

“Research on the effective scaling of soil
and water conservation technologies
under different agroecosystems in North
and Central West Tunisia”
(SWC@Scale)

Technical Progress Report

From 1 July to 31 December 2021

Compiled by: Aymen Frija, Udo Rudiger, Zied Idoudi, Oussama Jebali,
Hassen Ouerghemmi, Boubaker Dhehibi, Haithem Bahri; Hatem
Cheikh M’Hamed; Mourad Rekik, Mounir Louhaichi.

Contents

Project framework and objectives.....	5
Progress on activities.	5
1.1. Installation and monitoring of experimental plots for the SWCT to be tested based on scientific protocols.....	8
1.1.1. Agronomic trials and parameters to be measured during the cropping season 2021-2022.	8
1.1.2. Overview of the research site 1: Kairouan, Oueslatia, Oued Elgsab.....	9
1.1.3. Overview of the research site 2: Siliana; Rhahla, Gaafour.....	13
1.2. Analysis and reporting of measurement results: Agronomic, environmental, and economic parameters.....	15
2.1. Activity 2.3 - Stakeholder and farming systems analysis in the project sites	19
2.1.1. Communities and system characterization.....	19
2.1.2. Stakeholders and social networks analysis.....	23
2.2. Activity 2.4 Establishment of agronomic trials, and demonstration plots of SWCT for the 2021-22 cropping season in both target sites	24
3.1. Activity 3.1.2 Development of Lite version of the scaling scan tool.....	28
3.2. Activity 3.1.3 Identification of scaling activities (strategy) using scaling scan per SWCT	28
3.3. Activity 3.1.4 Co-implementation of the identified scaling activities for all SWCT	29
3.4. Activity 3.2.2 - Create and support knowledge hubs and innovation platforms (IP) around SWCT	32
3.5. Activity 3.2.3 Develop e-learning modules on SWCT and initiate learning sessions	32
3.6. Activity 3.2.4 Develop and send technical SMS messages on SWCT	33
3.7. Additional knowledge products	33
3.7.1. Technical Sheets & Posters	33
3.7.2. Online Communication: Blogs, Videos, Institutional Social Media Posts	33
3.7.3. Development, Use, and training on the use of Open Data Kits for data collection.....	34
3.7.4. Foster Networking, Capacity Building, and Training for Key Actors on the Implementation of Sustainable SWC Practices and Technologies.....	34
.....	66
List of references.....	69

List of Tables

Table 1. Progress of project activities by December 2021.	6
Table 2. Main characteristics of the identified farming systems in El Khol, Kairouan.....	19
Table 3. Main characteristics of the identified farm types in Rhahla, Siliana.....	21
Table 4. Farmer's Perception on the SWC Techniques in Siliana, El Rhahla	22
Table 5. Farm's preferences for different SWC Techniques	22

Table 6. Results of Social Network Analysis (SNA) indicators in El Khol site, Kairouan	23
Table 7. Demonstration plots implemented in both sites for training and field days purposes.	25
Table 8. Plots for seeds multiplication of forage crops.	25
Table 9. Additional (experimental and demonstration) plots established in Oueslatia, Oued El Gssab (Rainfed). Kairouan Experimental Site	26
Table 10. SWC practices implemented in the different demonstration plots of the project.	26
Table 11. Scaling scan results for the “minimum tillage” technology in Rhahla, Siliana	28
Table 12. Scaling scan results for the "forage mixtures" practice in El Khol, Kairouan.	28
Table 13. Summary of main Capacity Development (CapDev) events and the number of respective beneficiaries during the last six months of 2021	37
Table 14. Benefit-Cost Analysis of Technologies using Partial Budget Analysis	40

List of photos

Photo 1. Installation of the Wischmeier protocol for soil erosion measurement in Siliana and Kairouan sites.....	7
Photo 2. Installation of the Wischmeier protocol for soil erosion measurement in Kairouan (Oued Elgsab).	12
Photo 3. Pedological profile in the experimental plot of Kairouan, Oued Elgsab – Oueslatia Region .	12
Photo 4. Installation of the Wischmeier protocol (and soil pedology profile) for soil erosion measurement in a cereal plot in Rhahla site, Siliana	14
Photo 5. Scientific meeting to discuss and validate the protocols implemented in both sites with INRAT, INGREF, and DGAFTA project members.	15
Photo 6. Sowing of durum wheat in the experimental plot using conventional and no till seeders ...	16
Photo 7. Sowing of forage mixtures between the row of olive trees in no-tillage plot using no-till seeder	16
Photo 8. Sowing of forage mixtures in pure stand in no-tillage plot using no-till seeder	17
Photo 9. Landscape in Kairouan, El Khol, Hajeb Layoun scaling site.	18
Photo 10. Working group implementing scaling scan tool in a project workshop, Hammamet, 1st December 2021.....	27
Photo 11. Public invitation to participate in the election of the executive board members of SMSA “Ankoud El Kaier” published on 06 January 2022 in two Tunisian newspapers (Al Chourouk, left – Le Quotidien, right).....	30
Photo 12. The launch of field activities in Rhahla, Siliana.	31
Photo 13. Building community leadership through farmers trainings	32
Photo 14. Photo Overview of some CapDev events under SWC@Scale Project during the last six months of 2021	35
Photo 15. Overview of the scaling scan meeting of the project, Hammamet, 1st December 2021. ...	66

