot as well as their quantifying methods. A balance needs to be found between the costs of the analysis of the MRV system to produce these outcomes, and the precision required by outcome buyers. These indicators, if selected, could then be valorized through an outcome-based payment pilot in 2025.

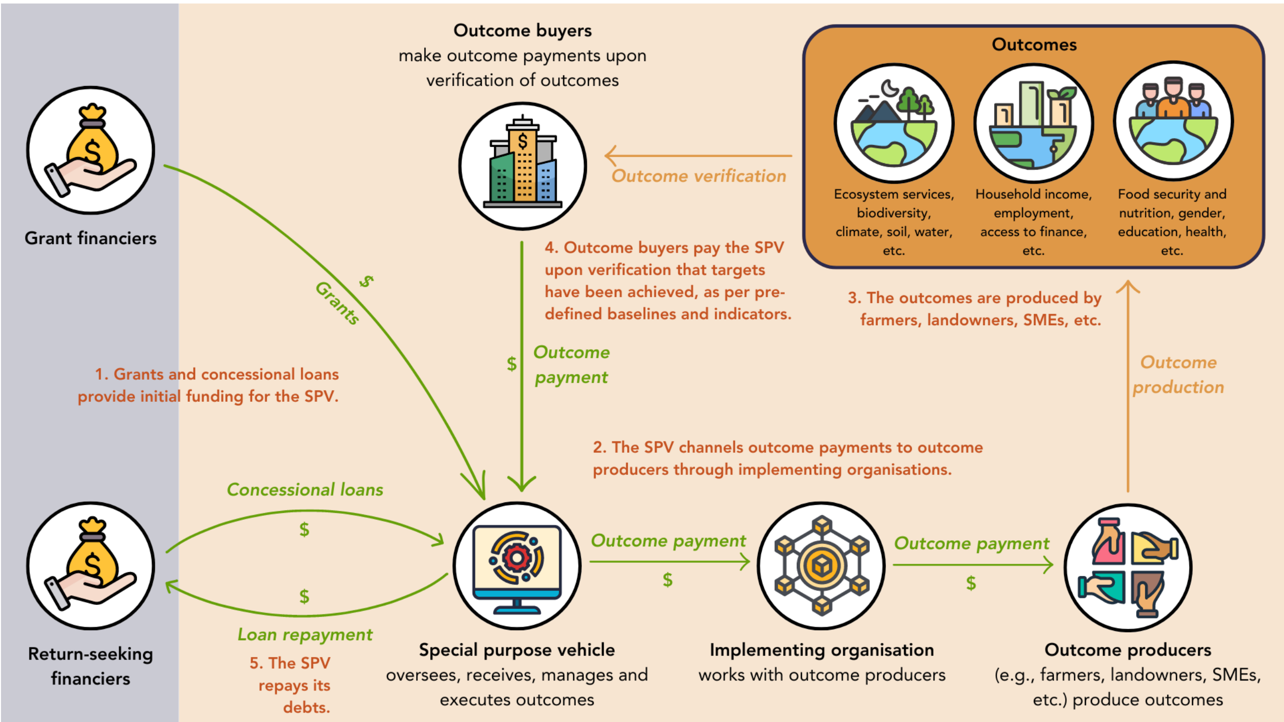


Figure 49: ShambaCenter business model

31 https://www.shambacentre.org/

RegenNetwork[32] is a blockchain-powered platform and decentralized ecosystem that enables the issuance and trading of ecological credits, or "eco-credits" for carbon, biodiversity, and other ecosystem services. The DeiMeas team collaborated with RegenNetwork to co-develop a practice-based methodology aimed at generating "eco-credits." These credits would represent farmers' adoption of agroecological practices and associated environmental and social co-benefits, beyond just GHG mitigation. The objective is to create a verifiable commodity that captures the transition process itself, and incentivizing farmers through a practice-based payment system. The draft methodology is currently under review by a third-party auditor and should be finalized by Q3 2025. Its implementation will require field pilots, involving collaboration with private sector impact buyers from the early stages.

c. Hybrid Models

AgriG8[33] is a Singaporean private actor combining low-interest transition finance, carbon finance and digital MRV support for sustainable value chain players. This hybrid model aims to increase early finance access for smallholder farmers involved in sustainable value chains (Figure 50). Their model targets actors across the value chain, including input providers and cooperatives, providing micro-loans for lower interest rates to transitioning farmers (in collaboration with a local financial institution). Additionally, their MRV tool aims to increase efficiency of the field data collection for the certification process and improves digital traceability for value chains such as SRP, opening potential opportunities from GHG accounting and additional incentive through carbon finance (AWD, fertilizer reduction...).

To support the calibration of their MRV tool to Cambodian cropping systems, the DeiMeas team signed a NDA with Agrig8 to share ground-proofed data. AgriG8 is expected to launch a pilot project in 2025 in Kanghot.

32 https://www.regen.network/

33 https://www.agrig8.com/

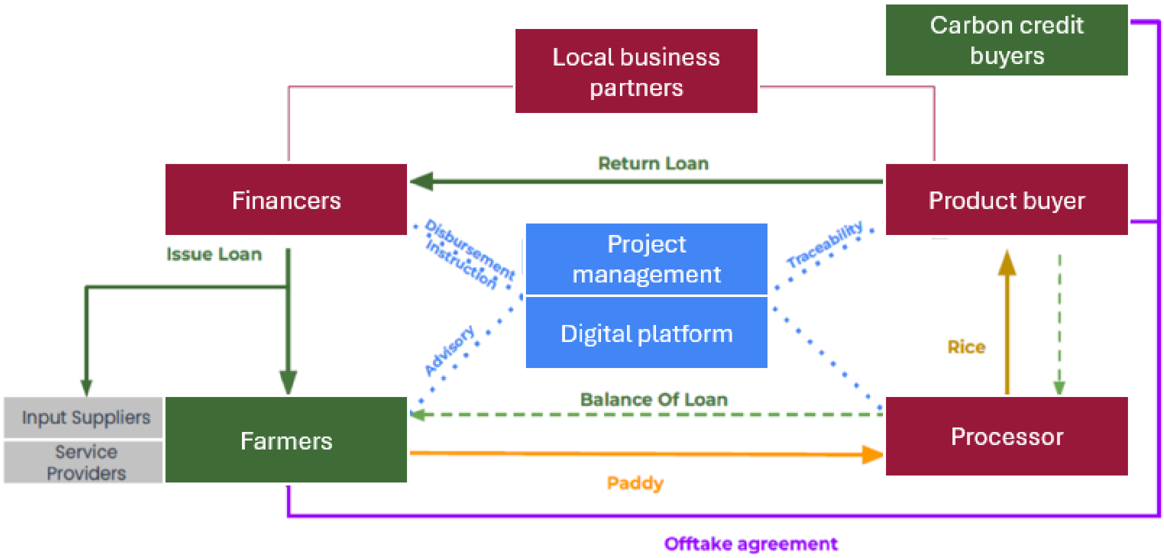


Figure 50: Agrig8 business model

Discussions and field visits were organized in 2023 with **Chamroeun**[34], a microfinance institution in Cambodia, founded in 2006 by the French NGO Entrepreneurs du Monde. Through their micro insurance company PREVOIR, we aimed to test access for transition farmers to loans and insurance (with lower interest or insurance premium for farmers implementing AE practices). However, their activities had to stop due to administrative issues.

