



**Final narrative report
ACTEA Small Grant Facility
PROMOCROP**

Disseminating underutilized species and cover/relay crops as a foundation of resilient farming systems

**Contract in the Framework of ACTAE regional project
CANSEA component**

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PARTNERSHIP

The Conservation Agriculture Service Center (CASC), from the Department of Agricultural Land resources Management General Directorate of Agriculture (GDA/DALRM), focuses its activities on the design and assessment of direct seeding mulch-based cropping (DMC) systems in the rain-fed lowlands and uplands of Cambodia. ECHO Asia (<https://www.echocommunity.org/>), which has operated for more than 30 years, is one of the key players to conserve and serve as a resource for development workers who wish to experiment with underutilized crops, green manure and cover crops. ECHO Asia conducts regular conferences and workshops in the region and disseminates knowledge and know-how through several tools of communication (quarterly note, news, webpage, seed swap...). The ECHO Asia Seedbank maintains a collection of hard-to-find and underutilized seeds that are locally/regionally adapted and thrive under difficult growing conditions in the tropics and sub-tropics. The Royal University of Agriculture (RUA) recently established the Center of Excellence on Sustainable Agricultural Intensification and Nutrition (CE SAIN) that aims at fostering the dissemination of SI cropping and farming systems through research, education and extension. Several technology parks, embedding a large diversity of practices and plant species, were established through CE SAIN's support in keys agro-ecosystems. These technology parks are keys elements to disseminate seeds, knowledge and know-how.

THE FUNDED INITIATIVE : Disseminating underutilized species and cover/relay crops as a foundation of resilient farming systems

Main field of involvement

Genetic resources, crop diversification, under-utilized species, soil fertility management, fodder, nutritive value, seed production

Summary

Agro-ecological systems rely on nutrients saving and recycling strategy, continuous flow of organic compounds, intense soil biological activity, among others. Using a large diversity of plants in time (through e.g. intercropping, relay cropping and/or rotations) and space (at field, farm, landscape and territory scales) is the main driver that smallholder farmers have in hands to reach those goals. Availability of seeds, low diversity of species, and the lack of specific markets for secondary crops are regularly emphasized as the main bottlenecks for the dissemination of agroecological practices and systems. The action aims at building capacities to preserve, save and share seeds with smallholder farmers and development operators, and to empower rural communities into seed production activity.

Capacities were built for eleven field technicians involved on genetic bank preservation, seed production and saving through training organized at ECHO Asia (Chiang Mai, Thailand). In addition, smallholder farmers in Cambodia and Lao PDR were regularly trained through field days, short-term training and empowered to produce seeds of cover/relay crops. Training and sharing knowledge event was organized at the Bos Khnor Station (Aug. 2018) bringing together farmers, development operators and lecturers (84 attendees). A seed swap activity was conducted to share the genetic resources brought by the participants and to enhance the connections between communities.

Facilities of the genetic bank at the Bos Khnor Station have been improved with upgrade drying and storing capacities. This genetic bank preserves ~ 50 species including staple

crops, cash and secondary crops, and cover/relay crops. Seeds are preserved, produced and stored and are made available to anyone. In 2017 and 2018, four and nine tons of seeds were shared with farmers, development operators, and private sector, respectively.

On-farm seed production is also promoted in the uplands of Battambang (Cambodia; 12 households, 30 ha) empowering smallholder farmers into seed production. Introducing a new specie within a community is also a way to provide options and for farmers to assess directly on their own farms what are the main issues to produce seeds, and which benefits can be reached with cover crops prior staple and cash crops cultivation. In Cambodia, seeds are now produced mainly for *Crotalaria juncea* (sunnhemp, 10 ha), *Crotalaria ochroleuca* (2 ha), *Stylosanthes guianensis* (cv. Ubon, 12 ha), *Centrosema pascuorum* (cv. Cavalcade, 3 ha), sorghum (3 ha).

E-learning resources, emphasizing the use of under-utilized species and cover/relay crops, have been developed for Bsc students presenting (i) the use of a large plant biodiversity, (ii) what about cover/relay crops and which benefits can be expected, and (iii) how to choose and use cover/relay crops depending on local contexts.