List of Annexes

Annex 1. Sheets for data collection and calculation of partial budget analysis for the experimental and demonstration plots.	40
Annex 2. Survey used for communities and systems characterization in both scaling sites.....	41
Annex 3. Survey used for collecting data used in the "Social Network Analysis".	47
Annex 4. Communities and farm characteristics in El Khol site, Kairouan (source: own analysis based on primary data analysis).....	49
Annex 5. Communities and farm characteristics in Rhahla site, Siliana (source: own analysis based on primary data analysis).....	53

Annex 6. Results of the scaling scan exercise undertaken for the promoted technologies in both project sites, Kairouan and Siliana.....	62
Annex 7. Follow up sheets for the experimental and demonstration plots.	67

Project framework and objectives

The objective of this project agreement is to inform the development ProSol project (led by DGAFTA – Tunisian Ministry of Agriculture, Hydraulic Resources and Fisheries) on the best scaling pathways for enhanced Soil and Water Conservation practices (SWCT) through a set of research and “research for scaling” activities. The project is expected to mainstream existing conceptual and practical knowledge to support the effective implementation of the ProSol program and provide additional guidance to ACTA 2050 strategy. Specific objectives include: i) generating scientific measures and evidence on the benefits of selected SWCT; ii) co-developing and designing a practical and comprehensive scaling approach of SWCT that can fit in the PADIT structure; iii) implementing the scaling approach in the priority areas defined by the DGAFTA for a selection of SWCTs promoted by the ProSol program; iv) developing an impact assessment framework compatible with the type of SWCT being implemented; and finally v) Capacity development.

The project combines research, research for scaling, monitoring and evaluation, and capacity development interventions into four components with a set of specific activities developed under each of them (figure 1).

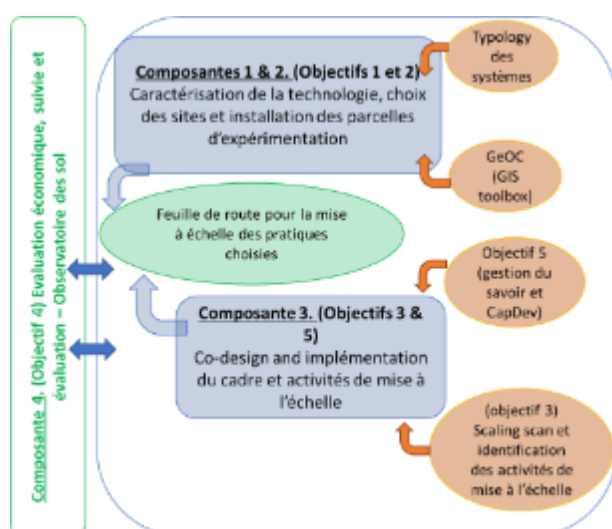


Figure 1. Conceptual framework: project components and aligned objectives.

Overall, this project is expected to select two locations corresponding to two major production systems of Tunisia (cereal-based and olive-based systems), where different research and scaling activities will be conducted. The following tasks are expected to be undertaken in each site:

- experimental plots will be installed to generate evidence about the potential biophysical and economic benefits of specific SWCT appropriate to the considered systems;
- participatory diagnosis of communities and farm systems with focus on farmers preferences and perceptions of the promoted SWCT;
- implementation of capacity development and other knowledge management activities as it will be identified in the scaling road maps of each site,
- monitoring and evaluating the progress on scaling and social learning, technologies' adoption, feedback on the different scaling activities, etc.

These core activities are further supported by other complementary selection, partnership, and coordination tasks, which will be listed in the following progress sections.

Progress on activities.

The project team has achieved adequate progress on the different planned activities. The progress is summarized in table 1 and will be detailed in the different sections of this report.

Table 1. Progress of project activities by December 2021.