The Sustainable Rice Platform (SRP[35]) is a global non-profit, promoting climate-smart rice farming through the SRP Standard and Assurance Scheme, which guides farmers to adopt sustainable practices (e.g., water efficiency, GHG reduction, pest management, no-child labor...) and enable certification and market linkages. In Battambang province, the SRP value chain is carried by AMRU and BUAC and supported by the WAT4CAM and DeiMeas field teams on farmers' training, practice adoption and data collection processes.

The SRP certification aims for farmer to access a premium on the rice selling price (increasing gross income), for the verified practice adoption of the SRP standard. We consider the SRP as a practice-based certification. Additionally, procedures related to GHG inventory are being included in the SRP certification, opening the way toward carbon finance through insetting and offsetting mechanisms, and thus potential additional result-based incentive for adopting farmers.

34 https://chamroeunmfi.com.kh/
35 https://sustainablerice.org/

RegenAgri[36] is a global regenerative agriculture certification initiative originally designed by Control Union. It applies a certification model, assessing farms, ranging from smallholders to agribusinesses, on soil health, biodiversity, water management, and GHG emissions. RegenAgri has different certification models, at the product level, the farm (or agribusiness) level or certification of the impact (carbon mitigation and co-benefits). This hybrid certification model can open "regenerative" market and value chain, and the climate mitigation impact of the regenerative practices implemented can be valorized through insetting (internal GHG inventory) or offsetting (generating and selling carbon credits) mechanisms. ARMU has shown interest toward the RegenAgri certification but had a focus on SRP in 2024 and 2025.

36 https://regenagri.org/

Table 8: Detail on the main financial mechanisms assessed

								Carbon Market detail				Co-Benefits measurement	
Model	**Mechanism**	**Main actors**	**Country**	**Implementation stage**	**Main crop**	**MRV provider**	**Carbon Market interest**	**Avoidance (AWD...)**	**Removal (SOC, biomass...)**	**Insetting / Offsetting**	**VCM/ Compliance**	**Biodiversity**	**Social & Livelihood**
Result-based	Carbon finance	**Carbon Farm**	France	Piloting	Rice	Yes	Yes	AWD		Offsetting	VCM		
Result-based	Carbon finance	**Thanks Carbon**	Korean	Piloting	Rice		Yes	AWD		Offsetting	VCM		
Result-based	Carbon finance	**Green Carbon**	Japan	Piloting	Rice		Yes	AWD		Offsetting	VCM/JCM		
Result-based	Carbon finance	**ACORN**	Netherland	Stopped	Agroforestry only		Yes		Agroforestry biomass	Offsetting	VCM		
Hybrid	Carbon finance	**Husk Venture**	Cambodia	Scaling-up	Rice		Yes		Biochar	Offsetting	VCM		
Hybrid	Low-interest finance	**AgriG8**	Singapore	Piloting	Rice, Mungbean	Yes	Yes	AWD		Both	VCM	Unclear	
Practice-based	Low-interest finance	**Chamroeun Prévoir**	Cambodia	Stopped	Not restricted							Unclear	
Practice-based	Outcome based payment	**Regen Network**	USA	Design phase	Not restricted							Yes	
Practice-based	Outcome based payment	**Shamba Center**	Swiss	Design phase	Not restricted							Yes	Yes
Hybrid	Value chain and certification	**Regen Agri**	United Kingdom	Design phase	Not restricted		Yes		SOC sequestration	Insetting	Unclear	Yes	Unclear
Hybrid	Value chain and certification	**SRP**	Global	Scaling-up	Rice		Yes	AWD		Insetting	Unclear	Yes	Yes

3. Key Highlights of the Financial Mechanisms Study

a. Requirements to Develop Carbon Farming in Cambodia

As detailed in a previous part of this report, carbon farming projects are already on-going around the world. Through the DeiMeas pilot we highlighted some challenges and requirements for carbon farming to be implemented and scaled in Cambodia:

- **Aggregation:** where in Europe, USA or Australia, farmers can own large farms (hundred to several thousands of hectares for some farms in Australia), Cambodian smallholder farmers own much smaller farmland areas (<2ha/household). There is a need to involve many farmers to reach a small total of surface impacted. It leads to labor intensive technical assistance and data collection. Digitalization (farmer app, satellite monitoring…) and the training of strong local partners (cooperatives, private sector, extension department…) shall be further strengthened to support farmer's aggregation.

- **Boots on the ground:** Throughout the DeiMeas pilot and through the interviews conducted with actors of the private sector, we witnessed that the "Boots on the ground", referring to all field-based activities (training, assistance, data collection…) were undervalued in most projects (certification, outcome-based or result-based). More details on this topic can be found later in this report.

- **MRV:** Precise carbon capture quantification is complex, and soil or greenhouse gases analysis are costly in Cambodia. There is a need to continue supporting the development and calibration of innovative technologies to allow the measurement of the impacts of farmer's transition, precisely and cost-effectively.

- **Early financing**: Result-based approach, relying on credit certification and sale to incentivize farmer would often require several years before first payment. Whether it is for offtake along the value chain, or early finance access (from end-buyer), private sector should be identified and involved from the project design stage to ensure project financial viability and early payments to farmers.

- **Policy dialogue:** Develop policies to support development of carbon farming and regenerative agriculture in Cambodia and to recognize farmers as important allies in the climate change.

b. Going Beyond Carbon

Carbon market is a tool not an objective. Carbon finance can support the implementation and farmer's adoption but won't support full business plan or even cover entire project budgets. Placing carbon revenues in the center of a transition business model, rather than on a holistic agroecological approach, may bring risks and uncertainties to smallholder farmers.