Location

Cambodia, Kampong Cham (Chamcarleu district, Bos Khnor), Kampong Thom (Santuk district, Stung Chinit), Battambang (Rattanak Mondoul district, Sangha, Pichangva and Okmom villages, and Banan district), and Preah Vihear provinces.

Background

Preserving a large diversity of plants at different scales (field, farm, landscape and territory) and time is the main tools that smallholder farmers have in hands to be engaged into agroecological farming systems.

Several operators are involved in the region in the promotion of agro-ecological innovations, on the conservation and dissemination of a diversity of underutilized species that can be used for grain, fodder, fiber and oil productions but that can also be used as a cover/relay crops to enhance biological processes. Dissemination of such agro-ecological practices and farming systems are regularly impair by a range of constraints. Among those, the availability of seeds and the lack of specific markets for secondary crops are regularly emphasized as main bottlenecks.

GDA/DALRM in Cambodia through a partnership with CIRAD and due to his long involvement in Conservation Agriculture managed a large diversity of species of staple, cash and cover/relay crops. All species are maintained and seed produced every year. This activity is essential as plant diversity if one of the main tool that smallholders can have to diversify their productions, to have a larger range of options but also to drive soil fertility improvement and thus adaptability to climate variability and climate change.

Considering plant diversity as the foundation of agro-ecological principles there is a need to maintain this germplasm and to continuously enrich it to have more options to co-design innovative cropping systems but also for smallholder farmers to diversify their farming systems and/or to improve the nutritional value of home gardens. The success of such operation is based on key elements with:

- Preserve and maintain seed banks (example of the Bos Khnor Station),
- Empower smallholder farmers and communities on seed production (Kampong Cham & NW Cambodia),
- Disseminate the knowledge and know-how on the use of underutilized species and cover/relay crops (training, seed swap, field days, on-farm demonstrations...),
- Share under-utilized species with smallholder farmers and development practitioners,

The current actions through ACTAE/PROMOCROP is a first tentative to explore these different issues. Based on limited funding, partners like ECHO Asia, CE SAIN, and Penn

State University brought additional resources to cover some of these topics listed above. The role of ECHO is mainly on capacity building, sharing knowledge and seed sources.

Germplasm conservation and dissemination is always challenging and several constraints may impair the sustainability of such actions particularly the cost of the seed bank maintenance, storage capacities and quality, lack of regular training to improve the knowledge and know-how of the key operators, lack of specific market demands for secondary crops and cover/relay crops.

A working session has been organized at the Royal University of Agriculture in Phnom Penh on March 7th and 8th 2017 to discuss with a range of partners the actions that will be implemented through PROMOCROP. This working session brought together the Royal University of Agriculture, the Department of Agricultural Land Resources Management (GDA/DALRM, Dr. Koy Ra, Mr. Leng Vira) and the Center of Excellence on Sustainable Agricultural Intensification and Nutrition (CESAIN, USAID funding, Dr. Lyda Hok, Mr. Manel Mao, Mr. Sambo Pheap, Mr. Syden Reach, Ms. Sieng Sreymom). Partners from the French Institute for Development (IRD, LMI LUSES, Thailand, Dr. Alain Brauman and Alexis Thaumazeau), the Institute of Technology of Cambodia (Dr. Fidero Kuok, Dr. Hasika Mith), the University of Battambang (Dr. Srean Pao, Ms. Channathy Ngang), Pennsylvania State University (Dr. Rick Bates and Dr. David Ader), Echo Asia (Dr. Abram Bicksler), CIRAD (Dr. Florent Tivet, Dr. Pascal Lienhard, Dr. Philippe Cao-Van) and from the Department of Land Resource Management (DALaM, MAF, Lao PDR, Mr. Thisadee Choulamountry, Mr. Soulikhone Chaivanna) joined this event.



Fig. 1: Workshop at the Royal University of Agriculture.

