



Study on services to irrigated agriculture

Operational Plan for Services improvement CAMBODIA

Stung Chinit irrigation scheme

Deliverable L2A

Jean-Marie BRUN
Sophoan MIN
Christophe RIGOURD

6 May 2022 FINAL VERSION



Iram Paris (siège social)
49, rue de la Glacière 75013 Paris France
Tél.: 33 (0)1 44 08 67 67 • Fax: 33 (0)1 43 31 66 31 iram@iram-fr.org • www.iram-fr.org

• Iram Montpellier
Parc scientifique Agropolis Bâtiment 3
34980 Montferrier sur Lez France
Tél.: 33 (0)4 99 23 24 67 • Fax: 33 (0)4 99 23 24 68



ARTE-FACT Development & Agri-Food Consulting Co., Ltd.,
 #405B Street 61 BT, Boeng Tompon, Phnom Penh – Cambodge Tél: +855 (0)12 807 817
 jm.brun@artefactdev.com



 BICHE SARL., Bureau d'Ingénieurs Conseils en Hydraulique et Environnement,
 9 rue Ahmed Rami 1002 Tunis, Belvédère, Tunisie Tél: +216 71285946 biche@gnet.tn

Content

Content	
Acronyms	
1. Introduction	
1.1. Recall of the study background and objectives	
1.1.1. Background on COSTEA	
1.1.2. COSTEA study on services to irrigating farmers	
1.2. Key elements of the methodology	
1.3. Main activities carried out in the country since the end of the diagnostic phase	
1.3.1. Restitution and consultation workshop	
1.3.2. Focus group meeting to fine tune operational recommendations	
1.4. Content of the present Operational Plan for Services improvement report	
2. Synthesis of the diagnosis for Stung Chinit Irrigation	
SCHEME (AFTER VALIDATION BY STAKEHOLDERS)	1
2.1. Synthesis of the territorial diagnosis	
2.2. Presentation of Stung Chinit irrigation scheme	
2.3. Synthesis of farms typology and analysis of service needs	
2.3.1. Key factors of farms differentiation	
2.3.2. Synthesis table of main types of farms	
2.3.3. Brief description of each type of farm	
2.4. Evolution of agriculture practices goes together with the evolution of services demand and offer in Stung Chinit area and evolution of the	
context	
2.5. Synthesis on the existing services offer	
2.6. Synthesis on the adequacy between services offers and needs	

3.1. Axis 1: Irrigation services management (O&M) 3.1.1. Theory of change 3.1.2. Operational modalities for restoring an efficient and economically viable Operation and Maintenance of the irrigation scheme 3.2. Axis 2: Promotion of more sustainable cropping practices 3.2.1. Theory of change 3.2.2. Operational modalities for achieving more sustainable and more profitable cropping practices in Stung Chinit irrigation scheme 3.3. Summary of the future service delivery scenario 4. CONCLUSIONS 4.1. Next necessary first steps to implement the road map 4.2. Critical analysis and limits of the methodology used 4.3. Critical analysis and limits of outcomes
3.1.2. Operational modalities for restoring an efficient and economically viable Operation and Maintenance of the irrigation scheme 3.2. Axis 2: Promotion of more sustainable cropping practices 3.2.1. Theory of change 3.2.2. Operational modalities for achieving more sustainable and more profitable cropping practices in Stung Chinit irrigation scheme 3.3. Summary of the future service delivery scenario 4. CONCLUSIONS 4.1. Next necessary first steps to implement the road map 4.2. Critical analysis and limits of the methodology used 4.3. Critical analysis and limits of outcomes
Operation and Maintenance of the irrigation scheme 3.2. Axis 2: Promotion of more sustainable cropping practices 3.2.1. Theory of change 3.2.2. Operational modalities for achieving more sustainable and more profitable cropping practices in Stung Chinit irrigation scheme 4.3.3. Summary of the future service delivery scenario 4. CONCLUSIONS 4.1. Next necessary first steps to implement the road map 4.2. Critical analysis and limits of the methodology used 4.3. Critical analysis and limits of outcomes 47
3.2.1. Theory of change 3.2.2. Operational modalities for achieving more sustainable and more profitable cropping practices in Stung Chinit irrigation scheme 4.3.3. Summary of the future service delivery scenario 4. CONCLUSIONS 4.1. Next necessary first steps to implement the road map 4.2. Critical analysis and limits of the methodology used 4.3. Critical analysis and limits of outcomes
3.2.2. Operational modalities for achieving more sustainable and more profitable cropping practices in Stung Chinit irrigation scheme 3.3. Summary of the future service delivery scenario 4. CONCLUSIONS 4.1. Next necessary first steps to implement the road map 4.2. Critical analysis and limits of the methodology used 4.3. Critical analysis and limits of outcomes
42. Critical analysis and limits of outcomes 42. 3.3. Summary of the future service delivery scenario 43. 4.1. Next necessary first steps to implement the road map 44. 4.2. Critical analysis and limits of the methodology used 45. 47. Critical analysis and limits of outcomes
4. CONCLUSIONS 4.1. Next necessary first steps to implement the road map 4.2. Critical analysis and limits of the methodology used 4.3. Critical analysis and limits of outcomes 47
4.1. Next necessary first steps to implement the road map 4.2. Critical analysis and limits of the methodology used 4.3. Critical analysis and limits of outcomes 47
4.2. Critical analysis and limits of the methodology used 4.3. Critical analysis and limits of outcomes 47
4.3. Critical analysis and limits of outcomes 47
4.4. How "services to irrigating farmers" has been relevant as the entry point of the study for Stung Chinit case 48
5. ANNEXES 49
5.1. ANNEX 1: Agenda of the consultation workshop (14/01) 49
5.2. ANNEX 2: Attendance list of the consultation workshop 50
5.3. ANNEX 3: Attendance list of the focus group discussion 51
5.4. ANNEX 4: FAO's all rice price index recent trends
5.5. ANNEXE 5: Evaluation of rice production on Stung Chinit according to the 13 principles of agroecology 53
5.6. ANNEX 6: Report of FWUC expenditures in Year 2019 and Year 2020 55
List of Tables
Table 1: Main activities and outcomes, since the delivery of the
"Territorial diagnosis, typology and assessment of service needs and offers" report.
Table 2: Evolution of surface used in dry season in Stung Chinit irrigation scheme:
Table 3: Overview of farms profile in our typology 18

	Table 4: Summary of evolution of practices in the scheme and related	
	services	21
	Table 5: Overall SWOT analysis of services	24
	Table 6: Overview of satisfaction, constraints, risks of services in Stung Chinit	26
	Table 7: Stakeholders roles and responsibilities in the renewed structure for the management of O&M	33
	Table 8: Preliminary operational steps for improvement of the irrigation services management	34
	Table 9: Stakeholders roles and responsibilities in the promotion of more sustainable cropping practices	42
	Table 10: Preliminary operational steps for the promotion of more sustainable cropping practices	43
Li	ist of Maps and figures	
	Map 1: Localisation of Kampong Thom in Cambodia.	14
	Figure 1: West-East transect representation of the South of Kampong Thom province	15
	Figure 2: Evolution of surface with a second rice crop in Stung Chinit scheme over the past 14 years	20
	Figure 3: A visual synthesis of services to irrigating farmers in Stung Chinit area	23
	Figure 4: Overview of some of the key issues to be addressed and vicious cycles regarding O&M management	28
	Figure 5: A summarized vision of addressed issues and restoration of a positive / virtuous cycle	29
	Figure 6: Overview of some of the key issues to be addressed and vicious cycles regarding rice cropping practices intensification and lack of independent technical / economical advisory	36
	Figure 7: A summarized vision of pathway toward changes of cropping practices	39
	Figure 8: Summary of the future service delivery scenario	45

(IFAD

Acronyms

ADB	Asian Development Bank						
AFD	Agence Française de Développement / French Agency for Development						
ASPIRE	Agriculture Services Programme for Innovation, Resilience and Extension project)						
ASIrri	Projet d'Appui aux Irrigants et aux Services aux Irrigants						
AVSF	Agronomes et Vétérinaires Sans Frontières						
CAVAC	Cambodia Agriculture Value Chain Program (AusAID)						
CARDI	Cambodian Agriculture Research and Development Institute						
CASC	Conservation Agriculture Service Center						
CC	Commune Councils						
CCA	Climate Change Adaptation						
CDRI	Cambodia Development Resource Institute						
CIRAD	Centre International de Recherche Agronomique pour le Développement						
COSTEA	Comité Scientifique et Technique de l'Eau Agricole						
CRIC	Chinit Reservoir Irrigation Committee						
DAE	Department of Agricultural Extension						
Dis.	District						
DALRM	Department of Agricultural Land Resources Management						
DAP	Diammonium Phosphate						
DOANRE	District Office of Agriculture, Natural Resources and Environment						
DP	Development Partners						
DRC	Department of Rice Crops						
DS	Dry Season						
FBG	Fertilizer Buying Group						
FO	Farmer Organisations						
FWN	Farmer and Water Network						
FWUC	Farmer Water User Community						
GDA	General Directorate of Agriculture						
НН	Household						
IBG	Input Buying Group						
IRAM	Institut de Recherche et d'Application des Méthodes de Développement						
ISC	Irrigation Service Center						
ISF	Irrigation Service Fee						
IWRM	Integrated Water Resources Management						
MAFF	Ministry of Agriculture, Forestry and Fisheries						
MEF	Ministry of Economy and Finance						
MFI	Micro-Finance Institution						
MLMUPC	Ministry of Land Management Urban Planning and Construction						
MoWRaM	Ministry of Water Resources and Meteorology						

MRD	Ministry of Rural Development
NGO	Non-Governmental Organization
NIS	National Institute of Statistics (of the Ministry of Planning)
NWISP	North-West Irrigation Sector Project (ADB/AFD)
O&M	Operation and Maintenance (of irrigation schemes)
PDA(FF)	Provincial Department of Agriculture (Forestry and Fisheries)
PDoWRaM	Provincial Department of Water Resources and Meteorology
PDRD	Provincial Department of Rural Development
PIMD	Participatory Irrigation Management Development
PIP	Public Investment Program
PPP	Public-Private Partnership
PSG	Paddy Selling Group
RGC	Royal Government of Cambodia
RiceSDP	Climate Resilient Rice Commercialization Sector Development Program
SAW	Strategy on Agriculture and Water
SCCRP	Support to the Commercialization of Cambodian Rice Project
SCIRIP	Stung Chinit Irrigation and Rural Infrastructure Project
SNEC	Supreme National Economic Council
SPS	Sanitary and Phyto-Sanitary
SRP	Sustainable Rice Platform
ToR	Terms of Reference
TWGAW	Technical Working Group on Agriculture and Water
WASP	Water and Agriculture Sector Project (financed by AFD - completed)
WAT4CAM	Water resources management & Agro-ecological Transition for Cambodia (financed by AFD – on-going)
WICI	Weather Index Crop Insurance
WS	Wet Season

Units, measures, currencies

ha	hectare
KHR	hectare Cambodian Riel (1 US\$ \approx 4,080 KHR)
km	kilometre
m	metre
US\$	United States Dollar

1. Introduction

The present document is the third deliverable¹ of the Cambodia part of the implementation of the study on "services to irrigated agriculture" commissioned by COSTEA.

1.1. Recall of the study background and objectives

1.1.1. Background on COSTEA

Since June 2013, the French Association for Water, Irrigation and Drainage (AFEID) has been working with the French Development Agency (AFD) and a large set of international partners, within the framework of the Scientific and Technical Committee of Water in Agriculture (Comité Scientifique et Technique de l'Eau Agricole – COSTEA), the overall objective of which is to promote the sharing of knowledge and experiences between actors in irrigation in order to support operations and policies in agricultural water.

The specific objectives of COSTEA are as follows:

- Produce conceptual and methodological summaries on the technical, economic, environmental and institutional aspects of agricultural water;
- Support the production of new references on innovations;
- Support actors in developing countries in the development and development of their policies, programs and projects;
- Structure an interdisciplinary and multi-actor network of irrigation partners based on the 3 previous objectives.

COSTEA's geographic coverage extends to the Mediterranean, West Africa and South East Asia.

¹ After the kick-off report for Cambodia (Deliverable L0A) and the Territorial diagnosis, typology and assessment of service needs and offers – Cambodia (Deliverable L1A).