Agroecology brings more than carbon or climate benefits and these additional outcomes should also be measured and valued. Quantifying other benefits of farmer's transition (i.e., reduction of pesticides, biodiversity conservation or enhancement, water management, soil health, economic performance, yields…) are equally (or even more) important as carbon quantification. Methodologies and protocols should be adapted to local context and support the measurement of these co-benefits. Innovative financial mechanisms are being developed, recognizing and incentivizing these co-benefits (Outcome-based payment, practice-based certifications…).

It is interesting to note that most of the models that were assessed during the DeiMeas pilot were relying on a common intervention design, as graphically represented on Figure 51. Project developers and other actors willing to develop finance mechanisms should remain aware of the previous implementation and tests that were conducted, avoiding repeating similar mistakes and increase communication among partners on the field.

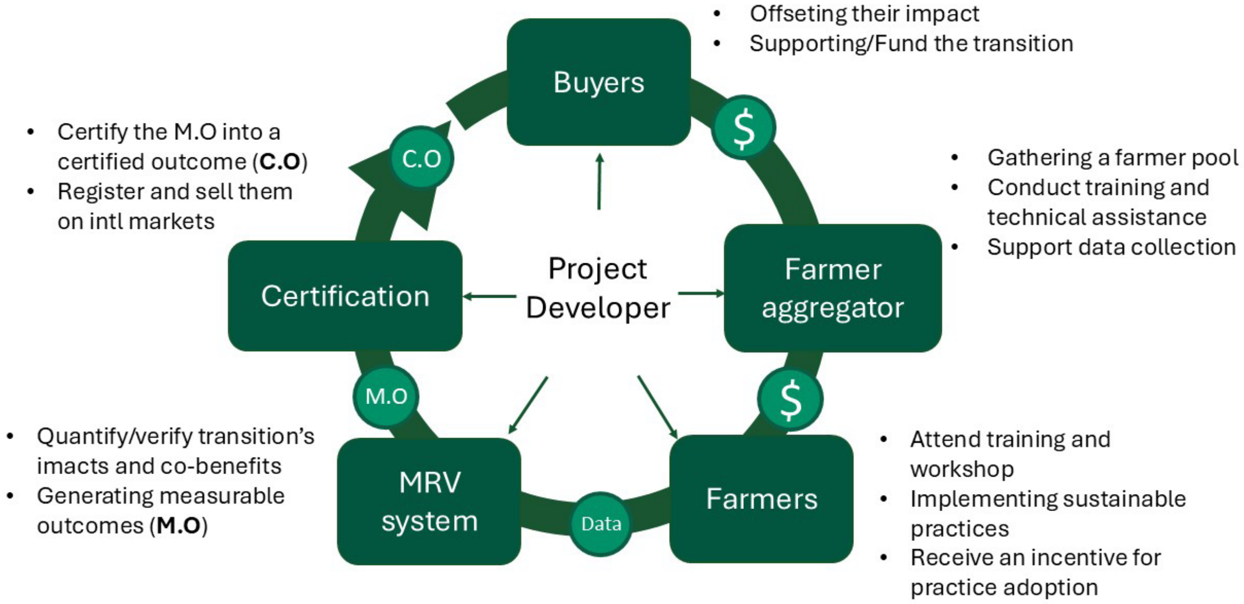


Figure 51: Exploring the different financial mechanism to support farmer's transition toward agroecology practices

Supporting the transition of smallholder farmers solely with carbon credits may not be optimal (complexity, lengthy procedures, market volatility...), and complementary or "blended" mechanisms could be tested (Figure 52). **A complementary approach** through additional revenues from value chain (certification, premium on production...) and valuation of transition's impact (additional incentives from outcome-based payment, carbon credits...), would ensure a long-term support and financial incentives distributed over time. A flexible, context-specific financing strategy will be key to enabling a resilient and long-term smallholder farmers' transition.

A theoretical model of a complementary business model for smallholder farmers in Battambang was drafted (Figure 53), involving farmers and cooperatives for the aggregation. This model included a premium for certification (such as SRP) and an incentive for impact (carbon farming and/or outcome-based payment) bringing additional incentive for climate mitigation and environmental benefits, generated from farmer transition toward agroecology practices. The MRV for both mechanisms (premium and incentive) would be shared, reducing costs from data collection. The incentive could be supported through i) an insetting model through SRP or RegenAgri, or ii) an offsetting model through a private actor such as GreenCarbon, CarbonFarm or ThanksCarbon. Similar models are being tested in Kanghot, involving AMRU (local rice miller) as main actors, linked to the field partners, supporting the sustainable value chains' development and buying farmers' rice with a premium.

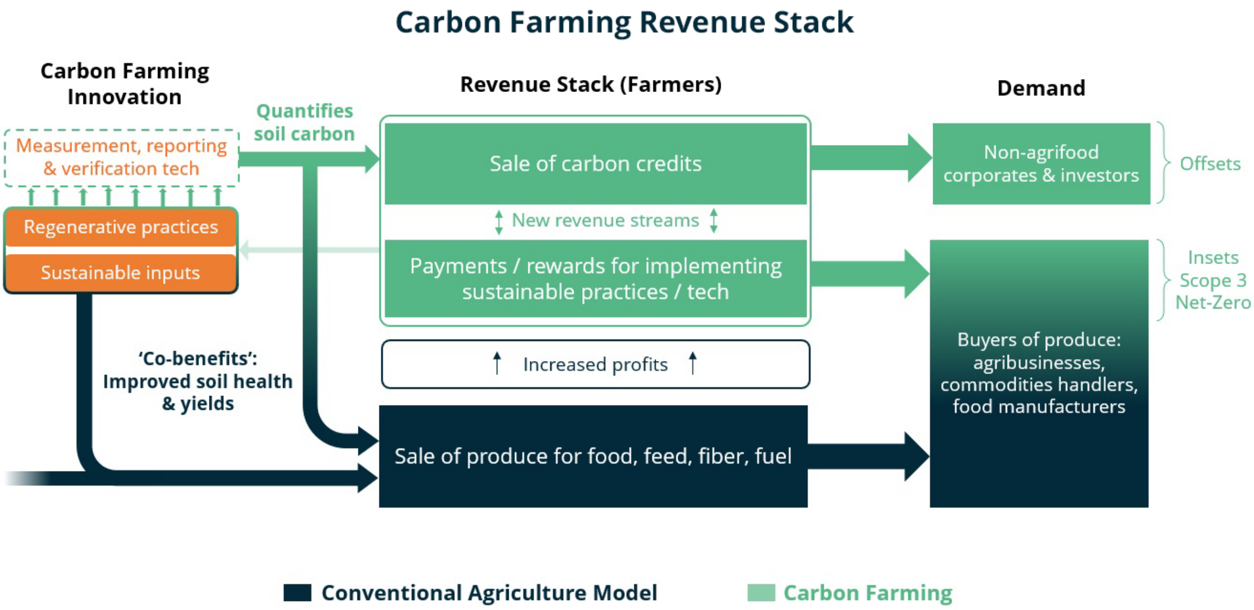


Figure 52: Complementary or Blended financing approach (source: Cleantech)