Previous works

The activities in the field of Conservation Agriculture started in 2004 through the project *Crop diversification and Small-scale Rubber plantation* funded by AFD (Kampong Cham). In 2008, the PADAC (*Projet d'Amélioration de l'Agriculture Cambodgienne*) was initiated (AFD funding) and ended in 2013 with as a main targeted areas Kampong Cham and Battambang provinces. Activities were also implemented in the pioneer front of Battambang (Rattanak Mondoul district) from 2010 to 2014 under the *Sustainable Agriculture and Natural Resources Management CRSP* (USAID) (Kong et al., 2016).

Seed preservation and production were already part of the core activities of the team that was involved in the design of alternatives cropping systems both in the lowlands and in the uplands. The first step was to screen a large range of species across contrasted agroecosystems (soil, water regime) from the upper sandy terraces of the rainfed lowland, the flood plains, to the uplands with again diverse biophysical conditions (sandy soils, red oxisol, alkaline soils of the uplands of Battambang) to identify the main species that can be used on different environment based on local contexts. This preliminary work was of paramount importance and allows today the team and smallholder farmers in different

regions of Cambodia to diversify their farming systems and to move towards an integrated management of soil fertility.

Since 2014, the team from GDA/CIRAD decided to engage into a process of demand-creation with smallholder farmers, projects, NGO and private sector to foster the dissemination of such genetic resources. Thus, on-farm demonstrations were amplified in Kampong Thom, Battambang and more recently Preah Vihear (Sansom Mlup Prey, Ibis rice). Farmers were empowered to produce seeds of cover/relay crops as an alternative income after main staple and cash crops.

Historical presence in the area and potential knowledge of local stakeholders

The action makes the link between the Bos Khnor experimental station (12°12'30"N, 105°19'7"E, 118 m asl), that belongs to MAFF/GDA, and on-farm support that are provided in three main provinces of Cambodia with Kampong Thom, Battambang and Preah Vihear.

Direct seeding mulch-based cropping (DMC) systems are implemented at Bos Khnor since 2004 representing the oldest experiments under CA/DMC management in the region. Research experiments (randomized block design) are implemented since 2009 embedding the main upland crops with soybean, maize, cassava and upland rice in rotation with cover/relay crops.

One of the main specificities of the station is also to be the foundation of one of the largest genetic bank of annual crops and cover/relay crops in the region. The genetic bank comprises ~ 50 species and 335 cultivars (aerobic rice, soybean, cowpea, mung bean, rice-bean, others pulses, cassava collection, cover/relay crops and fodder species).

There is a need to preserve and to enhance the capacities of this genetic bank through an improvement of the facilities and a process of capacity building of field technicians, smallholder farmers and development operators.

Beneficiaries and targeted audience

Field technicians and smallholder farmers are the two main beneficiaries of the intervention through capacity building activities and empowerment for the seed production. In addition, projects, NGO and private sectors are also a targeted audience as potential buyers of such genetic resources, creating the demand and allowing a larger share of such resources. However, the identification of a small-scale private company is still needed to take over the promotion and the selling process.

Main objectives

The goal is to improve the capacities of key operators in Cambodia to preserve, produce and share a diversity of cover/relay crops and underutilized species that are of primary interest to foster and disseminate agro-ecological innovations.

Specific objectives are:

- Preserve and maintain seed banks and biodiversity,
- Empower smallholder farmers and communities on seed production,
- Disseminate knowledge and know-how on the use of underutilized species and cover/relay crops (training, seed swap, field days, on-farm demonstrations...),
- Share seeds of under-utilized species with smallholder farmers and development practitioners.

Approach & method

In a first step, capacity of field technician at the genetic bank was first strengthened. In addition, physical improvement of the genetic bank was sought and additional implements purchased with solar dryer and cocoon from Grain Pro. As a second step, dissemination of cover/relay crops in the uplands but more largely after wet season rice in the flood plains of the Tonle Sap Lake was enhanced with the objective to develop progressively the demand from smallholder farmers and development practitioners and ensure a larger share at national scale of such genetic resources. As a third step, farmers were empowered in the uplands of Battambang to produce seeds of cover/relay crops that are then shared to others communities. At this stage, seed production started under public funding. However, a public-private partnership is currently explored through the recent involvement of Swisscontact.