1.1.2. COSTEA study on services to irrigating farmers

COSTEA has commissioned a study on "services to irrigating farmers" which aims at elaborating a global framework for the formulation and the organization of supports for irrigating farmers in several contexts of intervention of AFD on irrigation policies in order to maximize their impact. The study is implemented in two countries (Tunisia and Cambodia) by a consortium led by IRAM, associated to ARTE-FACT in Cambodia and BICHE in Tunisia.

The study is implemented on one site only (in each country) and will assess service needs and existing service provision systems in place. The study has two dimensions:

- A methodological dimension: develop methods and tools to assess needs for services in irrigated context, test them and draw lessons.
- An operational dimension: on the selected irrigation scheme, the study is expected to
 elaborate the vision of an implementable frame for multiple services development to
 irrigating farmers. [Nota bene: Yet, it is not the responsibility of the study team to
 operationalize this frame, but it could be carried over by an existing or up to come
 project].

1.2. Key elements of the methodology

The methodology of the study has been detailed in the first report delivered, entitled "Study on services to irrigated agriculture – Launching Report – CAMBODIA". One will refer to that report for details.

In summary, the proceeding of the study has been based on the implementation of:

- A territorial diagnosis to better understand the local context (and its evolution over the past 10 to 15 years);
- An assessment of farmers' needs in terms of services = "demand" side: including
 a typology of farmers, with possibly differentiated needs for different groups;
- An assessment of services that are currently available = <u>supply side</u>: Description
 of the current situation of services offer (and how the evolutions have contributed to
 unlock the potential of irrigation over the last decade), mapping of service providers,
 and SWOT analysis of service provision to irrigating farmers.
- An assessment of **how supply actually responds to farmers' needs** and the elaboration of an **operational frame for services improvement.**

Methodology of implementation of the study has combined:

- Review of bibliography and documentation specific to the selected site as well as on the broader context.
- Initial meetings to introduce the study at national level first, then to local stakeholders.
- Key informant interviews,
- Farmer surveys (notably used to build the typology),
- Focus group discussions,
- Restitution and consultation workshop and final focus group discussions (see details below).

1.3. Main activities carried out in the country since the end of the diagnostic phase

1.3.1. Restitution and consultation workshop

As anticipated² in the previous phase, the final stage of the study on services to irrigated agriculture in Cambodia has consisted in the organisation of a restitution and consultation workshop in Stung Chinit area, with the main stakeholders of the irrigated agriculture.

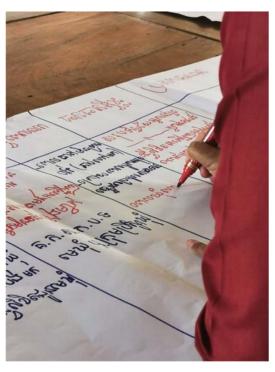


² See previous report (deliverable L1A) "Study on services to irrigated agriculture: Territorial diagnosis, typology and assessment of service needs and offers – CAMBODIA Stung Chinit irrigation scheme" COSTEA, December 2021, page 65.

▲ Restitution and consultation workshop on 14th of January 2022 (Photo: J.M. Brun, ARTE-FACT, 2022).

The purpose was to present the outcomes of the study and finalize the prioritization of the issues, then organise an open consultation to set the basis of operational action plans for the improvement of services. The agenda of the workshop is presented in Annex 1 to this report. The attendance list is in Annex 2.

After the overall presentation of the main findings of the diagnostic phase, the restitution and consultation workshop has focused on two main subjects on which the most important stakes were identified³:



- Focus Topic 1: Long term viability of the irrigation management: identified risks and needs to review the modalities of service organisation, stakeholders' roles and responsibility, etc.⁴
- Focus Topic 2: Advisory to farmer, technical-economical models and better use of inputs for sustainability and natural resources preservation.

The restitution and consultation workshop has generally validated the main findings of the diagnostic phase. In the afternoon session, group discussions have identified and explored some of the actions that could be considered to make improvements and address challenges. But it did not go very far and focused on few specific actions only.

▲ Group session / Restitution and consultation workshop on 14th of January 2022 (Photo: J.M. Brun, ARTE-FACT, 2022).

1.3.2. Focus group meeting to fine tune operational recommendations

To carry over the work started in the restitution and consultation workshop, a focus group meeting took place two week after. It gathered less participants (only from within the district

³ They correspond to the cells in red color of the table "overview of satisfaction, constraints, risks of services in Stung Chinit" in the report (deliverable L1A) "Study on services to irrigated agriculture: Territorial diagnosis, typology and assessment of service needs and offers – CAMBODIA Stung Chinit irrigation scheme" COSTEA, December 2021, page 62.

⁴ The first topic relates to the institutional arrangement of the Operation and Maintenance of the scheme, i.e. to the supply of water to farmers as a service, but stakes here are more on the institutional model and possibly the services or partnership that the FWUC would require. It may be seen as the margin of the scope of the study but could not be ignored in a participative process as failure to address the issues would jeopardize the irrigation service, and that would invalidate the other questions on services to irrigated agriculture.

area, except for the study team and the participation of the Irrigation Service Center) – See Attendance list in Annex 3 to this report.

The process of the focus group meeting has followed the following steps:

First a recall of the outputs of the previous restitution and consultation workshop.



▲ Focus group meeting on 27th of January 2022 (Photo: J.M. Brun, ARTE-FACT, 2022).

Then a discussion to identify solutions and concrete actions to address issues and improve services, and trying to identify who could be the entities responsible to take action, and if necessary with which external support.

The results of the discussions provide avenues for action. However, it does not constitute a project document or a very elaborate and costed action plan. It would be useful to be able to continue and support the process, but that goes beyond the means of this study.

Table 1: Main activities and outcomes, since the delivery of the "Territorial diagnosis, typology and assessment of service needs and offers" report.

DATES	ACTIVITIES	OUTCOMES
06 to 13 January 2022	Team meeting to prepare the restitution and consultation workshop. Prepare invitations and logistic. Prepare Power Point for the debriefing and consultation workshop of 14/01 and translate to Khmer (bilingual).	Final agenda developed. List of participants and invitation prepared and sent. Power point prepared.
14 January	Restitution and consultation workshop in Stung Chinit.	Main outcomes of the diagnostic endorsed and first elements of operational plans identified.
15 to 26 January 2022	Preparation of focus group meeting: facilitation process, logistic, invitation of participants	Facilitation process prepared and participants invited to focus group meeting.
27 January 2022	Focus group meeting in Stung Chinit.	Elements of operational plans are developed (to some extends).
February	Consolidation of outcomes and reporting.	Draft report (L2A): Operational Plan for Services improvement CAMBODIA.

1.4. Content of the present Operational Plan for Services improvement report

The present "Operational Plan for Services improvement report (Cambodia)" contains:

- A Synthesis of the territorial diagnosis after validation by stakeholders (section 2);
- The Operational Plan for Services improvement (section 3).
- A conclusions section (section 4)

2. Synthesis of the diagnosis for Stung Chinit Irrigation Scheme (after validation by stakeholders)

Elements presented in this section are a summary of the outcomes of the diagnosis implemented in the previous phase of the study. The diagnosis has been presented to stakeholders on the 14th of January 2022, and, overall, was validated. For more details, the readers will refer to the full report of the previous phase (Deliverable L1A: "Study on services to irrigated agriculture: Territorial diagnosis, typology and assessment of service needs and offers – CAMBODIA Stung Chinit irrigation scheme" COSTEA, December 2021) available here: https://www.comite-costea.fr/wp-content/uploads/COSTEA-Study-on-services-to-irrigated-agriculture-Phase-2-TERRITORIAL-

DIAGNOSIS-REPORT-Cambodia-EN-FINAL-1.pdf

2.1. Synthesis of the territorial diagnosis

Map 1: Localisation of Kampong Thom in Cambodia.



Kampong Thom province is located in central Cambodia, on the East side of Tonle Sap river and lake, and North of Phnom Penh. Agriculture is the main economic sector of the province. Rice production is predominant, with more than 210,000 ha of wet season rice (PDAFF data). Yet, there has been a very significant development of other crops in the upper lands of the provinces over the past 15 years, with notably cassava (51,186 ha) and perennial plantations of cashew nuts (78,455 ha), rubber (61,781 ha) and to a more limited extent, mango orchards.

The West-East transect representation of the province (Figure 1 next page) gives a schematic representation of the agricultural activities in the region. Irrigated rice has considerably been developed in Kampong Thom province over the past 15 to 20 years. Stung Chinit was among the first large schemes rehabilitated. It is now considered as part of a broader <u>system</u> which includes other schemes fed by the same reservoir on Stung Chinit river, notably Baray scheme located in the South.

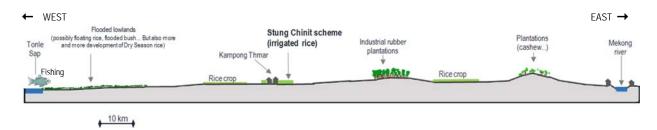


Figure 1: West-East transect representation of the South of Kampong Thom province

The upper lands area in the East of Kampong Thom province (or in neighbouring provinces), which used to be forest or bush area where farmers from Stung Chinit area used to work in dry season (logging...), have progressively been converted to plantations or orchards. Also regulation on logging / preventive measures of deforestation have been consolidated and more strictly implemented (restrictions on the transportation of wood for instance). This evolution has significantly contributed to the development of dry season rice production in Stung Chinit scheme as the alternative logging activity in dry season was no more an income generation opportunity for farmers.

Beyond the local context, at national level, the dynamism of the rice sector is also a major factor of the evolution of rice production within Stung Chinit irrigation scheme, with both a development of milling capacities in Cambodia, notably for export market, and also a strong and stable demand from traders who are exporting paddy to Vietnam.

Lastly the Stung Chinit area has also witnessed the development of numerous economic activities supporting the agricultural sector such as input supply network and service-based mechanisation.

2.2. Presentation of Stung Chinit irrigation scheme

Location		Santuk district, Kampong Thom province.				
	Initially developed	Approximatly 2,400 ha (rehabilitation since 2002, completed in 2006).				
Surface (ha)	Currently developed	Approx. 2,800 ha (2,786.87 ha as per the last update database of FWUC, with 9,020 rice field plots registered)				
	Currently used within the scheme	Approx. 2,800 ha (100 % of irrigated surfaces are used)				
	Used outside of the scheme command area	Another (formal) scheme developed in the South (approx. 5,000 ha), using water from the same reservoir on the Chinit river.				
	Initial construction	First Built around 1977 during the Khmer Rouge regime				
Date	Rehabilitation(s)	Rehabilitation in 2002-2006 (water availability and use started in 2006-2007) (More recent construction of quaternary canals since 2018-2019).				
	Initially	2,828 land owners inside the scheme				
Number of farmers	Nowadays	2,850 land owners in the up-dated register of FWUC (2021) – Note that owners and users are not necessarily the same: a number of plots are rented.				
(users)	Land tenure statute of farmers	Secured land ownership (« hard » land titles) for a very large majority of surfaces.				
	% of women owners	Data not available				
	Source of water used	Reservoir (barrage) on the Chinit river				
	Water distribution system (supply down to land plot level)	Primary canal / 5 secondary canals / Tertiary canals supplying water to irrigation blocks. More recent Quaternary canals to distribute water to each plots (for part of the scheme) + drainage canals.				
Water	Water management	Transfer of responsibility for the operation and maintenance to the FWUC from Secondary infrastructures.				
	Irrigation service fees	Irrigation Service Fees (now named « contribution ») of 60,000 KHR/ha/year (approx. 15 US\$) regardless of the number of crop cycles. Charged to land owner. Collecting the ISF becomes increasingly difficult for the FWUC.				
	Average size of farms in the command area	Average surface per land owner = 0.98 ha. But this does not necessarily reflect the average size of farms.				
	Production systems	Rice crop practically exclusively.				
Agriculture	Cropping intensity	Nowadays two to three cycles of rice crop per year (early wet season / late wet season / dry season).				
	Agroecological practices	Nowadays: a conventional intensification of rice crop (« green revolution » model): mono-cropping of rice, 2 or 3 cycle per year, intensive use of chemical fertilizers, pesticides and herbicides, intensive use of machines.				
Organisations	Farmer Organisations	Scarce cases of farmers being members of an Agricultural Cooperative (AC) in the area. AC providing support to their members on cash credit, production of paddy seeds, and collaboration with inputs supplier company. Attempts at establishing collective input supply and marketing of paddy have failed.				
	Water User organisation	FWUC established since the rehabilitation of the scheme				
On-going or fore	seen projects	None identified on-going project covering Stung Chinit scheme area.				





▲ Secondary canal in Stung Chinit scheme (Photo JM Brun, GRET, 2007).