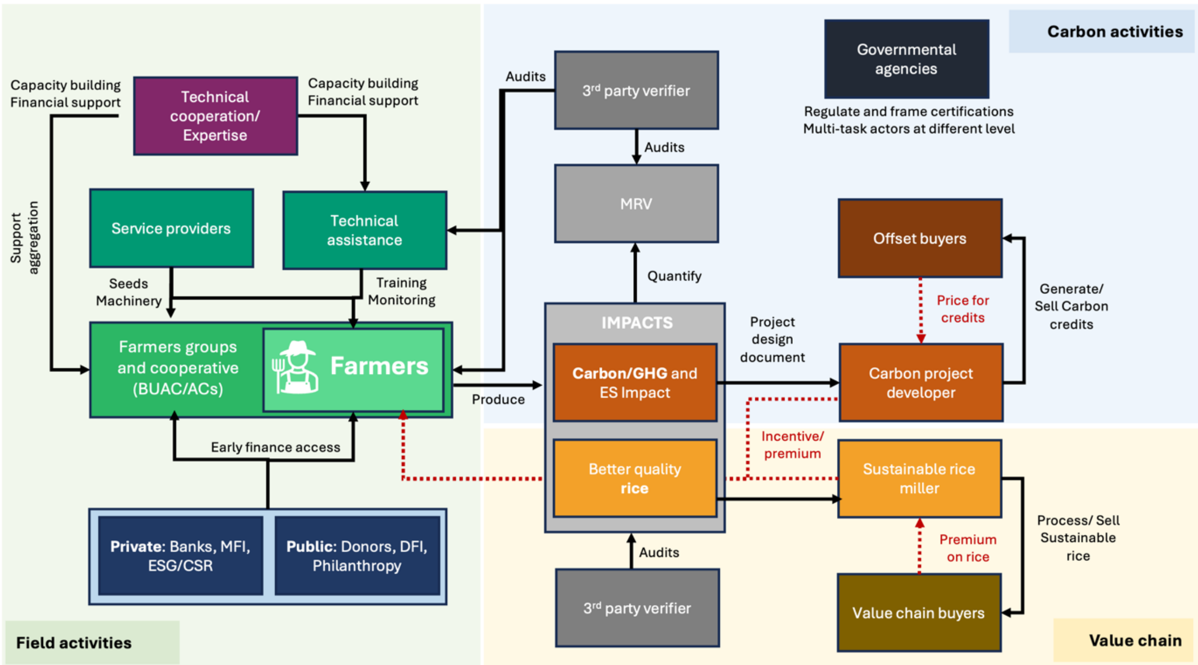


Figure 53: theoretical model of a complementary business model, including certification and carbon farming mechanisms to support farmer transition toward agroecology practices (source: authors)

4. Cost of Boots on the Ground

a. Under-Estimated "Boots on the Ground"

Throughout DeiMeas pilot and through the interviews conducted with actors of the private sector, we witnessed that the "**Boots on the Ground**" were undervalued in most projects (certification, outcome-based or result-based). These projects often have detailed and complex financial systems but very little detail on farmer training and technical assistance during transition, or on data collection and field measurements. These field-based activities are often lacking implementation details, and even more, lack sufficient budget to ensure the best adoption for farmers and the efficient monitoring of the practices and impacts. The main field-based activities (Figure 54) include:

- **Farmer aggregation**: Gathering sufficient farmers or farmer groups together to meet the minimum surface area usually required for profitable business model (often referred to as break-even implementation surface).
- **Expertise**: Providing on-the-ground expertise to assess feasibility, mitigate risks during the transition, and build the capacity of local field teams including ACs, FWUC and CAOs. Agronomic expertise is often required to identify the adapted AE practices, considering all context-specific parameters (soil type, crop variety, value chain, machinery access...).
- **Technical assistance**: Ensuring continuous support to help farmers implement the practice effectively and overcome technical or agronomical challenges (ensuring a safe practice adoption and avoid potential mistakes or yield losses).
- **Data monitoring**: Collecting reliable data is crucial for measuring and verifying transition's impacts. This ensures compliance with MRV requirements and avoid under or over quantification, which can lead to profit losses for the farmers and project on one side, or false claims on the other.
- **Funding management**: Ensuring fair and equitable management of the project funds, from pre-financing to individual or collective farmer incentive for practice adoption.

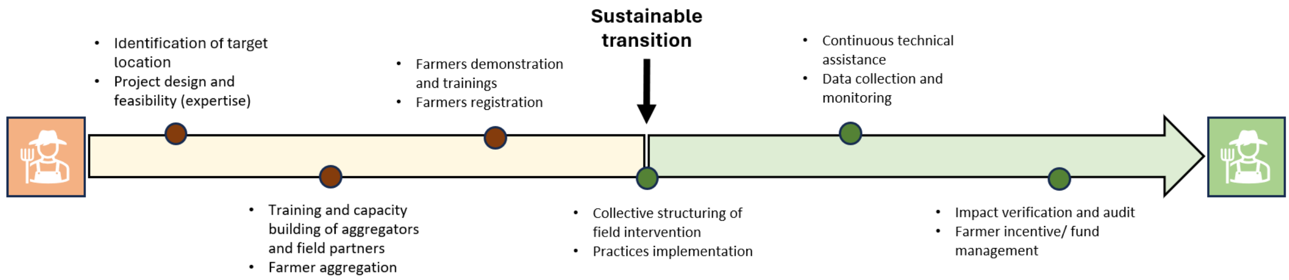


Figure 54: Main field activities implemented in a sustainable practices transition project

b. Estimated Cost of the "Boots on the Ground"

DeiMeas research team estimated what the costs of these **"Boots on the Ground"** would be in theoretical future AE transition project, whether it is part of a certification, practice-based or impact-based system. Costs were calculated for a 5-year intervention, small-scale (500 farmers) to medium scale (5000 farmers) . The different costs were separated between i) Fixed (office, supplies, materials...), ii) Variable (registration events, technical visits, farmer trainings...) and iii) Operational costs (salaries, logistic, fuel...). The boots on the ground cost estimations were between **~17 to ~40 US$/ha/year** (small to medium scale). It is worth noting that these costs can be shared (and potentially minimized) between different field partners (such as BUAC, FWUC, private sector...) or even public field teams (PDAFF, CAO...). The detail of the calculation can be found in Table 9.