Main activities

The project implemented four main activities:

- Build the capacities of smallholder farmer, agronomists and development practitioners.
- Strengthen a genetic bank to produce, store seeds and help with seed supply.
- Sharing seeds of cover crops with smallholder farmers, development operators and private sector.
- Disseminate the knowledge and know-how on the use of underutilized species and cover/relay crops (training, seed swap, field days, on-farm demonstrations...).

Building capacities of field technicians - Training at ECHO Asia (October 2017)

ECHO Asia trained a team (11 persons; Oct. 2017) from Cambodia strengthening their knowledge, technical proficiency, and ability to produce, store and deploy key cover/relay crops and underutilized species.

A training and sharing knowledge event has been organized at the Bos Khnor Station (Aug. 2018) bringing together over 80 participants with smallholder farmers, development operators and national universities.

Field days

Field days are regularly organized not exclusively to explain the process of seed preservation and seed production but also to present all activities implemented in the Bos Khnor Station with (i) design of innovative cropping systems, (ii) preservation of germplasm, and (iii) experiments and analytical studies mainly on soil ecosystem services assessment. In 2017, the following field visit were organized in the Bos Khnor Station.

Strengthen a genetic bank - Produce and conserve seed banks of cover/relay crops

The action aims at strengthening the capacities to produce and conserve seed for key cover/relay crops and underutilized species.

On-station: seed preservation and production

The germplasm is conserved at the Bos Khnor Station that belongs to the General Directorate of Agriculture (GDA), located in Chamcarleu district, Kampong Cham province (latitude 12°12'30"N, longitude 105°19'7"E, 118 m asl). An area of 2.2 ha is dedicated to the preservation and seed production of key cover/relay crops with today ~ 55 species representing 335 cultivars including staple crops, cash crops and cover/relay crops. An additional 4.2 ha (yellow frame) is regularly used to produce seeds at a larger scale to address the request of smallholder farmers and development operators.

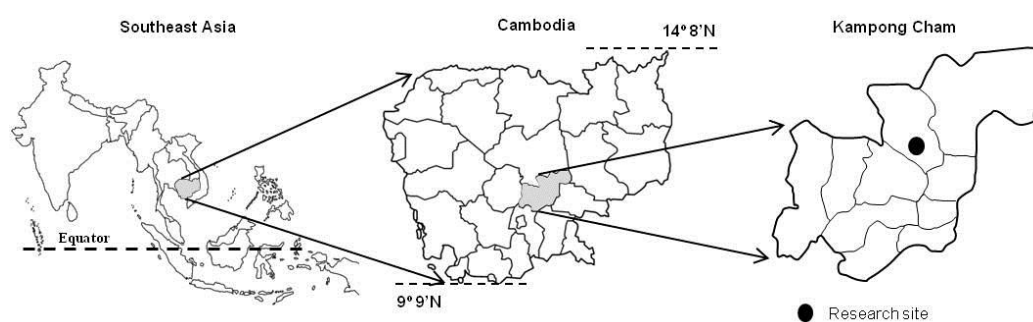


Fig. 2: Map of the Bos Khnor Station, Chamcarleu district, Kampong Cham.

List of main species available

Grasses	1	Brachiaria brizantha
	2	Brachiaria decumbens
	3	Brachiaria humidicola
	4	Brachiaria ruziziensis
	5	Brachiaria mullato
	6	Brachiaria mutica
	7	Eleusine coracana
	8	Zea mays
	9	Panicum maximum
	10	Pennisetum typhoides
	11	Pennisetum purpureum
	12	Sorghum bicolor
	13	Tripsacum laxum
Legumes	14	Arachis pinto
	15	Arachis repens
	16	Cajanus cajan
	17	Canavalia ensiformis
	18	Centrosema pascuorum
	19	Crotalaria juncea
	20	Crotalaria ochroleuca
	21	Crotalaria aturubens
	22	Crotalaria zanzibarica
	23	Desmodium intortum
	24	Desmodium ovalifolium
	25	Dolichos lablab
	26	Gylcine max
	27	Macroptilium bracteatum
	28	Macrotyloma axillare
	29	Mucuna pruriens
	30	Neonotonia wigthii
	31	Pueraria phaseoloides
	32	Sesbania grandiflora
	33	Sesbania rostrata
Others	34	Stylosanthes guianensis
	35	Vigna radiata
	36	Vigna umbellata
	37	Vigna unguiculata
	38	Amaranthus cruentus
	39	Corchorus capsularis
	40	Hibiscus cannabinus
	41	Hibiscus sabdariffa
	42	Sesamum indicum
	43	Helianthus annuus



Fig. 3: Presentation of some species preserved at the Bos Khnor Station.