The scheme consists in one reservoir on the Chinit river (shared with another scheme in the South) a main canal going straight from South to North from the reservoir and 5 secondary canals supply water to a command area of 2,800 ha. The water is delivered by gravity from the reservoir to the main canal then secondary canal, and distributed in tertiary canal to each block by open flume systems. Fields are mainly fed by gravity, except in dry season for some higher plots of land that cannot be irrigated or have to use pumping. Downstream of the blocks, drains are evacuating the surplus of water.

Table 2: Evolution of surface used in dry season in Stung Chinit irrigation scheme:

YEAR	2015	2016	2017	2018	2019	2020
Surface used in dry season	317 ha	875 ha	1,230 ha	1,350 ha	1,135 ha	2,360 ha

2.3. Synthesis of farms typology and analysis of service needs

2.3.1. Key factors of farms differentiation

The study being focused on the irrigating farmers, and the scheme being used exclusively⁵ for rice cropping, the typology is quite largely based on the surface of rice field and on the cropping practices (one wet season crop only or several crops).

Farmers doing only one rice crop in wet season are segregated in one category. The other classes in the typology are farmers growing two or three crop of rice per year, and the break down between classes is mainly determined by land surface cultivated.

2.3.2. Synthesis table of main types of farms

The Table 3 below presents an overview of the types of farmers in our typology.

Table 3: Overview of farms profile in our typology

TYPOLOGY CLASSES	NUMBER OF CROP PER YEAR	SURFACE PER FARMER	ESTIMATED SHARE OF SURFACES*	OTHER COMMENTS
Class 1	1 crop per year only (in wet season), either because they have other priorities, or lack water.	0.2 to 2.0 ha	Maximum 20% of the scheme command area	A few may rent out their land in DS. A significant part of rice is for HH consumption
Class 2	2 or 3 crops per year	Less than 1 ha	Around 50% of the scheme command area	A significant part of rice is for HH consumption
Class 3	2 or 3 crops per year	1 to 4 ha	Around 20% of the scheme command area	
Class 4	2 or 3 crops per year	Above 4 / 5 ha	Probably less than 10% of the scheme command area	Some are tractor owners
Class 5	2 or 3 crops per year	Above 10 ha, mainly rented	Probably less than 10% of the scheme command area	Can be 1 crop if rent in DS only

(DS = Dry season; HH = Household)

-

^{*} This is only a rough estimation made by experts. There are no statistical data available.

⁵ Apart for very exceptional cases.

2.3.3. Brief description of each type of farm

- Class 1: Farmers cropping only one cycle in wet season. There are two sub-classes here depending on the reason why they do only one crop:
 - O Class 1-A: Farmers who are using their rice-fields inside the scheme only in the wet season, mainly because they have <u>other priority activities in dry season</u> (up-land farming such as cassava or cashew production, palm sugar production...). In the dry season their rice fields in the scheme are either not used or rented out to other farmers.
 - Class 1-B: Farmers who grow rice only in the wet season because their field is located in the higher part of the scheme's command area and far from canals, so with an insufficient access to water in dry season.
- Class 2: Farmers cropping 2 or 3 times in the scheme on less than 1 ha. Despite having limited area, rice farming is an important source of income to sustain their livelihood, quite often associated to small livestock production (chicken, cattle...). The area of rice field they own in the scheme has been stable or has decreased in the recent years.
- Class 3: Farmers cropping rice on 1 to 4 ha and at least two times per year. Rice is a major source of income for their household (even if area remains limited). Some of them are renting land in to crop rice on larger areas. They may have complementary incomes from selling labour, small businesses... This category is the one that uses less daily labourers, undertaking most of the non-mechanized cropping tasks on their own.
- Class 4: Larger rice farmers cropping areas of more than 4-5 ha (inside and also possibly outside the scheme) that they own or rent, rather with a trend of increasing their rice fields areas over recent years. They may own their own tractors and can generate additional income from selling mechanisation services. They produce at least two crops per year (at least on part of their land). It is noted also that (based on the limited number of cases surveyed) this group has a bit more in-house labour force available, which contribute to their capacity to extend on larger areas. Yet they are also still hiring labour for part of the tasks of rice crop maintenance (fertilization, treatments).
- Class 5: Larger rice farmers cropping on more than 10 ha of land that they mainly rent (not own or only partly own) inside the scheme, either for one or several crop per year. They own their own tractor and are engaged in a very commercial agriculture model. This class would gather only a very small number of farmers (but represents a not so small area of cropped land) and include some farmers living in the area but also some outsiders who often have been among the pioneers of the development of double or triple rice cropping in Stung Chinit scheme.

Field investigations show that Class 1 is decreasing. It is very likely that there is a trend toward a progressive reduction of the number of farms, and increase of the average farm's surface combined with more inputs and capital intensive models. Classes 4 and 5 are building on economies of scale: the possibility to invest in their own mechanization increase the profitability of those models, creating an incentive for further growth. Hence, it is likely that

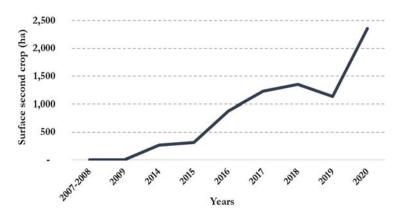
households engaged in larger farming on large surfaces (classes 4 and 5) will increase, to the detriment of smaller farms.

2.4. Evolution of agriculture practices goes together with the evolution of services demand and offer in Stung Chinit area and evolution of the context

During the surveys, interviewed farmers who are now doing at least two rice crops per year were asked about the determining factors that made them switch to two (or three) crops per year. Practically all of them have ranked irrigation (water availability) as the No 1 factor.

Yet, the history of the scheme use reveals that if it is a necessary condition, water availability is probably not a sufficient one. Indeed, water for irrigation is available in Stung Chinit since the end of the rehabilitation of the scheme (around 2006 / 2007). But double rice cropping has started to be widespread in the scheme only in recent years.

Figure 2: Evolution of surface with a second rice crop in Stung Chinit scheme over the past 14 years



This means that water availability alone is not enough to trigger the change in farmers' behaviours and strategies regarding double cropping and development of dry season rice.

Other determining factors and services to unlock the potential of production⁶ are:

- dynamic market demand / market prices and presence of buyers is often ranked second by interviewees;
- availability of new varieties of rice: non-photosensitive and short cycle varieties, notably initially imported from Vietnam;
- availability of suitable inputs at hands (dynamic input supply network);

⁶ This tend to confirm a hypothesis mentioned in the kick-off report report: "Beyond water availability, services related to value chains, are strong incentives to reach the full potential of irrigation".

- mechanisation services;
- pioneer farmers who have started to successfully experience dry season cropping in the scheme.

All those are thereof necessary and shall be considered among the priority services. Availability of credit services may also have contributed, in particular when it has started to be embedded with input supplies. From the study team point of view, land tenure stabilisation was less determining. Land titling was actually done for all the plots within the irrigation scheme at the same time of irrigation infrastructures rehabilitation, in the mid-2000 decade. Furthermore, the fact that no more forest land or bush for logging activity was accessible in dry season has suppressed an economic opportunity for farmers and forced them to find another one.

The Table 4 below shows a summarized overview of the history of the rice cropping practices in Stung Chinit scheme, enhancing the correlation between the progressive development of services (mechanisation, inputs supplies...) in parallel of the changes of practices in the scheme. It also shows how the availability of water alone was not enough to trigger the rice intensification.

Table 4: Summary of evolution of practices in the scheme and related services

		BEFORE REHAB.	2007- 2008	2009-2014	2015-2018	2019-2021	NEAR FUTURE
Situation	Rice production Features	wet season only (low yields)	Wet season only (low yields)	wet season, some second crop	Start 2 production cycles (3 for few pioneers)	2 to 3 cycles becomes more widespread	Maintain 2 -3 cycles but with risk of failure and higher costs? (Note:Soil fertility starts to decrease)
0)	Farmers technical knowledge on DS rice	No		Some pioneers bring techniques	Start to copy pioneers	More widespread knowledge of DS rice crop	More widespread knowledge of DS rice crop
	Irrigation Water availability	No irrigation service	Water availa	Water available			
Services	Inputs supplies	Very limited	Very limited	Few distributors	Offer of product increase	Diverse and quality products available	
Š	Mechanization	No service	Hand tractors	Hand tractors	Hand tractors and start to have tractors	Large availability of tractors and combine harvester	
	Market connection	Local collector	rs / middlemen New traders			More connections to market	

2.5. Synthesis on the existing services offer

A large number of services and service providers are available for farmers in Stung Chinit area. The Figure 3 next page provides a summarized overview of services available, some of which have been developed and/or scaled up recently, in the past 5 years⁷. The main actors for key service provisions are:

- The Farmer Water User Community (FWUC) and the Provincial Department of Water Resources and Meteorology (PDoWRaM) for irrigation service (Operation and Maintenance of the irrigation scheme).
- Private input suppliers for the supply of fertilizer, pesticides, herbicides, seeds, of course, but
 also to a large extend for technical advisory to farmers and credit services (embedded with
 the selling of inputs).
- Machinery owners (generally farmers acting as local service entrepreneurs) for the mechanization services (soil preparation and mechanized harvesting).
- Local collectors or agents are linking farmers to market (i.e. to rice millers or larger traders exporting paddy to Vietnam as detailed in the next pages).

Local public services of agriculture have a limited role in term of support provided directly to farmers, because of the lack of resources available. The District Office of Agriculture, Natural Resources and Environment explains that its main role is the collection of data and production of statistics and report, and to a lesser extent to provide technical advises to farmers in specific circumstances, and also, importantly, to inspect input suppliers.

Farmers' organisations have also a limited role in terms of services: FWUC of Stung Chinit is only involved in the irrigation service and the FWN (national body) is involved in advocacy. Attempts at getting involved collectively in input supply (Farmers' Buying Groups) and marketing (Paddy Selling Groups) have failed.

Banks and MFI are very present in the area, but are not really playing a major role in agricultural campaigns financing.

Therefore, apart from the irrigation service, all other key services (input supply, extension/advisory, marketing, mechanisation, credit) are provided by private sector stakeholders. Such strong involvement of the private sector in services delivery has advantages (effective service delivery, business model) and disadvantages (limited control/regulation and short-term profit seeking sometime at the cost of the sustainability of the agricultural model promoted).

More details are available in the previous report (deliverable L1A) "Study on services to irrigated agriculture: Territorial diagnosis, typology and assessment of service needs and offers – CAMBODIA Stung Chinit irrigation scheme" COSTEA, December 2021.

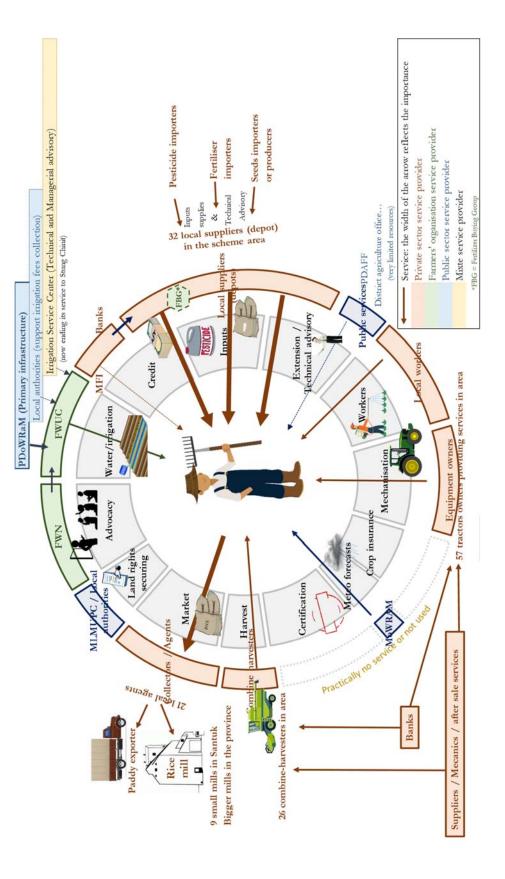


Figure 3: A visual synthesis of services to irrigating farmers in Stung Chinit area

2.6. Synthesis on the adequacy between services offers and needs

As a summary of the study findings, the SWOT analysis (Table 5 below) provides a quick overview of the situation on services and underlines some key issues. The object considered in the analysis are the services to farmers belonging to the "Stung Chinit irrigated agriculture system" as a whole (including farmers, FWUC, local authorities, service providers). Strength and Weaknesses refer to current situation within the system. Opportunities and Threats can refer to elements outside this systems, but also to anticipated perspectives that can be inherent to the system.