Table 9: Detail calculation of the "boots of the ground" cost for future interventions

Type	Variable	Small scale	Medium Scale
Intervention	# years	5	5
	Surface per HH	2	2
	# Farmers	500	5000
	Hectares	1000	10000
Fixed	Estimated HR Needed	2	10
	Material Cost (USD/project)	$1,200	$6,000
	Fixed Cost (USD/year)	$2,240	$2,240
Variable	Event (USD/year)	$3,000	$30,000
	Individual interview (USD/year)	$2,000	$20,000
	Field visit (USD/year)	$1,600	$16,000
Operational	Coordination Cost (USD/year)	$12,720	$12,720
	HR Cost (USD/year)	$18,240	$91,200
Total	Total annual cost (USD/year)	$39,800	$172,160
	HR %age	46%	53%
	Total project cost (USD/years)	$200,200	$866,800
	Cost per HH (USD/Year)	**$80.08**	**$34.67**
	Cost per ha (USD/Year)	**$40.04**	**$17.34**

Pillar 0: Communication and Capacity Building

1. Local Capacity Building

Alongside the activities of the 3 pillars, DeiMeas pilot conducted several capacity-building workshops and skills training with field teams and partners.

a. QGIS – Excel

DeiMeas organized **biannual field partners training courses** on digitalization of data collection and use of geospatial software for plot monitoring. These trainings gathered participants from different partner institutions such as PDAFF, BUAC, CAO, or CARDEC teams, coming from Battambang and neighboring provinces. The main software used during the trainings were Google Mymap, Kobo toolbox, Microsoft Excel and QGIS.

Some trainings focused on SRP certification, on data collection and GIS data management, provided to BUAC team members. The primary objective of these sessions was to enhance market system actors' skills in organizing, processing, and interpreting field data to support data-driven decision-making and improve future field operations independently from the DeiMeas team.

b. Soil Fresk

DeiMeas team organized the first Cambodian **Soil Collage**[37] ("La Fresque du Sol" in French) an educational and collaborative workshop designed to raise awareness about soil health and its critical role in ecosystems. The soil collage is an interactive, 3-hour collaborative workshop using 50 illustrated cards, during which participants collectively explore soil formation, ecological functions, main pressures (erosion, pollution, desertification...) and practical preservation strategies. Through collective learning and role-play, it encourages participants to understand the importance of soil conservation for agriculture, biodiversity, and climate regulation. The first soil collages were organized at Leng Dei educational garden[38] in Phnom Penh, and at Bayon School[39] in Siem Reap, during which additional soil collage facilitators were trained (Figure 55).

37 https://fresquedusol.com/

38 https://phnompenh.impacthub.net/impact_library/compost-city/

39 https://www.ecoledubayon.org/en/who-are-we/bayon-education-development/

c. Carbon Training

A training course was built on **"Carbon Finance and Agriculture**" and conducted during the final phase of the project with the aim of providing stakeholders (development partners, government stakeholders, and policymakers) essential knowledge to engage in carbon finance and support climate-related decision-making.

As carbon markets become more complex, with new rules, standards, and actors emerging, there is growing demand for clarity on how these markets function and how they can be used in development projects. The training covered the carbon market and history of international climate negotiations, highlights of Article 6 of the Paris Agreement, carbon farming practices, and limitations associated with the implementation. Special attention was given to the agriculture sector, giving details about "carbon farming" and climate mitigation practices such as conservation agriculture, AWD, biochar, and more.

A first 3-hour training was organized in 2025 at Swisscontact office with participants from 10+ partner organizations (Figure 56). This training was conducted by Pierre-Antoine VERNET (Swisscontact) and Dr. Vira Leng (DALRM/GDA). Additional trainings are planned with institutional partners and policy makers (MAFF-GDA, MoE, ASEAN...) to support them in their climate actions.

Figure 55: Pictures of the first in-person soil collage (Fresque du Sol) in Cambodia, in Phnom Penh (left) and Siem Reap (right)

Figure 56: Poster used for the carbon finance and agriculture training

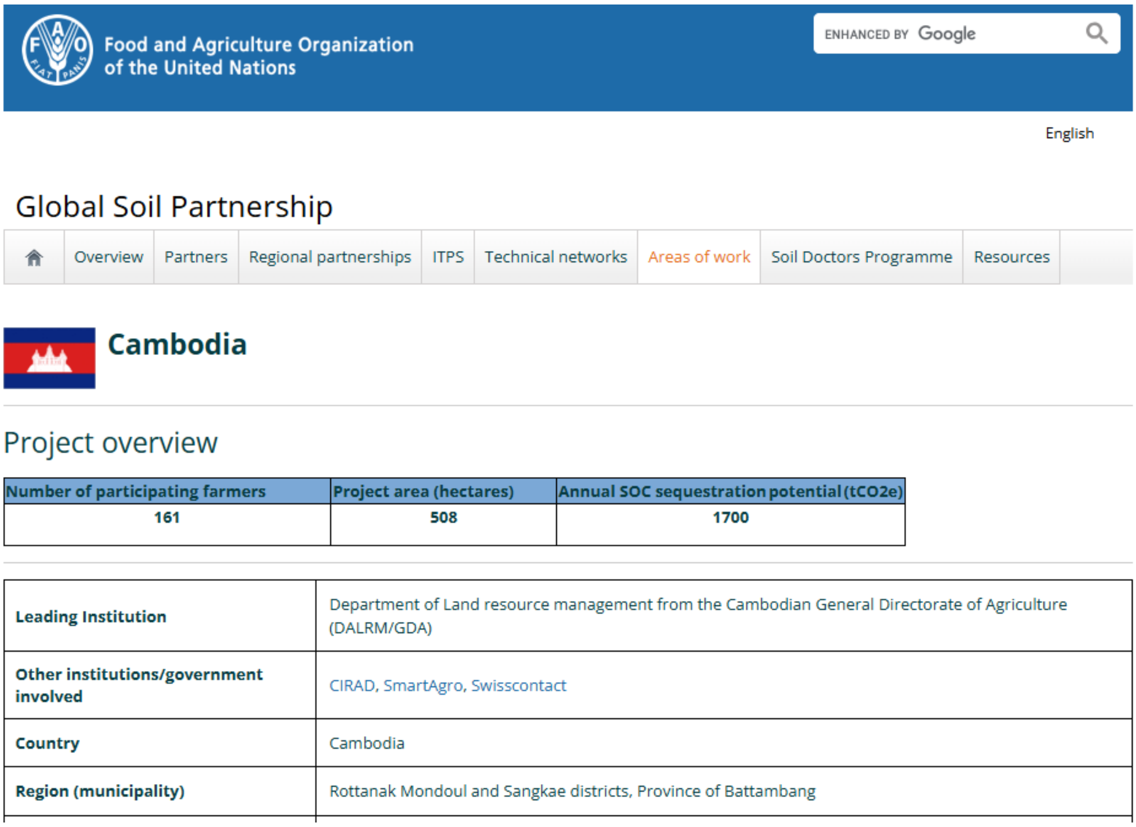
2. Global Soil Partnership (GSP)