Mr. Ouddom CHETT is in charge of this action aiming at preserving and producing seed of staple crops and key cover crops. In addition, tools to improve drying and seed conservation were bought with Grain Pro.



Fig. 4: Solar bubble dryer from Grain Pro, Bos Khnor Station; capacity of 2 tons.

The preservation and seed production at the Bos Khnor Station is based on three main components with (i) a 1st component dedicated to the annual crops, (ii) a 2nd component dedicated to perennial crops, and (iii) a 3rd component of seed production. The seed production is conducted at the Bos Khnor Station on 2 ha.



Fig. 5: Amaranth as an example of under-utilized specie preserved at the Bos Khnor Station.



Fig. 6: Collection of cover/relay crops.



Fig. 7: Collection of aerobic rice.



Fig. 8: Soybean, mung bean, cowpea and rice-bean collection.



Fig. 9: Seed production of sunnhemp (*Crotalaria juncea*), Bos Khnor Station, November 2017.



Fig. 10: Seed production of sorghum, November 2017, Bos Khnor Station.

Empowering smallholder farmers into seed production

Besides on-station seed preservation and production, and based on increasing request from smallholder farmers but also partners (projects, NGO ...), farmers are empowered to produce seed of key cover/relay crops with mainly two *Crotalaria* species (*C. juncea* and *C. ochroleuca*), *Stylosanthes guianensis*, Sorghum and *Centrosema pascuorum*. This activity started in September 2017 with 4ha of seed production and has been extended to 34ha.

Introducing a new specie in a community like in the NW region of Cambodia is also a way to provide new options to farmers and to assess directly on their own farms what are the main issues to produce seeds and which benefits can be reached with sunnhemp as a cover crop prior maize sowing (how much increase in yield). All farmers who are engaged on seed

production of *Crotalaria* sp. in the uplands will grow maize next June. We expect that a positive impact of sunnhemp cultivation will be observed bringing higher productivity and profitability. In 2018, and in Battambang and Kampong Cham provinces, 12 farmers produce seeds of cover crops covering 34 ha with *Crotalaria juncea* (14ha), *Crotalaria ochroleuca* (3ha), *Stylosanthes guianensis* (12ha), *Centrosema pascuorum* (3ha), *Sesbania* sp (0.2ha), *Sorghum* (1ha) and pearl millet (0.5ha).

The production costs and benefits of seed productions is presented in the following table for the seed production of sunnhemp of 2017/2018. In 2017, sowing date ranged from Sept. 13th to Oct. 20th in order to assess the productivity at the end of the rainy season. The main issue is related to the pod-boring caterpillars which can have a negative impact on seed production. The other issue is related to the height of the sunnhemp. With an early sowing date, sunnhemp is relatively tall (over 2-m high) and pest control management is then difficult. One way to overcome such constraint is to cut the sunnhemp before flowering keeping only 1-m plant height to induce branching, reducing height and thus facilitating pest control if needed. In addition, use of biological agents (*B. thuringensis*) and bio-insecticide (neem oil, among others) should be explored to avoid using chemical insecticide for the seed production.

Based on 1st results the yields of sunnhemp ranged from 670 to 1000 kg/ha with a net profit from \$380 to \$644/ha. This net income is on the same range that cropping mungbean (from 200 kg to 800 kg/ha) after an early corn in the uplands of Battambang.