Table 5: Overall SWOT analysis of services

STRENGTH OPPORTUNITIES (/FUTURE PERSPECTIVES) IRRIGATION IRRIGATION Irrigation water supply is still working relatively well. The presence of ISC and FWN in Kampong Thom can INPUT SUPPLY and MECHANIZATION still be a chance to support the FWUC, as they can offer near-at-hand support services to the FWUC and Very dynamic private sector investing in the provision have strong competences on these matters. of services (mechanization) and input supplies. OTHER SERVICES **CREDIT** Pilots on agricultural crop insurance in neighbouring Large offer of credit services: numerous banks and communes that could be extended to scheme area. MFI present locally (possibly used for investments such as mechanisation... less for agriculture campaign credit) + facilities of payments proposed directly by suppliers (for campaign credit). MARKET LINKAGE Solid connection with paddy buyers. **OVERALL** Viable business model (private sector) of key **WEAKNESSES** THREATS (/ANTICIPATED RISKS OR EVOLUTIONS)

IRRIGATION

- FWUC internal capacities still require to be strengthened (turnover) and/or completed by externalized services for certain functions.
- Communication by FWUC with water users has been reduced
- Collection of ISF remains difficult.
- Declining support and collaboration of Local Authorities is a threat to the functioning of the FWUC.
- End of ISC support to FWUC (without alternative). TECHNICAL ADVICES / EXTENSION
- Lack of budgetary and human resources of public services for agricultural extension and technical advices to farmers.
- Over-reliance on input suppliers who have vested interest in selling more input than what might be strictly necessary or optimal.

Costs of financial services (interest rate) still relatively high.

MARKET LINKAGE

Low capacity of negotiation of producers on prices (failure of "Paddy Selling Groups experience").

IRRIGATION SERVICE

The economic and social viability of the irrigation service is threatened by decrease of the actual collection of fees and increase of maintenance costs (identified as a mid-term threat, but rooted in today's weaknesses).

TECHNICAL ADVICES / INPUTS USE

- Degradation of soil fertility (not proven based on scientific evidences, but reported by some farmers, linked with double/triple cropping).
- Negative externalities on environment and biodiversity (impact on fisheries...)

MARKET LINKAGE

A certain dependency on Vietnamese market in particular for short cycle non-photosensitive varieties of rice.

GENERAL

- · Low diversification of agriculture in the area. Profitability sensitive to evolution of input prices and volatility of market prices for paddy.
- Given the strength of the private sector in service delivery, short-term profit seeking sometime at the cost of the sustainability of the agricultural model promoted.

The Table 6, page 26 assesses more specifically the different service needs, starting from the ones considered (according to the different surveys and interviews) as higher priorities. From our team analysis, two main points (in red in Table 6), appears as the highest concerns. They are the ones that have been focused on during the last phase of the study, i.e. the development of operational plan for services improvement.

The first one is related to the **irrigation service.** The perception by farmers of the water supply service is generally good (with some limits, often underlined by large farmers – notably in classes 3 and 4 of the typology – see section 3) and most of the farmers are also considering that the price charged for the irrigation service is acceptable. But the FWUC is currently facing a crisis (institutional, organisational and financial) which represents a real threat for the sustainability of the irrigation service. Whereas the maintenance costs are significantly increasing due to higher use of the scheme and the increased use of heavy machinery, the FWUC is facing more and more difficulties to collect the contribution from farmers partly due to reduced communication with users and also to the reduction of local authorities' engagement aside the FWUC. Moreover, the support of ISC is coming to an end. All these elements could jeopardize in a relatively short term the capacity to sustain the irrigation service in Stung Chinit scheme. Whereas it might not yet be perceived by water users, it seems important to acknowledge the difficulties faced and to undertake a comprehensive review and renegotiation of the conditions of irrigation management and necessity of collaboration between all institutions.

The second one relates to the **chemical-intensive cropping methods** used (and hence concerns at the same time input supplies and technical advisory to farmers). Here again, the subject does not yet appear as a very hot concern for farmers (except for their complaints on the high price of inputs, in particular fertilizers). But the level of chemical-based intensification starts to come with important threats:

- a) the sustainability and profitability of rice production could be questioned in the future because of decreasing soil fertility (need to apply more and more fertilizers to obtain the same yields as reported by farmers, and not surprisingly when moving to a two or three rice crop per year system on the same land and with prices of inputs being on a growing trend);
- b) the impact of chemical intensive practices has already started to show negative impact on the environment and natural resources. Locally (within the scheme or in its vicinity), capture and harvest of wild fishes in ponds dug in the scheme or downstream has already severely decreased. At a larger level, the impact of such rice intensification around the Tonle Sap may come with significant negative impacts on the fishery sector on the Lake (also combined with changes in hydraulic regime). It probably impacts also terrestrial biodiversity (insects, soil fauna and flora), but this is not documented at the moment and farmers or local stakeholders in Stung Chinit did not mention or expressed concerns on this aspect.
- c) the impact of chemical intensive practices on health of farm workers.

= Significant concerns or risks

= Some concerns or risks

= Quite satisfactory

= Satisfactory

Color codes:

Table 6: Overview of satisfaction, constraints, risks of services in Stung Chinit

3. Operational plan(s) for services improvement

The operational plan that has been elaborated on the basis of the outcome of final restitution and consultation workshop (of 14th of January) and focus group meeting (of 27th of January) is focusing only on the topics identified as key issues in the diagnostic phase, i.e. topics highlighted in the red colour cells in the Table 6 of the previous page:

- The latent crisis that threatens the irrigation service delivery itself (the economic viability of the Operation & Maintenance management, which is threatened by the increase of maintenance costs while the FWUC is facing difficulties to recover financial contributions from users). → Addressed in Section 3.1. Irrigation service management (O&M).
- Issues related to the long term sustainability and environmental impact of the conventional technical model of intensive rice cropping system. → Addressed in Section 3.2. Promotion of more sustainable cropping practices.

Discussion on improvements to be made were orientated toward a consensually envisioned goal of an "Economically and Environmentally sustainable and profitable irrigated agriculture in Stung Chinit Scheme". This encompasses two main goals, in relation to the two core issues to address:

- An efficient and economically viable Operation and Maintenance of the irrigation scheme
- An evolution toward more sustainable and profitable cropping practices, with reduced negative environmental impacts.

For each of these two axis, we will consider the changes / improvement required to address these two issues (the possible pathways for the changes to happen, the "Theory of Change"). Then, we will provide (based on the outcomes of restitution and consultation workshop, and focus group discussion) some concrete suggestions on the operational modalities that could be considered to improve the services to irrigating farmers⁸.

In addition to these two priority axes, the operational plan could also be completed with additional measures to take care of the third pillar of Stung Chinit sustainable development: the social aspects (in particular measures for health protection of farm workers) and for supporting class 1 farmers when they wish to maintain a viable farming activity.

⁸ The management of the water supply and its organisation being encompassed in these services to irrigating farmers.

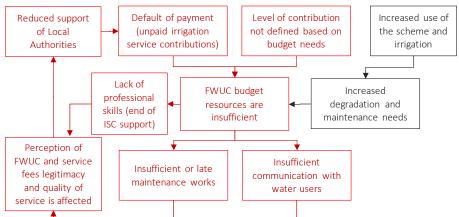
3.1. Axis 1: Irrigation services management (O&M)

3.1.1. Theory of change

a. Issues relating to the sustainable management of irrigation service (O&M)

The diagnostic phase of the study has identified issues that are threatening the long term viability of the irrigation service itself in Stung Chinit scheme: the decrease of actual service fee (/contribution)⁹ collection (combined with increased needs for maintenance), the degradation of the support from Local Authorities, the end of the Irrigation Service Center's support are all factors that could jeopardize the sustainability and economic viability of Stung Chinit irrigation scheme Operation & Maintenance. These factors are interconnected and summarized in the Figure 4 below:

Figure 4: Overview of some of the key issues to be addressed and vicious cycles regarding O&M management



The core problem identified is that, currently, the effective budget resources of the FWUC are not sufficient to properly cover the costs of FWUC's functions on Operation and Maintenance (Report of FWUC expenditures in 2019 and 2020 is shown in Annex 6). The progressive reduction of budget resources has initiated a vicious cycle: With insufficient maintenance done, and a reduced communication / interface with farmers (less meetings are organised at village level to provide information on FWUC activities or on water management plans, for instance), the perception of the FWUC by water users is degraded. And hence the willingness to pay the fees decreases.

Meanwhile, the support of local authorities (communes and district) has decreased (partly due to turnover in the local administration, and lack of information of new comers on the roles

⁹ We use here both terms "Irrigation Service Fees (ISF)" or "Contribution (to irrigation costs)". In Cambodia, the terminology recommended by MoWRaM has evolved with time, and the word "contribution" is nowadays preferred. But because this report is to be used by COSTEA internationally, we may also still use the term "Irrigation Service Fee" which is commonly used in several other countries.

and responsibilities of LA in the institutional irrigation service management system). One of the important role of local authorities is to help FWUC to address cases of non-payment of farmers' contribution to the cost of irrigation service. The increasing number of unsolved cases of non-payment is the other driver that fuels this vicious cycle.

b. Formulation of a renewed vision / main goal for Irrigation service management (O&M)

Overall, a certain consensus was reached during the restitution and consultation workshop on a common vision on this topic that could be formulated as:

"Restoring an efficient and economically viable Operation and Maintenance of the irrigation scheme".

The main goal is to rebuild a broader consensus and actual engagement of key stakeholders for the institutional system of O&M management to operate properly, based on a viable economic model.

c. Changes expected to achieve these goals and realise this vision

Main required elements (changes) to achieve the above goal shall address the key bottlenecks or obstacles shown above. Hence the desired situation is summarized in the Figure 5 below, and is mirroring the Figure 4 (previous page) of key issues to address.

Measures taken to enforce payment of fees Recovery of irrigation Increased use of Reconnect the setting Restore support of service contribution of fees' rate based on the scheme and **Local Authorities** is improved costs irrigation Hire (or source Higher maintenance FWUC budget out) qualified costs can be sufficient **Human Resources** addressedFWUC and Improved irrigation service Maintenance communication with contribution improved users (meetings, FB...) regain legitimacy

Figure 5: A summarized vision of addressed issues and restoration of a positive / virtuous cycle

[Note: Boxes in white background and bold fonts indicate the main entry points to initiate the changes / improvements].

The Figure 5 (previous page) is obviously very summarized and does not reflect the whole complexity of the issues. It does not cover all the elements¹⁰ required for the institutional system of O&M management to perform well, but only some key elements that have been mentioned to be improved¹¹.

The main changes to be operated are the following:

• Restoration of the partnership with Local Authorities (communes and district). Partnership with (/support from) local authorities is essential for the FWUC, notably to ensure the case of non-payment of irrigation contribution to be addressed (and avoid a "snow-ball effect" and erosion of fees/contributions collection, as it was already happening in 2020-21). The need for this collaboration was well identified since the time of the implementation of SCIRIP project (2002-2007), and was addressed and materialized by the creation of the "CRIC" (Chinit Reservoir Irrigation Committee)¹². The CRIC has been inactive in the recent years¹³, until July 2021 when it started to be reactivated. Yet it is important to pursue the process of revitalisation of the partnership with local authorities, and notably to ensure the actual commitment of commune councils in the enforcement of irrigation service fees / contribution collection. In practice (and as discussed during the consultation workshop in January 2022) the involvement of Local Authorities in the irrigation contribution is expected to be materialized by communes summoning non-payers (after the FWUC has made all effort to recover on its own) to come to commune office to discuss the case. For most recalcitrant and emblematic cases, if commune intervention is not sufficient, they shall be summoned at district level. It has to be mentioned that FWUC Stung Chinit pays incentives to local authorities to undertake this role (in 2019, this has represented 11% of the budget of the FWUC - See Annex 6)... even if the support of Local Authorities was not always at the level expected.

¹⁰ A number of other fundamental pillars have to be ensured as well. For instance, here, the role of MoWRaM / PDoWRaM in O&M of the schemes are not mentioned for a matter of simplification. They are also, obviously, of the highest importance, and we don't forget them. But this part of O&M has not been discussed much during the study and the restitution workshop.

¹¹ We also have to recall that the O&M of irrigation is not the main subject of the study ("Services to irrigating farmers"), which explains that we don't explore this subject in details here. Nevertheless, considering the risks for the long term service of water supply to farmers, it was necessary to take O&M into account to some extent. Indeed, if there is no irrigation anymore, there is no "services to irrigating farmers" as well.