Along with DALRM, the DeiMeas team have worked on a partnership with the **Global Soil Partnership** (GSP) of the Food and Agriculture Organization (FAO). Two main GSP programs were initiated in Cambodia with Dei Meas support:

- The Recarbonization of Global Soils (**RECSOIL**[40]) program: a comprehensive tool to scale up sustainable soil management practices based on SOC sequestration, using protocols documents such as i) the assessment of Sustainable Soil Management (SSM) and ii) the GSOC MRV Protocol. DeiMeas was recognized as part of the research network (FAO/GSP), opening possibility to exchange experience and feedback with similar pilot project around the world, using comprehensive tool to scale up sustainable soil management practices based on SOC sequestration (Figure 57).

- The **Soil Doctor Program**[41] (SDP): a farmer-to-farmer training initiative that aims to provide farmers with educational materials to learn about sustainable soil management. The first SDP training of trainers (ToT) was organized in 2024 with the support of DeiMeas (Figure 58), gathering 91 participants, including 32 official trainees, 30 farmers, 19 certified trainers from the Thai Land Development Department (LDD).

40 https://www.fao.org/global-soil-partnership/areas-of-work/recsoil/recsoil-home/en/
41 https://www.fao.org/global-soil-partnership/soil-doctors-programme/about-the-programme/en/


Food and Agriculture Organization of the United Nations

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English

Global Soil Partnership

Overview | Partners | Regional partnerships | ITPS | Technical networks | Areas of work | Soil Doctors Programme | Resources

Cambodia

Project overview

Number of participating farmers	Project area (hectares)	Annual SOC sequestration potential (tCO2e)
161	508	1700

Leading Institution	Department of Land resource management from the Cambodian General Directorate of Agriculture (DALRM/GDA)
Other institutions/government involved	CIRAD, SmartAgro, Swisscontact
Country	Cambodia
Region (municipality)	Rottanak Mondoul and Sangkae districts, Province of Battambang

Figure 57: Recognition of DeiMeas from Global Soil Partnership (FAO)

Since then, 6 Soil Doctor trainings were organized by DeiMeas teams, gathering 100+ farmers in Battambang province, in partnership with CAO, CARDEC and PDAFF. These trainings aimed to build farmers' knowledge on soil health, fertility management, climate change adaptation and resilient farming systems.

Figure 58: Soil doctor farmers' training and training of trainer

3. Production and communication

During the 3-year DeiMeas pilot, several **documents and materials have** been produced:

- Annual report 2022
- Annual report 2023
- AWD pilot report 2024
- A DeiMeas research pilot slide deck
- 2-pages Leaflet (in Khmer and English)

Articles and websites referring to DeiMeas:

- ASSET website including all material and articles on the pilot
- Transition finance article
- Farmers success stories article
- DeiMeas pilot article
- Reward system article
- Soil Doctor Program article
- FAO/GSP – RECSOIL program website

Scientific articles and MSc reports contributing to the MRV system:

- Jade Boucher, 2022. MSc report on the agroeconomic assessment in Kanghot
- Francois Gatignol, 2022. MSc report on Biofunctool use in Kanghot
- Koun et al. 2023: Scientific article on soil dynamic in upland Battambang
- Dr. Vira Leng PhD study, Bos Khnor, 2024. Diachronic analysis of soil organic C and N stocks. Leng et al. 2024
- Sambo Pheap PhD study, 2025. Multicriteria assessment of recently implemented conservation agriculture cropping systems across farmers' plots in northwestern Cambodia. Pheap et al., 2025

Conferences and workshop in which DeiMeas was presented:

The DeiMeas pilot was presented and discussed during national and international conferences and workshops, such as: TARASA, The Technical Working Group of Agriculture and Water (TWG-AW), Sustainable Rice forum, the CASIC steering committee, the Cambodian Climate Change Forum (CCCF), or the ASEAN Workshop on Carbon Neutrality, allowing many discussions and debates around transition finance, and increasing visibility of the pilot.

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Additional interesting documents:

- Carbon trading and smallholder rice farmers in SEA
- Cambodian framework Article 6: Operations Manual for the Implementation of Article 6 of the Paris Agreement on Climate Change in Cambodia
- Ecosystem marketplace state of voluntary carbon market 2024
- World bank group State and trend of carbon prices 2023
- Word bank: Cambodia Country Climate and Development Report
- The Nature Conservancy: Article 6 explainer
- FAO: GSOC MRV protocol
- VCS-Verra methodology: VCM0042, VCM0017 and VM0051
- GoldStandard: Methodology for methane emission reduction by adjusted water management practice in rice cultivation.
- Transition to agroecology food system: A review of incentive for adoption

Annexes

Figure 62: Pictures of individual and collective discussions with farmers in Kanghot on AWD