Name	Village	Surface (ha)	Cropping system	Date of sowing	Total			Yield (kg/ha)	Income (\$)	Net profit (\$/ha)
					Input cost (\$)	Service(\$)	Labor			
Minh Neth	Pichangva	1,00	Corn/Juncea	13/09/17	86	204	5	800	800	510
Van Sun	Sangha	1,30	Corn/Juncea	13/09/17	61	295	28	1153	1153	797
Ben Hoeurn	Pichangva	1,30	Corn/Juncea	06/10/17	97	230	31	1010	1010	683
Sok Sothy	Sangha	1,30	Corn/Juncea	21/10/17	75	42,5	1	250	250	133

Table 1: On-farm economic performance of sunnhemp seed production, Rattanak Mondoul, Battambang.





Fig. 11: Seed production of sunnhemp in Sangha village, Rattanak Mondoul district, Battambang province.

Sharing seeds of cover crops with smallholder farmers, development operators and private sector

Approximately 4 and 9 tons of seeds were provided to smallholder farmers, development operators, private sector in 2017 and 2018, respectively. Requests are increasing year by year and globally seed producers involved in this activity will produce a total amount of 14 tons of seeds early 2019 mainly for sunnhemp (*Crotalaria juncea*), *Crotalaria ochroleuca*, sorghum, pearl millet, *Stylosanthes guianensis* and *Centrosema pascuorum*.

Species with small seed size and thus lower seed rate per hectare are mainly promoted. It allows farmers to be able to produce seeds on their own fields. For the grasses, two main species are disseminated with *Sorghum bicolor* and *Pennisetum typhoides* (pearl millet). Finger millet (*Eleusine coracana*) is also of interest (cover crops, fodder but also nutritive value) and we are looking to promote this specie with partner like Sansom Mlup Prey in Preah Vihear.

In Banan District (Battambang; 4 villages), farmers established ~150 ha of cover crops after wet season rice with for most of them a collective land management implementing large blocks. Cover crops will be used for three main purposes: improvement of the soil fertility, use of cover crops as cattle feed and seed production of cover crops (sunnhemp and *Crotalaria ochroleuca* mainly). There is huge opportunity to produce grains and protein in the dry season on the residual soil moisture transforming the landscape through a better integration of animal husbandry, and generating additional income.

Contribution to an agroecology transition

Plant diversity is the core element to fulfil the biophysical principles of Agroecology. The increase of seeds of cover crops shared between the team, smallholder farmers, development operators and private sectors is a good output of the action. However, direct sharing process from farmer-to-farmer has observed in the uplands of Battambang in 2017 is by far a more powerful and robust indicator of the efficiency of the action. Through this link (<https://bit.ly/2CS9JDQ>) Ms. Phon Sovanny, a seed producer of Sangha village (Rattanak

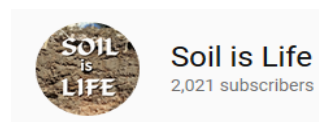
Mondoul district, Battambang), explains how she produced seeds of sunnhemp, what are the main advantages and what are the feedbacks of others farmers in the same community.

Communication & dissemination activities and events organized

A range of clips were developed mainly giving a focus on smallholder farmers testimonies about the use of cover/relay crops:

- Use of cover/relay crops after rice in the flood plains of Banan (Battambang) and use of sunnhemp of a tool to generate additional income and to communicate (<https://bit.ly/2POpa7w>),
- Seed production of sunnhemp in the uplands of Battambang (<https://bit.ly/2CS9JDQ>),
- Benefits of forest ecosystem and use of cover/relay crops under an organic rice management system in Preah Vihear (<https://bit.ly/2Bu9Tjn>).

A Youtube Channel 'Soil is Life' has been created in 2018 by Lay Vichet (RUA, Computer Center) aggregation over 200 clips, testimonies and educational resources.



The use of sunnhemp after wet season rice in the flood plains of Battambang was at flowering stage for the Chinese new year (February 2018) offering a yellow landscape for the visitors. Mr. Sareth Lam (farmer who used the sunnhemp on his field) charged 500 riels per person to have the right to enter his field to take pictures. He generated a net income of \$750 in few days and this unexpected event contributed to communicate about the benefits of the sunnhemp.



Fig. 12: People visiting the field of Mr. Sareth Lam during the Chinese New Year, February 2018.