¹² The Chinit River Irrigation Committee was officially created by a "*Deyka*" of the provincial governor (in March 2007). It plays an important coordination/facilitation role for any issue related to O&M. It is composed of Santuk district governor (Chairman), the acting director of PDOWRAM (Vice Chairman), the commune chiefs of Kompong Thmar, Prasat and Beng Lvea, and the five members of the FWUC committee. At that time, the article 2 of the Deyka was defining CRIC's roles as follow: i. Advice on the general management of the irrigation infrastructures (main structures, secondary drains, tertiary and quaternary infrastructures); ii. Follow-up and solve the conflicts or problems which occur in the FWUC; iii. Follow-up and comment in the operation and maintenance in Chinit reservoir; iv. Collaboration and coordination between FWUC committee with PDOWRAM, and other organizations; v. Coordination for a fair water sharing; vi. Collaboration and coordination with FWUC committee on ISF collection and enforcement of internal regulations.

¹³ Partly due to the turnover in institutions: for instance, the new district governor / vice-governors were not informed about the CRIC and the district's role in the management of Stung Chinit irrigation scheme.

- Restoration and improvement of communication channels with farmer water users: Enforcement procedures need to be in place to avoid "free-riders" practices. But of course, it is even more important to create the conditions of the willingness to pay for the service among users. As shown during the diagnostic phase of the study, the current level of satisfaction of farmers with the irrigation service is high. Yet it does not always translate in a willingness to pay the contribution to the costs of irrigation service, partly because cases of non-payers who still benefit from the service are not solved (see above), but also because of a lack of communication of the FWUC toward users. It is important that the FWUC regularly recall its role and showcases what the actions it undertakes for water users. It is also important that it maintains the possibilities of a dialogue with users to hear the possible requests or claim and address them. Yet in the last two years, the FWUC has reduced¹⁴ the opportunities of communications with users, notably as skipped the organisation of regular meetings with farmers water users at village level.
- Reconnect the calculation of the contribution price / irrigation service fees with the estimation of budget needs: For the past decade and until recently (2021) the FWUC has been charging a flat amount of 60,000 KHR/ha/year for the irrigation service. The development of double or triple cropping and the increase of maintenance costs was not passed on to the billing rate. Since the recent start of restoration of the partnership with local authorities (CRIC meeting of July 2021), the price of irrigation service has started to be discussed again (as well as the principle of billing per season instead of annually). But discussion on the new billing rate was not based for the time being on the estimation of actual costs to be engaged by the FWUC (for its share of O&M responsibilities), but was rather a political decision (based on what is considered rightly or wrongly as a price that farmers will be willing to pay). In order to ensure the long term viability of the irrigation management, it is important to restore this link. Besides, being able to show that the billing rate is based on tangible costs and is not arbitrarily determined is also a factor that is foreseen to contribute to the transparency of the management and thereof to users' willingness to contribute.
- Mobilisation of adequate skills: with the current withdrawal of the Irrigation Service Center (ISC) support to FWUC (due to lack of financial resources of ISC, and lack of recognition by FWUC institutional partners of the usefulness of this support), the FWUC is facing a new challenge. Internally, FWUC team is lacking competences for tasks requiring specific skills, notably to consolidate financial reports and to manage users' data for invoicing purpose, as well as monitoring of payment recovery. Sourcing (hiring our outsourcing) of relevant skills is even more necessary in the present time, as the FWUC is in the process of switching from an annual fee collection system (based on database of land owner) to a biannual collection system with a need to differentiate plots used in wet season only and plots used in dry season (hence a need to collect data on land use per season and to manage

¹⁴ Partly because of the reduction of its financial resources, partly also, in 2020 and 2021, because of Covid-19 pandemic.

properly these data for invoicing). A full time position might not be necessary (this shall be properly assessed), and therefore the option of out-sourcing could be more cost-effective than hiring salaried staff. Resuming the mobilisation of ISC (or possibly FWN, or another structure) could be reconsidered as a possible option.

d. Hypothesis and risks

The main challenge for the changes to be conducted is to consolidate a larger consensus on the reforms and improvements in irrigation management to be made and to rebuild an effective solidarity and partnership on the basis of this shared vision.

In other words, key hypothesises are that:

- The willingness of cooperation between local authorities, FWUC (and PDoWRaM as well of course) is confirmed and solid.
- Provided that improvements are made, a majority of the farmer water users will be supportive
 and will accept the new billing system and rates.
- The FWUC can mobilise skilled human resources (by recruiting or by outsourcing to service providers) to help to undertake tasks that the committee or current staff are not able to fully handle by themselves.

3.1.2. Operational modalities for restoring an efficient and economically viable Operation and Maintenance of the irrigation scheme

a. Stakeholders and distribution of roles and responsibilities in service offer

The Table 7 next page summarizes the main stakeholders engaged and their foreseen roles and responsibilities. It is underlined again that what is described here does not encompasses all the roles and tasks required for the Operation and Maintenance of the Scheme, but focuses here only on specific activities on which improvements are needed to address the current difficulties faced by the FWUC.

It is also noted that a large number of the functions described below correspond to roles or duties that where already identified as such since the early stage of O&M system development in Stung Chinit scheme, but which adoption or implementation has progressively been eroded and required to be restored. A major issue is indeed to ensure that each actor engaged actually fulfil its roles and commitments.

Yet there are also new actions required, in particular in relation to the switching from annual contribution collection based on land ownership only, to a billing of irrigation service costs in dry season based on the actual cropping in that season.

Table 7: Stakeholders roles and responsibilities in the renewed structure for the management of O&M

STAKEHOLDERS	ROLES AND RESPONSIBILITIES				
FWUC Committee + salaried staffs	 Prepare an annual work plan and budget plan, and use it to serve as the basis for setting the billing rate per hectare and per season (in consultation with CRIC); 				
	 Prepare comprehensive action report and financial report on FWUC's O&M activities to ensure transparency; 				
	Organise meetings with users at village level at least one or two time per year to provide information, consult on water management, and get feedback from users;				
	Set up a link for more regular information provision to water users, so the perception of FWUC service is better perceived.				
	Organise the billing of irrigation service costs to users.				
	Make decision and implement water management and maintenance work.				
	Manage FWUC finance in an efficient and transparent way.				
FWUC Village representatives	Be the first interlocutor of farmers / water users to deliver and collect information;				
	Organise village level meetings and invite farmers / water users;				
	Gather data on land ownership and land use within the scheme;				
	Collect Contributions to Irrigation Service Costs and transfer to FWUC committee / bank account.				
Head of Communes / Commune councils	Support communication to users on FWUC role and encourage farmers compliance with collective rules and principles				
	 Help to address cases of non-payment of fees that could not be addressed by FWUC alone or by village authorities. 				
	Take part in CRIC meetings.				
District governor	Convene and chair CRIC meeting.				
	 Ensure communes and village authorities are fully aware of their roles and undertake their support to FWUC fully and diligently. 				
	 Help to address directly the most severe and cases of non-payment or non- respect of rules by users (long lasting unsolved cases, concerning large surface of land and important amount at stakes). 				
CRIC	Advice on the general management of the irrigation infrastructures;				
	Take part in the decision of ISF level (taking into account acceptability and technical constraint).				
	Follow-up and solve the conflicts or problems which occur in the FWUC;				
	 Collaboration and coordination between FWUC committee with PDOWRAM, and other organizations; 				
	Collaboration and coordination with FWUC committee on ISF collection and enforcement of internal regulations.				
ISC (or alternately FWN, or hired salaried staff)	Provide support to develop the information collection system on land use in dry season;				
	Provide support to develop the data management and irrigation service billing system to help FWUC to switch from annual billing to seasonal billing.				
PDoWRaM	Ensure that water is supplied adequately within the main canal;				
	Ensure the maintenance of infrastructures that remains under MoWRaM responsibility;				
	Participate in meetings with FWUCs, local authorities and users as required to support FWUC work.				
Farmers / Water	Help to provide feedback to the FWUC and to identify maintenance needs;				
Users	Provide information on land ownership (especially in case of change of				
	owners) and on land use in dry season;				
	 Attend village meetings to get clear information on water management and on FWUC activities; 				
	Pay their due contribution to irrigation service costs, fully and on time.				

b. Tentative operational roadmap

The consultation workshop of 14th January and the focus group meeting of 27th of January 2022 have both contributed to develop preliminary operational steps to undertake in order to implement the process. They are described in the following Table 8 (after some adjustments / improvement made by the study team to improve clarity and coherence):

Table 8: Preliminary operational steps for improvement of the irrigation services management

ACTIONS	WHERE?	WHEN?	WHO IS RESPONSIBLE	WHO SUPPORTS
Resume and maintain regular CRIC meetings	FWUC office	At least 1 to 2 times per year. Next by June 2022.	District governor	FWUC, PDoWRaM, Communes.
Resume information and consultation meetings with farmer water users	Village level, in all villages in the scheme	2 time per year, from 2022	FWUC committee and FWUC village representatives	Village authorities
Create group or page on social media to provide more regular information to members / farmer water users on FWUC activities	FWUC office, then register farmers in villages	From 2022	FWUC committee + village representatives	ISC? / FWN?
Improve managerial capacities of WUC committee	FWUC office	2022-23	MoWRaM / ISC	WAT4CAM?
Maintain an up-to-date register of land owners inside scheme	In all Stung Chinit irrigation scheme	Annually	FWUC village representative. FWUC committee	ISC Village and commune authorities
Collect data on dry season cropping (for each plot)	In all Stung Chinit irrigation scheme	Annually, during dry season, from DS 2021-22	FWUC village representative. FWUC committee	ISC May need support funds (FWN? WAT4CAM?)
Up-date system / database for two-seasons invoicing	FWUC office	First months of 2022	ISC?	
Prepare invoices to farmer water users based on data collected	FWUC office	2 times per year (after WS and after DS)	FWUC committee and staff	ISC
Enforce irrigation service contribution at FWUC level	In villages	During and after collection period	FWUC village representative.	Village chiefs. FWUC committee
Take action at commune level against users who have not paid irrigation service contribution	Commune office	After period of contribution collection by FWUC	Commune leaders	Village chiefs. FWUC committee
Take action at district level against users who have not paid irrigation service contribution (most important cases)	District office	After communes have addressed most of the cases	District governor or deputy	FWUC committee, commune leaders, police.

3.2. Axis 2: Promotion of more sustainable cropping practices

3.2.1. Theory of change

a. Issues relating to the sustainable development of irrigation on the site and the challenges of services to irrigating farmers

The second main topic on which intervention is proposed to improve the service to irrigating farmers is focused on the cropping practices. The diagnostic has identified issues with the current rice intensification model that has spread throughout Stung Chinit Irrigation Scheme over the past few years, in particular:

- At the farm level, the doubts on its long term sustainability, due to the progressive reduction
 of soil fertility (reported by farmers but no data collected yet), in particular when three rice
 crops are practiced annually on the same rice plots. Furthermore, the increasing use of
 pesticides and herbicides destroys life in the soil, alters the functioning of the ecosystems and
 these products become less and less efficient.
- At the farm level, the increasing use of chemical inputs while they are increasingly expensive
 and less and less efficient will negatively impact farmers' income in the mid to long-term.
- The environmental externalities of the conventional rice intensification practices, with notably impact on fisheries and potentially on human health (farm workers for sure, potentially farmers and consumers).

(For reference, in Annex 5, we are presenting a table highlighting that the current production model ranks very low according to the 13 principles of agro-ecology).

It is underlined that the perception of these threats is not yet very widespread among rice farmers in Stung Chinit. Only some of the farmers are conscious of these risks and on the limit of the rice intensification model, in particular regarding its impacts on soils and natural resources / biodiversity¹⁵. Therefore, there will be a need to raise awareness first in order to trigger further changes.

¹⁵ Health issues related to pesticide are a bit more acknowledged by rice farmers... which is often why they are hiring daily labour to spread pesticides rather than doing it by themselves!

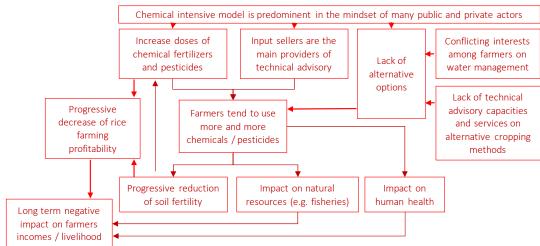


Figure 6: Overview of some of the key issues to be addressed and vicious cycles regarding rice cropping practices intensification and lack of independent technical / economical advisory

In term of services to irrigating farmers, two types of services are concerned with this subject:

- The technical (or technical-economical) advisory services.
- The input supply services.