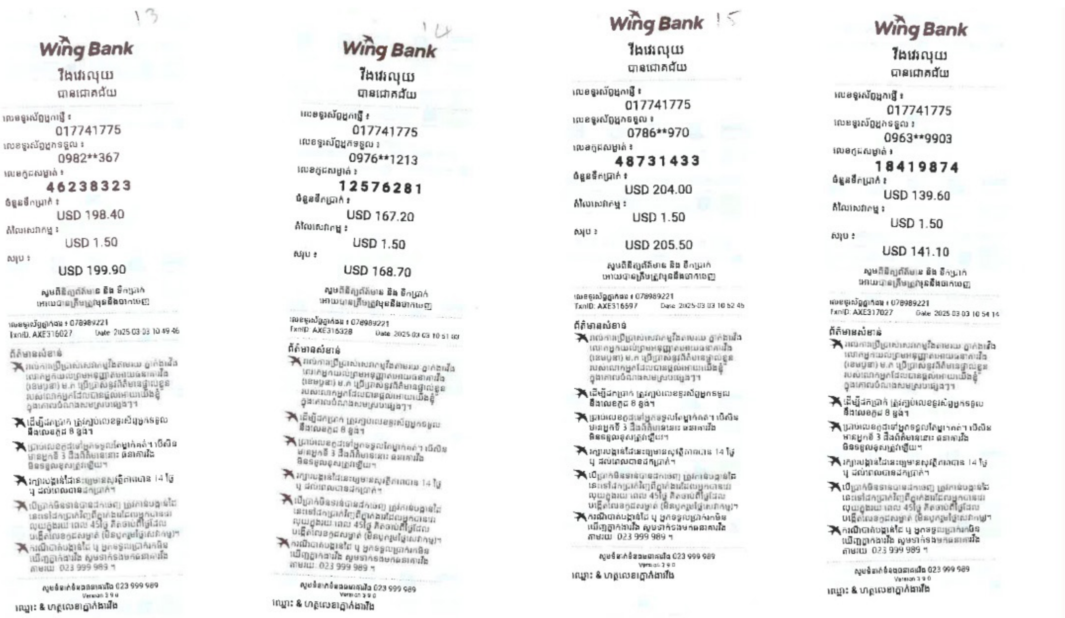

Figure 63: Example of proof of payment of farmer rewards sent through Wing

Figure 64: Certificates distributed to the DeiMeas farmers considered "long-term early adopters"

Figure 65: Swisscontact Panel Discussion in Cambodia Climate Change Forum 20244

Figure 66: DeiMeas 4th and 5th Coordination meeting

Figure 67: 6th Dei Meas Coordination Meeting

Figure 68: ASEAN-Japan Workshop on Carbon Neutrality, Food Security, and Agricultural

Figure 69 : Team training on pesticide uses and alternatives, PDAFF Battambang

Figure 70: CASIC's field visit, Upland area, Battambang province

Figure 71: Farmer group discussions in DeiMeas target villages in Battambang province

Figure 72: Cover crop (Crotalaria Juncea, Sunnhemp) seed production field in Sangha village, upland Battambang

Figure 73: Mungbean (vigna radiata) field in Sangha village, upland Battambang

Figure 74: DeiMeas 5th Reward Event

Figure 75: Certification distribution for Agro-Ecology early adopters, Upland Battambang

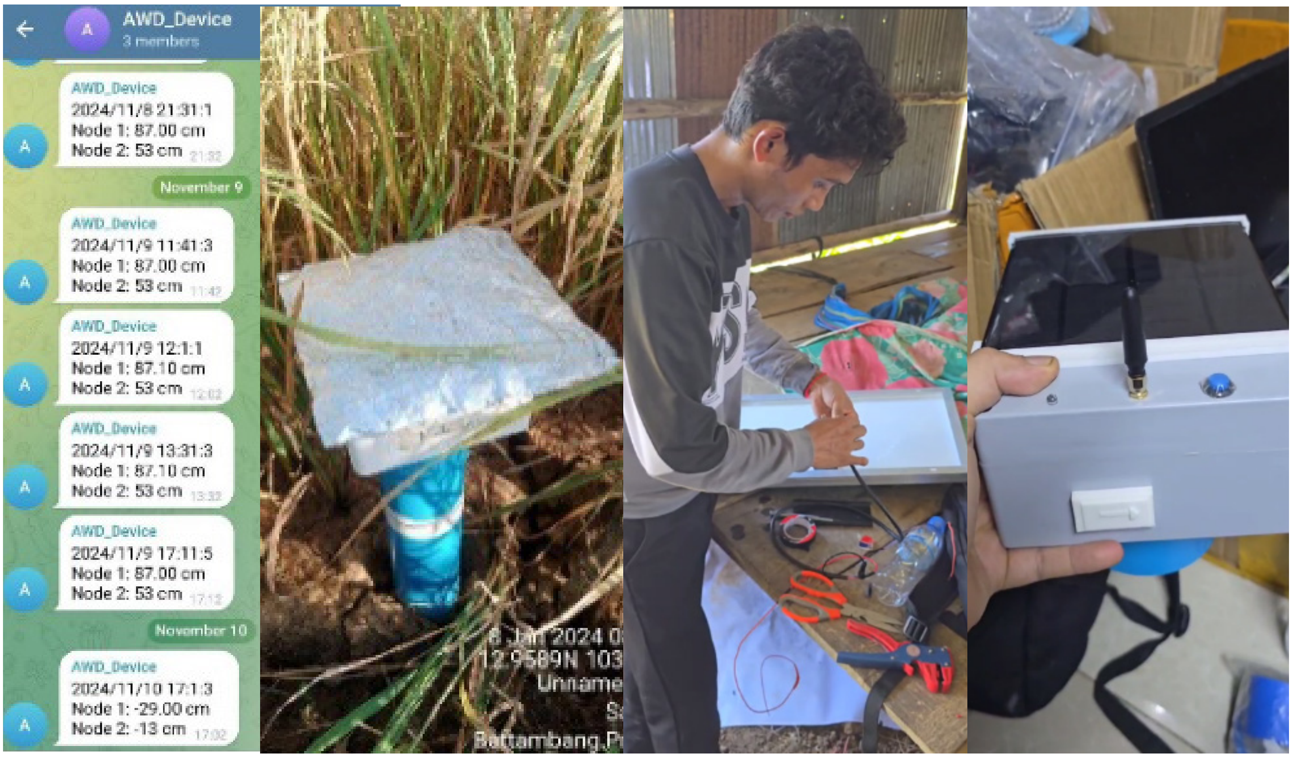

Figure 76: ITC water level monitoring device prototype

Table 10: Registration and Implementation table of the DeiMeas between 2022 and 2024