In addition, e-learning resources have been developed for an audience of Bsc students and are available through the following link: <http://e-learning.rua.edu.kh/courses/cover-crops/>. This resource is organized on 4 main sections with (i) Plant diversity and cover crops, (ii) Main functions of cover crops, (iii) How to choose a cover crop or a combination of cover crop, and (iv) How to use it. Several clips were edited to improve the interactivity to provide to students the opportunity to learn in different, combined and integrated ways.

A first draft of a technical handbook on how to produce, preserve seeds and how to select and use cover crops has been drafted by Camille Giraudet, a Msc student from SupAgro, in partnership with Lay Vichet (RUA, Computer Center) and with the support from Patrick Trail from ECHO Asia. This document will be finalized in the coming months through the collaboration with ECHO Asia, CE SAIN and Pennsylvania State University.

Training and field days are regularly organized both at the Bos Khnor Station and with the communities in Battambang and Kampong Thom. A training was organized in August 2018 at the Bos Khnor Station (*Seed saving and production, Soil health and Integrated Pest Management*) bringing together 80 participants with 50 farmers from 6 provinces and 34 development operators, governmental staff and partners from higher education and research institutes. A seed swap was organized based on genetic materials brought by the participants allowing a vast share of genetic resources.

Training on Seed saving and production, Soil health and Integrated pest management



- 5th and 6th August 2018
- Training on seed saving, seed production of under-utilized species, soil health and integrated pest management.
- Organized by the Department of Agricultural Land Resources Management (GDA/DALRM), CIRAD, Royal University of Agriculture (RUA), ECHO Asia, Sustainable Intensification Innovation Lab (CE SAIN, WAgN, ASMC) and Horticulture Innovation Lab.

Bos Khnor Station, Conservation Agriculture Service Center, Technology Park CE SAIN, Chamcarleu district, Kampong Cham, Aug. 5 and 6



Fig. 13: Seed swap organized during the training ‘Seed saving and production, Soil health, Integrated Pest Management’, Bos Khnor Station, Cambodia, Aug. 2018 (Credit Lay Vichet).

The resources used during this training are available through the following link from ECHO Asia website: <https://bit.ly/2FzAwYi>.

Lessons learnt

There is still a need to strengthen the capacity of the field technicians in charge of the genetic bank and to establish a cool room in the station upgrading the storage quality.

The seed preservation and production is mastered both by field technicians and smallholder farmers. On-farm seed production is above expectations with an average yield of sunnhemp,

as an example, of 800 kg/ha meaning that production cost is relatively low and still contribute to an additional income for farmers during the dry season (harvest of sunnhemp between Dec. and Jan. based on sowing date at the end of the wet season). For the coming harvest of seed of cover crops sunnhemp will be purchased at \$0.75/kg.

The process of seed sharing from farmer-to-farmer is obviously a powerful tool to foster the dissemination of cover/relay crops with the example of seed purchase from farmer in Sangha (<https://bit.ly/2CS9JDQ>).

New tool to communicate should be explored. A yellow landscape at the blooming stage of sunnhemp is a powerful tool and should be combined with testimonies of farmer broadcasted on social media and Youtube.

Main outputs and perspectives

The genetic bank at the Bos Khnor Station is in place and seed produced by different communities in Battambang and Preah Vihear mainly.

At this stage, seeds are mainly purchased and produced through public funding. A public – private partnership is explored through a partnership established recently with Swisscontact.

With our main partners, including RUA/CE SAIN, ECHO Asia, Kansas State and Pennsylvania State universities, we will explore in the coming months the possibility to implement seed banks in the different technology parks to have additional places in Cambodia where farmers and development operators can easily find cover/relay crops and under-utilized species. Those technology parks are always connected with education (high school and university) and extension agency with high school in Kampong Thom, station of the Provincial Department of Agriculture in Siem Reap, campus of the University of Battambang and of the Royal University of Agriculture. Being in permanent contact with students represents a great advantage to disseminate knowledge and benefits on the use of these species.

A technical handbook for development operators and a seed catalogue will be promoted with the main objective to share knowledge and know-how aggregated by the regional partners. Process of cover/relay crops cultivation, seed production, seed saving will be presented along with the description of main species used emphasizing growth conditions, benefits, and adaptability.

APPENDICES

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