The fact that inputs suppliers have become the main source of information and technical advisory to farmers is problematic as there is an obvious conflict of interest with their commercial objectives.

Some alternative options exist and have been promoted (in particular the growth of cover crops in dry season to bring more carbon to soils) but with insufficient resources to support their adoption, and now a major obstacle as more and more farmers are growing rice in dry season and thereof need water to be supplied in the irrigation blocs.

b. Formulation of a vision / main goal regarding technical advisory services and input supply services

During the restitution and consultation workshop, local stakeholders were able to agree on a common goal which can be formulated as:

"Achieving more sustainable and more profitable cropping practices in Stung Chinit irrigation scheme."

c. Changes expected to achieve these goals and realise this vision

As it was identified in the diagnostic phase of the study, the intensification of rice cropping in Stung Chinit scheme has been done with some success in the recent years but starts to generate collateral problems regarding: 1) degradation of soil fertility in the long term (which will be likely to harm the profitability of rice cropping in the mid-term); 2) impact on environment and natural resources (notably on inland fisheries); 3) impact on human health because of the intensive use of pesticides.

This diagnosis is partly predictive: the problems are only beginning to be apparent (the reduction of fish resources is already noticeable, and farmers are just starting to observe the decline of soil fertility). Yet the restitution and consultation workshop on 14th of January 2022 has acknowledged the trends, and has considered the advantages (or for some participants, the necessity) to limit rice cropping to two cycles per year¹⁶, and promote a different use of land plots in dry season to maintain or restore fertility and reduce the pressure on environment.

Five constraints are preventing the development of more sustainable cropping practices:

- 1. As mentioned above, farmers' awareness on these trends or risks is still not very widespread in Stung Chinit area (except maybe for the risk on farm workers and farmers' health related to the intensive use of pesticides). Better anticipation of mid-term impacts on soil fertility and environmental impacts shall be promoted through awareness raising. Many stakeholders have little awareness or trust in possible alternatives to the "green revolution" model (even when they see its limits) and this is an obstacle to the actual deployment of alternatives.
- 2. Some farmers in Stung Chinit have experimented and appreciated the non-tillage + cover crop practice promoted by DALRM and CASC (with support from CIRAD) on rice field. In this system, the cover crop is implanted in dry season (no dry season rice, so). But farmers have observed the benefits on soil fertility improvement. But with the development of dry season rice crop since 2019-2020, a conflict appeared on water management in irrigation blocs in dry season, as rice and cover crops obviously don't have the same water requirements. Farmers willing to grow dry season rice becoming the majority, the practice of growing cover crop in dry season was abandoned. In dry season, switching from rice crop to cover crop (or other crops) can only be done if there is a dialog and consensus among farmers in one irrigation bloc.
- **3.** For the option of no-tillage and cover crop system, specific services (mechanisation) and inputs (cover crop seeds) are needed. At a limited scale, the need can be addressed by dedicated public support services (like CASC) or projects. But the perspective of a scaling up would require the development of locally based (private, most likely) suppliers.
- **4.** A major difficulty is that the negative impact of intensive rice cropping is not always directly affecting the rice farmers themselves: they are not directly affected by the reduction of fish stocks if they are not fishermen / fish raiser as well. They are frequently hiring daily workers to spread insecticides to preserve their own health. And more and more land is rented by dry season-rice farmers, who, if they don't use their own land, are less concerned by the possible degradation of soil fertility. This, indeed, does not incentivise changes of practices.

¹⁶ Or at least not to do three cycle per year every year on the same plots.

5. Lastly, nearly all of rice sector stakeholders (farmers, input suppliers, millers, decision makers, consumers) are currently deriving short term benefits from the current green revolution model. At this stage, only two types of stakeholders are already perceiving the negative impacts: farm workers and fishermen. Yet these negative impacts are not documented and the mission has only anecdotal evidences of these existing impacts. Furthermore, farm workers have little weight in the decision making and orientations of the local rice sector.

Gliessmann (in FAO 2015)¹⁷ and HLPE (2019)¹⁸ suggest 5 levels of transition towards more sustainable food systems (related to the 13 principles of agroecology)¹⁹. In the case of Stung Chinit it is suggested to start with incremental changes first, knowing that this would possibly lay the ground for subsequent transformational changes in the longer term.

The suggested incremental changes are twofold:

- Given the fact that chemical inputs use is in the rise and that technical advice is dominated by input suppliers who have vested interest, a necessary change is to increase the efficiency of industrial and conventional practices in order to reduce the use of chemicals. This corresponds to a level 1 transition according to Gliessman. This will require some changes in the advisory system.
- Simultaneously, in addition to that, reducing the surface of dry season rice and replacing it by either cover crops in dry season to restore soil health and fertility or by other crops (pulses? peanuts is one of the option mentioned by participants in the consultation workshop) that would also benefit soil fertility, appears a possible alternative to work on. This corresponds to a level 2 transition according to Gliessman. The Figure 7 (next page) provides a schematic overview of levers required to trigger changes of practices. Furthermore, if climate changes result in a longer dry season, dry season rice cropping may become increasingly difficult. Looking at alternative crops would then be a good adaptative strategy to climate change, while also tackling the soil fertility issue.

In a pilot phase, the main changes to be operated are the following:

¹⁷ FAO, 2015. Agroecology for food security and nutrition - proceedings of the FAO international Symposium, 18-19 Septembre 2014, Rome, Italy, 2015.

¹⁸ Approches agroécologiques et autres approches novatrices pour une agriculture et des systèmes alimentaires durables propres à améliorer la sécurité alimentaire et la nutrition. Rapport du Groupe d'experts de haut niveau sur la sécurité alimentaire et la nutrition du Comité de la sécurité alimentaire mondiale, Rome. Rapport 14. 191 p.

¹⁹ Incremental changes: Level 1: Increase the efficiency of industrial and conventional practices in order to reduce the use and consumption of costly, scarce, or environmentally damaging inputs. Level 2: Substitute alternative practices for industrial/conventional inputs and practices. Transformational changes: Level 3. Redesign the agroecosystem so that it functions on the basis of a new set of ecological processes. Level 4. Re-establish a more direct connection between those who grow our food and those who consume it. Level 5. On the foundation created by the sustainable farm-scale agroecosystems achieved at Level 3, and the new relationships of sustainability of Level 4, build a new global food system, based on equity, participation, democracy, and justice, that is not only sustainable but helps restore and protects earth's life support systems upon which we all depend.

• Set-up an action-research group of pioneer farmers: Farmers in Stung Chinit will not all change their practices only because of extension messages. The experience shows (as seen in the diagnostic report) that the role of innovating farmers who makes the actual demonstration of possible (and profitable) alternative is the most efficient factor of change. To set up a group of farmers willing to innovate and to act as pioneers is essential. Experiences show that promoting more agroecological practices requires a drastic change in extension/advisory approach. Indeed one of the 13 principles of agroecology (FAO/HLPE) is the co-creation of knowledge²⁰. The pilot phase shall therefore test new advisory approaches and mechanisms (through farmers' groups, farmers' organisations, input suppliers...).

UNLOCK ENABLING FACTORS Adapt water Adequate input supply Adequate management plan offer for alternative mechanisation in Dry Season in models (seeds, etc.) services pilot blocs Technical support, promotion & training 11 on alternative Up-scale adequate service offer П methods (e.g. cover Set action-research farmer П crops, with support by TECHNICAL SUPPORT groups: participatory testing of a CASC) П variety of different cropping П Extension: share practices and models and technical-economical Capacity building and analysis of long term economic П analysis of results support on economic results П analysis П References (evidence based) + I Progressively aggregate more Market linkage farmers ownership П support for alternative farmers / more blocs DS crops П PILOT PHASE (PIONEERS) Beyond local level: A policy / regulatory Awareness raising on sustainability issues (soil fertility, health, environment)... framework more conducive to take environmental stakes **UP-SCALING PHASE (EXTENSION)** would be desirable

Figure 7: A summarized vision of pathway toward changes of cropping practices

• Identify irrigation blocs favourable to pilot new options (in dry season): as indicated, it is not possible to conciliate, in one irrigation bloc, the cropping of dry season rice with another crop requiring less water (no flood), such as cover crops or other dry season crop. Hence it is necessary to identify and select pilot blocs to undertake an action-research process on alternative to dry season rice. Different criteria can be considered in the selection process: a possibility would be to give a priority to blocs where water supply in dry season is actually

²⁰ Co-creation of knowledge. Enhance co-creation and horizontal sharing of knowledge including local and scientific innovation, especially through farmer-to-farmer exchange. (source: FAO/HLPE)

too limited to allow dry season rice²¹. With an objective to improve soil fertility in the long term, selecting blocs where a majority of the land is used by the owners themselves (and not rented out to a third farmer). And last of course selecting blocs where a majority of farmers are showing interest to experiment the alternative models proposed.

- Provide technical support: Technical support has to be provided to farmers / farmer
 action-research groups to propose adapted technical options, and also to provide services
 (for instance specific mechanisation, as needed) and inputs in the initial stages (i.e. before
 private service providers and input suppliers can see the potential and start to take over).
- Build technical-economic analysis capacities: Currently, services to farmers (including extension services) are mainly considering technical indicators of performances (yields) rather than economic indicators (profits, integrating their long term-viability). It is essential to change the paradigm here a consider economic criteria (including, as much as possible, not only the annual profitability but the long term economic impact, valuing in the analysis the increase or decrease of soil fertility, that shall be considered as a variation of capital). Develop a capacity of economic advisory services to farmers, and build farmers' capacities to assess their economic performances and results is essential here, as it is not anticipated that the possible innovations would bring higher yields, but they may increase the overall profitability of the farming systems. In addition to that, improving technical-economic analysis capacities of farmers should help reducing input consumption (more efficient input consumption based on optimum use rather than maximum use). Technical-economic advisory services will require financial support (from a project, from government later on?²²) as they are not likely to be fully financed by users in the short / medium term.
- Raise awareness on negative collateral impacts of intensive conventional rice cropping models (on soil fertility, on health, on natural resources...).
- Support market linkage: For the case of new dry season crops that could be introduced, access to market was identified as a bottleneck by the participants in the consultation workshop and focus group. A support to create the link with potential buyers could be needed.

Then, to progressively scale up, it will be needed to:

 Help successful pioneer farmers to become models: the role and impacts of pioneer farmers / innovators to initiate larger-scale change in practices is essential, as the recent history of farming practices in Stung Chinit scheme has proved. Innovating farmers can be helped to more efficiently undertake this role as models, by giving them more visibility,

²¹ This could have the side benefit of providing a service to these blocs with a more limited access to water in dry season, and to balance what they see today as a lower level of service they get from the FWUC.

²² The business model (financing mechanism, level of subsidies...) and the institutional model -who caries it) of such service would have to be studied.

supporting their communication skills, and possibly incentivise them to efficiently play this role.

- Integrate the discussion of water management option for different cropping models in the negotiation of water management plans.
- Encourage private sector to take over required services: Once a critical mass is reached, it can be possible to pull private sector actors to take over the services of input supplies and mechanisation services. Given the observed dynamism of private suppliers, this shall be possible if a sufficient scale is reached. Possibly with some support needed for services requiring more investment such as specific mechanisation needs.
- Reforming extension/advisory approaches: Given the fact that transition towards more sustainable food systems requires changing extension/advisory approach, the pilot phase should help establishing new advisory approaches and mechanisms consistent with the cocreation of knowledge principle. The scale-up phase shall draw lessons from the pilot so that in future extension/advisory services are not solely given by input suppliers with vested interests.
- Identify further changes towards more sustainable food systems (transformational changes) and assess their feasibility. The pilot phase will test two incremental changes (more efficient use of inputs / reducing inputs and alternative dry season crop) but other transformational and long term changes are necessary.

d. Hypothesis and risks

An important hypothesis is that, in a mid-term perspective, alternative practices that could be promoted (in dry season in particular) would become more profitable for farmers than growing dry season rice in a context of declining fertility. This depends a lot on external factors, in particular on the price of paddy, and on the prices of fertilizers. A hypothesis (highly probable) is that price of fertilizers is on an increasing trend. Trends on rice price are more uncertain (FAO's all rice prices index has been decreasing during year 2021, – See ANNEX 4: FAO's all rice price index recent trends – but there's no evidence this trend would continue).