Obj.	Component	Activities	Progress (description)	
Objective 1	Component 1: Research activities and installation of experimental fields	Act 1.1. Installation and monitoring of experimental fields for the SWCT to be tested based on scientific protocols	Selection of plots completed	
		Act 1.2. Analysis and reporting of results of different measurement of environmental and economic parameters	Not started yet	
Objective 2	Component 2: Identification, selection, and characterization of SWCT for different agroecosystems	Act 2.1 Selection and description of SWCT	Finalized (strategic tillage for cereal-based systems, intercropping and water harvesting for olive-based systems)	
		Act 2.2 Selection of SWCT sites	Finalized (official nomination is finalized for Kairouan; official nomination for Siliana will be finalized in few days). – See previous report.	
		Act 2.3 Stakeholder analysis per SWCT	Protocols for stakeholders' analysis ready. Focus groups have been postponed due to COVID.	
		Act 2.4 Establish demonstration plots of SWCT on each site and organize field visits	Accomplished. Around 74 demonstration plots have been fully installed in both sites. More details can be found in this report	
Objective 3	Component 3: Co-design and implementation of scaling framework and activities for SWCT / 3.1 Scaling Framework	Act 3.1.1 Assessment of scalability / scaling vision of SWCTs	Established by ICARDA team. Discussed and approved by larger PROSOL groups. – see previous project report.	
		Act 3.1.2 Development of Lite version of the scaling scan tool	Done. Like problem tree protocol designed. Lite version of the scaling scan questionnaire identified.	
		Act 3.1.3 Identification of scaling activities using scaling scan per SWCT (participatory workshops)	Accomplished. The participative scaling diagnosis and respective scaling strategies for both sites have been accomplished by the project team. See details in this report.	
		Act 3.1.4 Co-implementation of the identified scaling activities for all SWCT	Partly initiated - Most of the activities are planned for the first 6 months of 2022	
		Act 3.1.5 Assessment of farmers (and other stakeholders) responsiveness to the implemented scaling activities	Not yet started	
Objective 5	Component 3: Co-design and implementation of scaling framework and activities for SWCT / 3.2 Knowledge management and capacity development	Act 3.2.1 Identification and capacity assessment of potential organizations to host each of the knowledge hubs	Done. A list of indicators has been identified and used to characterize the capacity of hosting communities/OPAs	
		Act 3.2.2 Create and support knowledge hubs and innovation platforms (IP) around SWCT	Ongoing.	
		Act 3.2.3 Develop e-learning modules on SWCT and initiate learning sessions	Discussions undertaken with INRAT and INRGREF. Themes identified. Actual development will start soon.	
		Act 3.2.4 Develop and send technical SMS messages on SWCT	Messages are ready, need to be refined and send once appropriate (next season).	
Objective 4	Component 4: Impact assessment, monitoring and evaluation	Act 4.1 Desk review and stakeholder virtual consultation on indicators	Not yet started	
		Act 4.2 Develop indicators and data collection mechanisms	Part of the socioeconomic indicators and current levels of degradation are defined. Others will be developed in parallel to the implementation	
		Act 4.3 Design of indicators' modular matrix and adoption plan for institutionalization	Partly ready (list of global indicators ready but need to be adapted to the PROSOL case studies)	
		Act 4.4 Indicators and matrix applied to pilot projects	Ongoing.	
		Act 4.5 Evaluating the scaling strategy per SWCT	Ongoing. Data collection tools and forms have been developed.	
		Act 4.6 Publishing of results and reporting	Not started yet	
		Act 4.7 Organize national workshop to share scaling results and give recommendation	Not started yet	
		Act 4.8 Final project reporting	Not started yet	

Green: completed and reported; Orange: started and is ongoing; Brown: didn't start yet (planned in 2022)

RESEARCH SECTION

Component 1 –Research activities and establishment of experimental fields

Act 1.1. Installation and monitoring of experimental fields for the SWCT to be tested based on scientific protocols

Act 1.2. Analysis and reporting of results of different measurement of environmental and economic parameters



Photo 1. Installation of the Wischmeier protocol for soil erosion measurement in Siliana and Kairouan sites

Two activities were planned under this first experimental component of the project. These are as follows:

- Act 1.1. Installation and monitoring of experimental protocols for the SWCT under testing
- Act 1.2. Analysis of different measurement of environmental and economic parameters and results reporting

1.1. Installation and monitoring of experimental plots for the SWCT to be tested based on scientific protocols

INRAT and INRGREF teams have been actively engaged under this activity. Field visits and sites' selection was accomplished by July 2021. At that time, the team collected initial data about the landscapes where the experimental plots have been installed and conducted a GIS analysis to identify suitable plots. The next section reminds the different agronomic and erosion trials and parameters to be measured under this activity. A following section will provide the characteristics of the selected plots, and their respective watersheds, and illustrates the progress made in terms of installation of these experimental plots in both regions.