	Registration 2024			Implementation 2024				Registration 2023			Implementation 2023				Registration 2022			Implementation 2022			
Villages	**Farmers**	**Plots total**	**Surface**	**Farmers with reward**	**Plots with reward**	**Surface with reward**	**Reward 2024**	**Farmers**	**Plots total**	**Surface**	**Farmers with reward**	**Plots with reward**	**Surface with reward**	**Reward 2023**	**Farmers**	**Plots total**	**Surface**	**Farmers with reward**	**Plots with reward**	**Surface with reward**	**Reward 2022**
Domnak Dangkor	25	147	94	10	50	35	1568	26	146	95.0	20	101	64.5	2583.7	18	116	63.6	18	116	57	2,074
Reang Kessei	41	190	144	29	125	94	4595	37	157	121.0	24	102	75.5	3234.8	26	117	79.4	20	94	55	2,060
Wat Kandal	60	197	189	34	92	91	4015	41	148	140.0	19	68	65.9	2255.8	34	115	104.2	34	115	100	3,796
Svay Cheat	4	10	5	2	8	5	255	4	7	4.0	1	4	1.1	38.5	3	9	4.8	3	9	5	167
Total Lowland	**130**	**544**	**431**	**75**	**275**	**225**	**10433**	**108**	**458**	**360**	**64**	**275**	**207**	**8113**	**81**	**357**	**252**	**75**	**334**	**217**	**8097**
Sangha	32	53	111	14	20	45	3485	28	43	91	18	18	28	2726	15	20	48	15	20	46.3	2410
Pichangvar	31	44	80	19	23	41	2918	25	32	58	14	25	53	1369	11	13	35	9	10	26.4	1310
Total Upland	**63**	**97**	**191**	**33**	**43**	**86**	**6404**	**53**	**75**	**149**	**32**	**43**	**81**	**4095**	**26**	**33**	**82**	**24**	**30**	**73**	**3720**

Table 11: detailed soil tests of both DeiMeas pilot location, the upland of Rattanak Mondoul (top table) and the lowland of MC2-Kanghot (bottom)

Pair-plots Upland	Latitude	Longitude	Elevation (m)	Slope (%)	SOC (gC.kg-1 soil)	Carbonate (%)	Texture (%)		
							Clay	Silt	Sand
Plot 1	12.93504	102.86036	127.5	2	21.0	1.7	26.9	29.5	42.6
Plot 2	12.93124	102.85739	129.3	3	20.8	1.3	23.5	25.1	48.5
Plot 3	12.93918	102.85211	165.5	3	29.4	4.9	13.4	34.5	53.0
Plot 4	12.93136	102.84538	137.8	7	31.3	3.6	13.2	32.3	53.6
Plot 5	12.92982	102.84463	127.1	9	25.4	2.3	9.8	28.0	59.7
Plot 6	12.93084	102.84275	130.7	3	23.2	1.8	9.7	29.3	58.6
Plot 7	12.93507	102.83142	138.8	6	30.8	7.9	15.3	44.0	39.4

Blocks MC2 Kanghot	Particle Size			Total Carbon (C %)	Total Nitrogen (N %)	C/N Ratio (Unit)	Organic Matter OM (%)	Total Phosphorus P (%)	Available Phosphorus P (ppm)	Cation Exchange Capacity (C.E.C m.e/100g Soil)	Exchangeable Cation (m.e 100g/soil)				Total Exchangeable Bases (m.e/100g soil)	Bass Saturation (%)	Electrode Conductivity µS/cm	pH H2O	pH KCL
	(<0.002mm) Clay %	(0.002-0.05 mm) Silt %	(0.05 - 2mm) Sand %								Ca	Mg	Na	K					
Bloc B	14.87	46.97	38.65	1.97	0.17	11.42	3.39	0.04	30.08	11.82	2.95	1.36	0.58	0.88	5.82	49.50	56.67	4.71	3.67
Bloc C	18.25	42.76	38.43	1.88	0.17	10.83	3.22	0.02	36.33	12.85	3.42	1.44	0.61	0.86	6.26	48.58	64.75	4.63	3.67
Bloc E	44.84	42.61	13.22	1.97	0.18	11.14	3.39	0.03	32.64	18.60	6.17	1.89	0.87	1.09	10.01	53.86	76.17	4.84	3.79

Table 12: Detail on the 23 private actors contacted during the DeiMeas pilot

#	Private sector Name	Model, role or service	Financial mechanism category	Origin country	Crop of interest or target
1	Acorn	Carbon project developer	Result-based carbon finance	Netherlands	Agroforestry
2	Agrig8	Intermediary - MRV provider	Hybrid: Finance access - Result-based - Certification	Singapore	Rice and Mungbean
3	CarbonFarm	Carbon project developer	Result-based carbon finance	France	Rice
4	Chamroeun/Prevoir	Microfinance and microinsurance institution	Finance access	Cambodia	Farmers and cooperatives
5	ControlUnion	3rd party verifier	Certification	International	Certifications
6	CumulusCarbon	Carbon project developer	Result-based carbon finance	Canada	Large range of carbon projects
7	Green Carbon	Carbon project developer	Result-based carbon finance	Japan	Rice and Regenerative Agriculture
8	Husk Venture	Biochar producer and bio-input seller	Result-based carbon finance	Cambodia	Rice husk Biochar
9	Kosher Climate	Carbon project developer	Result-based carbon finance	India	Rice
10	Midori	Carbon project developer	Result-based carbon finance	Japan	Biochar
11	Mitti Labs	Carbon project developer	Result-based carbon finance	International	Rice

12	RegenAgri	International standard	Hybrid: Result-based - Certification	United Kingdom	Regenerative Agriculture
13	RegenNetwork	International certification standard - Broker	Hybrid: Result-based - Practice-based - Certification	USA	Regenerative Agriculture
14	Regenstudio	Carbon project developer	Result-based carbon finance	France	Large range of carbon projects
15	Regrow	Carbon project developer - MRV provider	Result-based carbon finance	International	Rice
16	Sagri	Carbon project developer - MRV provider	Result-based carbon finance	Japan	Rice
17	Shamba	Outcome-based payment	Practice-based	Switzerland	Regenerative Agriculture
18	SouthPole	Carbon project developer - Broker	Result-based carbon finance	Switzerland	Large range of carbon projects
19	SpiroCarbon	Carbon project developer	Result-based carbon finance	Thailand	Rice
20	SRP	International certification standard	Hybrid: Result-based - Certification	International	Rice
21	Techin Jin	MRV provider	Result-based carbon finance	Japan	Unclear
22	ThanksCarbon	Carbon project developer	Result-based carbon finance	South Korea	Rice
23	VNV Advisory	Carbon project developer	Result-based carbon finance	India	Rice

Project Lead:

Project Developper:

cirad

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SUSTAINABLE INNOVATIONS

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Partners:

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Battambang Union of Agriculture Cooperatives

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QUANTEDGE ADVANCEMENT INITIATIVE

LIEN AID

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Agency for Development and Cooperation SDC

SA
innovation for sustainable agriculture

SEQANA
Carbon Made Simple

REGEN NETWORK