Regarding the model of non-tillage cover-crop, a possible obstacle identified is the insufficient number of technically competent human resources that would be able to provide advices and accompany farmers in the change of practices. Service providers such as CASC need to be scaled up to be able to address the needs throughout the country. Furthermore, a change in extension/advisory approach is necessary: we need to move away from the simple transfer of technology approach to an approach of joint knowledge management.

Last, an important element in the setting proposed is the technical-economic advisory service. Competence in economic analysis is missing in MAFF current extension services, and the hypothesis is made that adequate service providers could be mobilise to play this role (and possibly build local capacities to carry over).

3.2.2. Operational modalities for achieving more sustainable and more profitable cropping practices in Stung Chinit irrigation scheme

a. Stakeholders and distribution of roles and responsibilities in service offer

The Table 9 (next page) identifies the groups, stakeholders or institutions which would have a role to play for the desired changes to occur.

Table 9: Stakeholders roles and responsibilities in the promotion of more sustainable cropping practices

STAKEHOLDERS	ROLES AND RESPONSIBILITIES
Group of innovative farmers	 Set up action-research group. Test innovations, document and share results (technical and economic); Contribute to disseminate results to other farmers (extension). Contribute to the reform of extension/advisory approaches and mechanisms
CASC or other specialized technical services (notably on Conservation Agriculture Model)	 Present technical innovative options; Provide on-the-ground guidance and advisory services to farmers; In a transitory period, help to procure special mechanization services required and inputs.
PDAFF or DOANRE	 Raise awareness of farmers on impact of conventional rice intensification on soil fertility, natural resources and health; Take part in facilitation of groups of innovative farmers and documentation of results; Take part in the implementation of extension at scaling up stage; Support the reform of extension/advisory approaches and mechanisms towards more co-creation of knowledge and valorisation of farmers' know-how; Contribute in encouraging engagement of private sector (service providers, input suppliers, and buyers of agricultural products for new commercial productions, if any).
FWUC	 Contribute to identify suitable irrigation blocs to implement pilots (taking into account criteria of access to water in DS, practice or not of DS rice, land use by land owners, etc.; Integrate the possibility of alternative to rice crop in dry season and other cropping option in the consultation and development of water management plans.
Farmers' organisations (FWN, FWUC, others?)	Contribute to the reform of extension/advisory approaches and mechanisms
A service provider to identify (could be a project, an NGO or local service company)	 Build capacities in economic analysis (farm management, economic comparisons of technical models, assessment of profitability); and support financially the costs of technical-economic advisory services; Accompany the action-research groups in economic analysis of results; Train extension services to be able to progressively integrate economic analysis.
	Help to develop market connection for new crops introduced in dry season.
Input suppliers	 Integrate additional inputs required in their offer (e.g. cover crop seeds); Better inform farmers on health and environmental hazards related to pesticide use.
Mechanisation service providers	When sufficient scale is reached, consider investing in special mechanisation equipment needed (notably for cover-crops + no-tillage model).

These main stakeholders are:

- Innovative farmers, gathered in action-research group(s)
- The Conservation Agriculture Service Center (CASC) or other specialized technical services (notably on Conservation Agriculture Model)
- PDAFF and/or DOANRE
- FWUC and possibly other farmers' organisations (such as FWN for instance)
- Input suppliers
- Mechanisation service providers

A need is also identified for a service provider to contribute to provide economic / managerial advices and to build capacities of local stakeholders on economic analysis. This service provider is not identified yet.

b. Tentative operational roadmap

The focus group meeting of 27th of January 2022 has started to identified a first set of operational steps to undertake in order to implement the process. It is described in the following Table 10 (after some adjustments / improvement made by the study team to improve clarity and coherence).

It still has to be considered as a very preliminary roadmap and it of course does not constitute in any way an engagement for the stakeholders listed here, but rather a basis of discussion to further envisage actual implementation.

Table 10: Preliminary operational steps for the promotion of more sustainable cropping practices

ACTIONS	WHERE?	WHEN?	WHO IS RESPONSIBLE	WHO SUPPORTS
Raise awareness of farmers on impact of conventional rice intensification on soil fertility, natural resources and health	Stung Chinit scheme area	From 2022	DOANRE	FWUC, PDAFF
Identification of suitable target area for pilot implementation (suitable irrigation blocs)	To be identifiedBut potentially:	Before Dry season 2022-23	FWUC committee and village representative.	Local authorities
Provide information to rice field owners (technique on cover crop plantation, production cycle, benefits, costs, benefits from the application of technique, rice yield)	commation to rice field chnique on cover crop production cycle, osts, benefits from the chnique on cover crop production cycle, osts, benefits from the chnique of the control of the cont		District agriculture staff, FWUC committee, village representative	Center for Conservation Agriculture Services
Present technical innovative options.		Before Dry season 2022-23	CASC or other specialized technical services (notably on Conservation Agriculture Model)	PDAFF or DOANRE
Provide on-the-ground guidance and advisory services to farmers		Starting from Dry season 2022-23	To be defined (CASC?)	PDAFF or DOANRE
Implementation and technical follow-up and monitoring		Starting from Dry season 2022-23	Farmer action- research group, with DOANRE's agriculture staff.	CASC, PDAFF, WAT4CAM Project. (?)

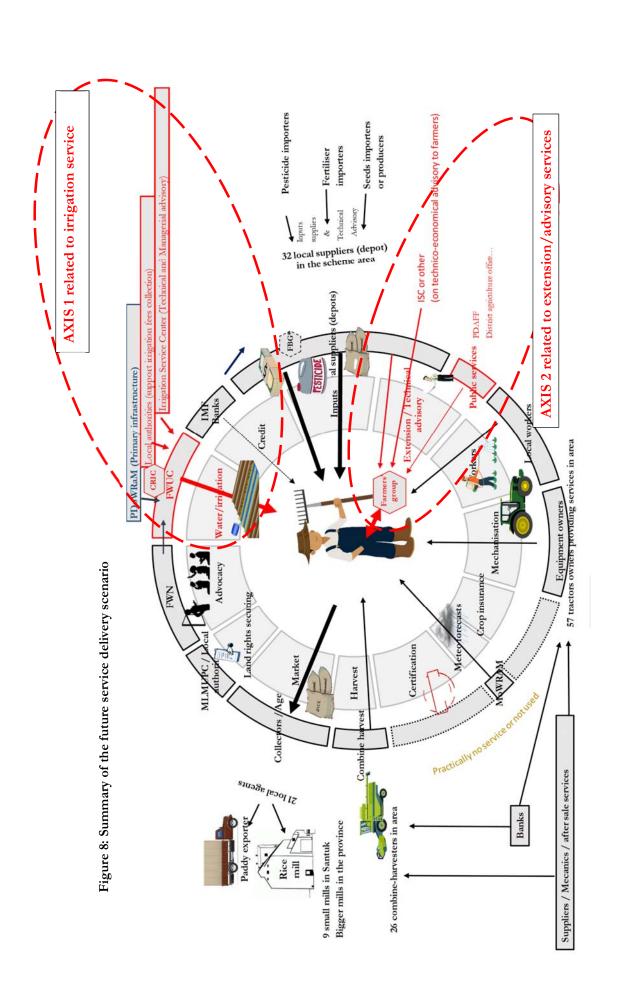
Continued from previous page

Material services and inputs supplies at the initial (pilot stage) (adequate mechanisation needed, seeds and other inputs, fences)	Selected area(s) for pilot implementation	Starting from Dry season 2022-23	Support project (WAT4CAM)? and/or CASC?	PDAFF or DOANRE
Technical and economical assessment		End of Dry season 2022-23	A service provider to identify	PDAFF or DOANRE
Extension / promotion of the innovation and scaling up	Progressively in new blocs within the scheme	Before Dry season 2023-24 and followings	DOANRE and farmer action research group	FWUC, PDAFF, CASC
Material services and inputs supplies at the scaling up stage (adequate mechanisation needed, seeds and other inputs, fences)		From dry season 2023-24	Local input suppliers; Local mechanisation services providers (Possibly purchase of inputs in groups).	DOANRE. Possible support from ASSET / WAT4CAM? CASC.
Continue technical and economical assessment and extension		From end of Dry season 2022-23	DOANRE / PDAFF	A service provider to identify
Identify potential production and market linkage for alternative crops in dry seasons	At provincial level or beyond	Before Dry season 2023-24 and followings	DOANRE / PDAFF	WAT4CAM? Other?

3.3. Summary of the future service delivery scenario

The figure next page summarises the vision of service delivery. The main changes are marked in red and are:

- As regard axis 1 Irrigation services management (O&M): Local authorities are remobilized, the CRIC is fully functional and the contract with ISC is resumed. Together this will reinforce the FWUC and improve and secure O&M service.
- As regard axis 2 Promotion of more sustainable cropping practices: Farmers' groups are
 established for both technical and technico-economical extension/advisory to ensure cocreation of knowledge. Public services are remobilised, mostly to regulate extension/advisory
 services and ensure a balance service (avoid over consumption of chemical due to vested
 interest of input suppliers). The ISC jointly with the FWUC (or other stakeholders) develop
 a technico-economical service for farmers and farmers' group.



4. Conclusions

4.1. Next necessary first steps to implement the road map

The present study has been commissioned by the COSTEA and supported by the MOWRAM and the MAFF, yet it was not initiated by decision makers in Cambodia. Despite the fact that the diagnosis has been validated by stakeholders in Cambodia and that the visions supporting the operational plan have been elaborated to a large extent with the stakeholders, there is no guarantee at all that findings and recommendations will be actually supported and implemented.

Hence some steps are necessary in the short term to ensure that the study is used. These steps are outside the scope of this study and of the mandate of the consortium Iram - Arte-Fact - Biche:

- Political dialogue between MOWRAM, MAFF, COSTEA and AFD to identify means to implement such operational plan, or part of it;
- Having identified means, conduct feasibility studies to fine tune the operational plan (including confirmation of orientations with stakeholders and definition of the sharing of responsibilities) before starting implementation.

4.2. Critical analysis and limits of the methodology used

The approach at the diagnostic stage has combined a territorial diagnostic, taking into account local context, value chain, farms typology and needs, with a mapping of existing services and their possible weakness or gaps. It has used different data collection methods to assess the suitability of services and the level of satisfaction of users. Moreover, the study team has added its analysis to identify and enhance stakes or specific matters that may not (or not yet) be perceived as issues by farmers.

Presenting, in a multi-stakeholder workshops, the outcomes and finding of the study seems to have contributed to renew the dialogue and questioning among stakeholders. It has provided an opportunity for the different institutions (FWUC, local authorities, relevant public services, etc.) to take a step back and analyse issues faced, and to consider solutions collectively.

It seems the process has generated interesting and useful interaction and has permitted to key players (FWUC, local authorities, public services) to find a common agreement on the analysis of issues, and in some cases to possible actions to take, whereas the study was implemented in a period of relative crisis between FWUC and local public institutions.

Yet a main limit was the time constraint, as such a process could have required more time and more iterations of dialogues to go further in the identification of solutions and planning of operational steps. This being said, the reactivation of the Chinit Reservoir Irrigation Committee (CRIC) shall allow to pursue a more institutionalize dialogue.

It also has to be noted that, because of Covid-19 and on restrictions on travels and / or meetings over the study period, the implementation of the assignment has been spread over a much longer period than initially planned. This has not been favourable to the quality of the process, as too much delays between the different steps has not contributed to create a momentum and maintain the focus of stakeholders along the process.

Last, more prospective analysis would be needed to consider the evolution of external factors that will continue to impact the irrigated agriculture practices in Stung Chinit scheme. Integrating climate change prospects and foreseen impact would notably be a dimension to consider, that was not included in the scope of the present study.

4.3. Critical analysis and limits of outcomes

Whereas the diagnostic phase has produced interesting material, it was still difficult to mobilise stakeholders to work on the production of an "operational framework" / roadmap for improvement of services while there is no initial commitment to implement such road map (no forthcoming project, no secured funding...). In particular, practically all the private service providers (input suppliers, mechanisation service providers, "agents" of combine harvester owner or paddy buyers...) did not attend the final consultation workshop and working group discussions, despite being invited.

Interesting orientations have been discussed and have retained the attention of participating stakeholders in the last workshop/focus group discussions. But the final outcome, as we see, is not yet fully operational and it would require additional work to be completed and fully operationalized.

The whole process was not backboned on an identified project, with actual budget resources secured to support the implementation afterward. This has been a major constraint to mobilise stakeholders (and not a very comfortable for the study team either) as it was clearly seen that the orientations proposed at the end of the process would have every chance of not being acted upon.

The active participation of some of the member of WAT4CAM technical assistance team in the restitution and consultation workshop of 14th January has been helpful to give a little bit of perspective of support toward implementation, yet with no guarantee of what will be possible or not.

Lastly the main recommendations also imply some significant strategic changes in the rice sector:

- It questions the production model based on the green revolution which is clearly not sustainable;
- It questions the domination of the private sector in the service delivery and the too limited role of farmers' organisations and public services;
- It questions the financing mechanisms and suggests that certain services be subsidised (by levies on the value chain?).

4.4. How "services to irrigating farmers" has been relevant as the entry point of the study for Stung Chinit case

The case of Stung Chinit irrigation scheme is well confirming the importance – beyond the service of water supply and operation & maintenance of irrigation infrastructures – of additional services to farmers to fully unlock the potential of the irrigation scheme. This was an assumption at the origin of this subject of research within COSTEA project. The history of Stung Chinit scheme retrospectively, illustrates particularly well the needs for services such as mechanisation, input supplies, market connection, innovation, etc.

On the other hand, it was found that a lot of services were already deployed and well adapted to farmers' demand, thanks to a dynamic private sector. The level of satisfaction of farmers regarding services offered was generally very high, and maybe this has not made easy the last part of the study process, focusing on further improvements... The absence of expressed expectations from farmers regarding non-commercial services, such as advocacy or publics services, was also not favourable to the emergence of proposals on these aspects.

5. ANNEXES

5.1. ANNEX 1: Agenda of the consultation workshop (14/01)

Date: 14 January 2022 / **Venue:** Stung Chinit FWUC office (Kampong Thma, Santuk district, Kampong Thom province)

TIME	ACTIVITIES / CONTENT	SPEAKER
08h15 – 08h30	Participant welcoming and registration	
08h30 - 08h35	Welcoming remarks by the host of the meeting	Mrs Rom Saroeun FWUC Stung Chinit
08h35 – 08h50	Introduction of the workshop: recall / presentation of the study and of the workshop objectives	Study team: Jean-Marie Brun and Min Sophoan
08h50 - 09h00	Importance and interest of the workshop and further plans for Stung Chinit irrigation scheme by MoWRaM representative.	(will be proposed to H.E. Chhea Bunrith)
09h00 – 10h00	Presentation of diagnostic outcomes: Presentation of the territorial analysis, typology, service mapping and identified issues for improvements, sustainability	Study team: Jean-Marie Brun and Min Sophoan
10h00 – 10h15	Coffee break	
10h15 – 11h45	<u>Discussion of diagnostic outcomes:</u> Discuss on the main problematic points (+ update) of the assessment and on the priority issues to address for improvement.	
11h45 – 13h15	Lunch break	
13h15 – 14h30	Focus Topic 1: Long term viability of the irrigation management: identified risks and needs to review the modalities of service organisation, stakeholders' roles and responsibility, etc. What is at stake? What are the weak points? Preliminary proposal or ideas to consolidate the service provision (to be further developed in dedicated focus group).	Facilitated by Study team: Jean-Marie Brun and Min Sophoan,
14h30 – 15h45	Focus Topic 2: Advisory to farmer, technical-economical models and better use of inputs for sustainability and natural resources preservation: - current situation and identified risks and stakes; - perception of farmers; - how to improve cost efficiency of input uses - how to reduce collateral impacts on soils, biodiversity, environment Preliminary proposal or ideas to optimise input use and move toward more sustainable practices (to be further developed in dedicated focus group).	Facilitated by Study team: Jean-Marie Brun and Min Sophoan
15h45 – 16h00	Summary of outcomes. Need for a second workshop? On which topic(s)? Other persons and institutions to associate in further reflection? Decide on the date. Closing.	Facilitated by Study team: Jean-Marie Brun and Min Sophoan

Working language: Khmer

5.2. ANNEX 2: Attendance list of the consultation workshop

NO	NAME	POSITION	INSTITUTION	
1	Jean-Marie BRUN	Consultant for COSTEA study	Arte-Fact Development & Agri-Food Consulting Co., Ltd.	
2	Sophoan MIN	Consultant for COSTEA study	Arte-Fact Development & Agri-Food Consulting Co., Ltd.	
3	Teng Bora	Chief of community Development Office	MoWRAM	
4	Chhang Seanglay	Officer	MoWRAM	
5	Chan Hok	Vice-Chief	DoANRE of Santuk District	
6	Cloth Theara	Field Supporter KPT	WAT4CAM	
7	Ban Sokhom	Vice-Chief	DoANRE of Santuk District	
8	Seng Sopheak	Director	ISC	
9	Neang Leng	Marketing on agriculture product	ISC	
10	Duong Sokkhim	Planning and marketing	ISC	
11	Aek Sam Sarin	Commune Council	Kampong Thmar Commune	
12	Kann Salorn	Vice-Chief	PDAFF Kampong Thom	
13	Aek Dy	Village Chief	Snor village	
14	Lach Neng	Commune Council	Prasat Commune	
15	Khoeum Koeurn	Treasuror	FWUC Stung Chinit	
16	So Hong	2 nd Vice-President	FWUC Stung Chinit	
17	Veng Voeurn	FWUC Village representative	Khmaek Village	
18	Rom Saroeun	President	FWUC Stung Chinit	
19	Nuon Boravoan	Vice-Chief	PDoWRaM Kampong Thom	
20	Muong Sideth	Head of Unit	AFD	
21	Im Sothy	ABS	WAT4CAM / TA AGRI	
22	Ly Kalyan	FWUC Expert	WAT4CAM / TA ISWM	

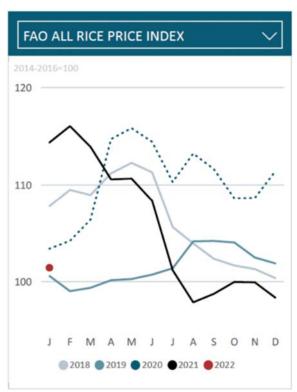
It was expected to have 25 to 30 participants in the workshops, but some invited people did not attend. In particular, there were less farmer representatives and the invited private sector service providers (input suppliers, combine harvester service agent, tractor owner...) did not come.

5.3. ANNEX 3: Attendance list of the focus group discussion

NAME	POSITION	INSTITUTION	
Ith Chanly	1 st Vice-President	FWUC Stung Chinit	
So Hong	2 nd Vice-President	FWUC Steung Chinit	
Um Im	Advance Farmers applyied CA	Khvaek Villge	
Chan Hok	Vice-Chief	DoANRE of Santuk District	
Duong Sokkhim	Planning and marketing	ISC	
Soeung Monyroat	Facilitator	FWN	
Seng Sopheak	Director	ISC	
Neang Leng	Marketing on agriculture product	ISC	
Rom Saroeun	President	FWUC Stung Chinit	
Sophoan MIN	Consultant for COSTEA study	Arte-Fact Development & Agri-Food Consulting Co. ,Ltd.	
Sok Socheat	Executive Secretary	FWN	
Jean-Marie BRUN	Consultant for COSTEA study	Arte-Fact Development & Agri-Food Consulting Co. ,Ltd.	
	Ith Chanly So Hong Um Im Chan Hok Duong Sokkhim Soeung Monyroat Seng Sopheak Neang Leng Rom Saroeun Sophoan MIN Sok Socheat	Ith Chanly 1st Vice-President 2nd Vice-President Um Im Advance Farmers applyied CA Chan Hok Vice-Chief Duong Sokkhim Planning and marketing Soeung Monyroat Seng Sopheak Director Neang Leng Marketing on agriculture product Rom Saroeun President Sophoan MIN Consultant for COSTEA study Sok Socheat Executive Secretary Jean-Marie BRUN Cnisultant for COSTEA	

It was expected to have more participants in this final focus group discussion to fine tune the operational plans with local stakeholders. But some invited people did not attend. In particular, again, invited private sector service providers (input suppliers, combine harvester service agent, tractor owner...) did not come.

5.4. ANNEX 4: FAO's all rice price index recent trends



Source: FAO Rice market monitor, "Rice Price Updatde", February 2022.

5.5. ANNEXE 5: Evaluation of rice production on Stung Chinit according to the 13 principles of agroecology

13 principles	Definition	Level of implementation of this principle in Stung Chinit		
of agroecology				
Recycling.	Preferentially use local renewable resources and close as far as	Low. Production system highly dependant on chemical		
	possible resource cycles of nutrients and biomass.	inputs		
Input	Reduce or eliminate dependency on purchased inputs.	Low. Production system highly dependant on chemical		
reduction.		inputs and their use increases		
	Secure and enhance soil health and functioning for improved plant	Low and declining. Degradatino of soil fertility becomes an		
Soil health.	growth, particularly by managing organic matter and by enhancing	issue, yet not well perceived by all farmers		
	soil biological activity.			
Animal health.	Ensure animal health and welfare.	Very limited hunsbandry , hence not an issue		
	Maintain and enhance diversity of species, functional diversity and	Very low and declining. Rice fields highly dominant and		
Biodiversity.	genetic resources and maintain biodiversity in the agroecosystem	negative impacts appear down stream		
	over time and space at field, farm and landscape scales.			
	Enhance positive ecological interaction, synergy, integration, and	Low. Rice fields highly dominant		
Synergy.	complementarity amongst the elements of agroecosystems (plants,			
	animals, trees, soil, water).			
Faanamia	Diversify on-farm incomes by ensuring small-scale farmers have	Low and declining. Farms are increasingly specialized on		
Economic	greater financial independence and value addition opportunities	paddy production		
diversification.	while enabling them to respond to demand from consumers.			
Co exection of	Enhance co-creation and horizontal sharing of knowledge including	?		
Co-creation of	local and scientific innovation, especially through farmer-to-farmer			
knowledge.	exchange.			

Social values and diets.	Build food systems based on the culture, identity, tradition, social and gender equity of local communities that provide healthy, diversified, seasonally and culturally appropriate diets.	Acceptable. Rice is indeed the base of the local diet.
Fairness.	Support dignified and robust livelihoods for all actors engaged in food systems, especially small-scale food producers, based on fair trade, fair employment and fair treatment of intellectual property rights.	Acceptable. Yet farm workers are at risk.
Connectivity.	Ensure proximity and confidence between producers and consumers through promotion of fair and short distribution networks and by reembedding food systems into local economies.	Acceptable. Producers are highly connected to the market, yet not directly to consumers.
Land and natural resource governance.	Recognize and support the needs and interests of family farmers, smallholders and peasant food producers as sustainable managers and guardians of natural and genetic resources.	Acceptable but at risk. Farmers have hard title deeds but renting is rising and very small-scale farms (class 1) are at risk.
Participation.	Encourage social organization and greater participation in decision-making by food producers and consumers to support decentralized governance and local adaptive management of agricultural and food systems.	?

5.6. ANNEX 6: Report of FWUC expenditures in Year 2019 and Year 2020

	2019		2020	
	Total Riel	%	Total Riel	%
Total expenses	135,896,300	100%	170,818,800	100%
Overal management at FWUC	39,197,800	29%	40,750,000	24%
Representative allowance expenses and staff salaries	17,632,800		23,640,000	
Salary and travel expenses of FWUC' staff	15,565,000		11,110,000	
Services	6,000,000		6,000,000	
Irrigation and water distribution process	17,597,000	13%	17,932,400	10%
Representative allowance expenses and staff salaries	12,247,000		11,932,400	
Salary and travel expenses of FWUC' staff	5,350,000		6,000,000	
Annual maintenance costs	42,160,000	31%	99,388,000	58%
Representative allowance expenses	20,000		-	
Salary and travel expenses of FWUC' staff	6,000,000		6,000,000	
Short service contract, labor, materials for repair and maintenance	36,140,000		93,388,000	
	2,808,000	2%	1,079,800	1%
Representative allowance expenses and staff salaries	1,934,000		170,000	
Salary and travel expenses of FWUC' staff	-		-	
Local authority allowance	874,000		909,800	
Services	-		-	
Collection of contributions fee, allowances, authorities	19,485,400	14%	5,776,300	3%
Local authority allowance	14,817,800		2,567,900	
Services	4,667,600		3,208,400	
Regular office expenses	4,878,200	4%	5,402,300	3%
Gasoline/electricity	198,500		530,700	
Administrative Expenses - Office Supplies - Water, Snacks	4,679,700		3,951,600	
Office maintenance	-		920,000	
Special expenses (elections)	9,769,900	7%	490,000	0%