1.1.1. Agronomic trials and parameters to be measured during the cropping season 2021-2022.

Protocols and characteristics of the agronomic trials implemented in the studied sites are as follows:

i. Trials in Kairouan, Oued Elgsab, Oueslatia

The objective of the trials is to test/assess different agronomic options in the olive trees system under rainfed condition in semi-arid regions for sustainable intensification of the agricultural production system based on olive trees. The agronomic options tested are promising and can enhance crop production, enhance land productivity by better valorizing the area under olive plantation, and at the same time contribute to improve soil fertility, reduce erosion, and increase WUE. In term of agronomic aspects, forage mixture (vetch*triticale) is considered as a good option that can enhance soil fertility and crop production. It is also an alternative for crop livestock integration by enhancing animal feeding. In addition, forage mixtures can potentially substitute oat crop (forage crop rationally cultivated by farmers in the study area). For the environmental aspects, especially concerning soil degradation due to water erosion, no-tillage and minimum tillage are considered as better alternatives to conventional tillage and have strong impact on reducing soil degradation and enhancing water use efficiency.

In this context, trials implemented are described below:

- Production system: Forage crops between the rows of olive trees
 - Land: sloppy land
- Twelve (12) treatments will be tested:
- Forage crop mixtures (vetch*triticale) under minimum tillage between the rows of olive trees
 - Forage crop mixtures (vetch*triticale) under no-tillage between the rows of olive trees
 - Forage crop mixtures (vetch*triticale) under conventional tillage between the rows of olive trees
 - Oat under minimum tillage between the rows of olive trees
 - Oat under no-tillage between the rows of olive trees
 - Oat under conventional tillage between the rows of olive trees
 - Forage crop mixtures (vetch*triticale) alone under minimum tillage
 - Forage crop mixtures (vetch*triticale) alone under no-tillage -
 - Forage crop mixtures (vetch*triticale) alone under conventional tillage
 - Oat alone under minimum tillage
 - Oat alone under no-tillage

- Oat alone under Conventional tillage
- Measurements to be undertaken: Initial soil characterization, yields component of crops, soil moisture during growing season, soil runoff during the growing season, above ground biomass of crops during growing season, LAI, NDVI, Chlorophyll index of cereal crops and WUE will be calculated.

ii. Trials in Siliana, Rhahla site

Soil degradation and water scarcity are the main challenges of the cereals production in the studied area. To sustain cereal production in the region, best agricultural practices that can allow limiting soil degradation and enhancing WUE would be needed. Crop rotation based on crop diversification and Conservation agriculture based on minimum soil disturbance and/or no-tillage are considered as promising options that can enhance crop production and at the same time preserves natural resources, especially soil and water (enhancing soil fertility, water erosion control and enhancing WUE). In term of agronomic aspects, forage mixtures (vetch*oat) is considered as good option for enhancing crop rotation, consequently enhancing cereals production, and enhancing animal feeding in term of quantity and quality. For the environmental aspects, it is known that conservation agriculture based on no-tillage and/or minimum tillage can be an alternative to conventional tillage and help reducing soil degradation and enhancing water use efficiency. In this context, trials were implemented in the Rhahla site in order to assess the effect of conservation agriculture based on no-tillage and/or minimum tillage on agronomic performances of durum wheat, water use efficiency of durum wheat and soil erosion. Trials are described below:

- Crop: Wheat and forage mixtures (vetch*triticale)
- Land: sloppy land
- Six (06) treatments will be tested:
 - Forage crop mixtures (vetch*oat) alone under minimum tillage
 - Forage crop mixtures (vetch*oat) alone under no-tillage
 - Forage crop mixtures (vetch*oat) alone under conventional tillage
 - Durum wheat alone under minimum tillage
 - Durum wheat alone under no-tillage
 - Durum wheat alone under conventional tillage
- Measurements to be undertaken: Initial soil characterization, yields component, soil moisture during growing season, soil runoff during the growing season, above ground biomass during growing season, LAI, NDVI, Chlorophyll index and WUE will be calculated.

1.1.2. Overview of the research site 1: Kairouan, Oueslatia, Oued Elgsab.

The first experimental plot has been installed in the region of Oueslatia, particularly in Oued Elgsab. The plot has been jointly selected by the project team (composed of INRAT, INRGREF, and ICARDA staff members) in addition to DG ACTA, national and local staff which are being involved in the PROSOL project. A google map screen shot of the plot is illustrated in Figure 2. Main soil characteristics of the watershed where this plot is installed in shown in Figure 3 while the topography map of the plot is shown in Figure 4.



Figure 2. Location of the olive experimental plot in Kairouan, Oued Elgsab. (Source – Google maps)

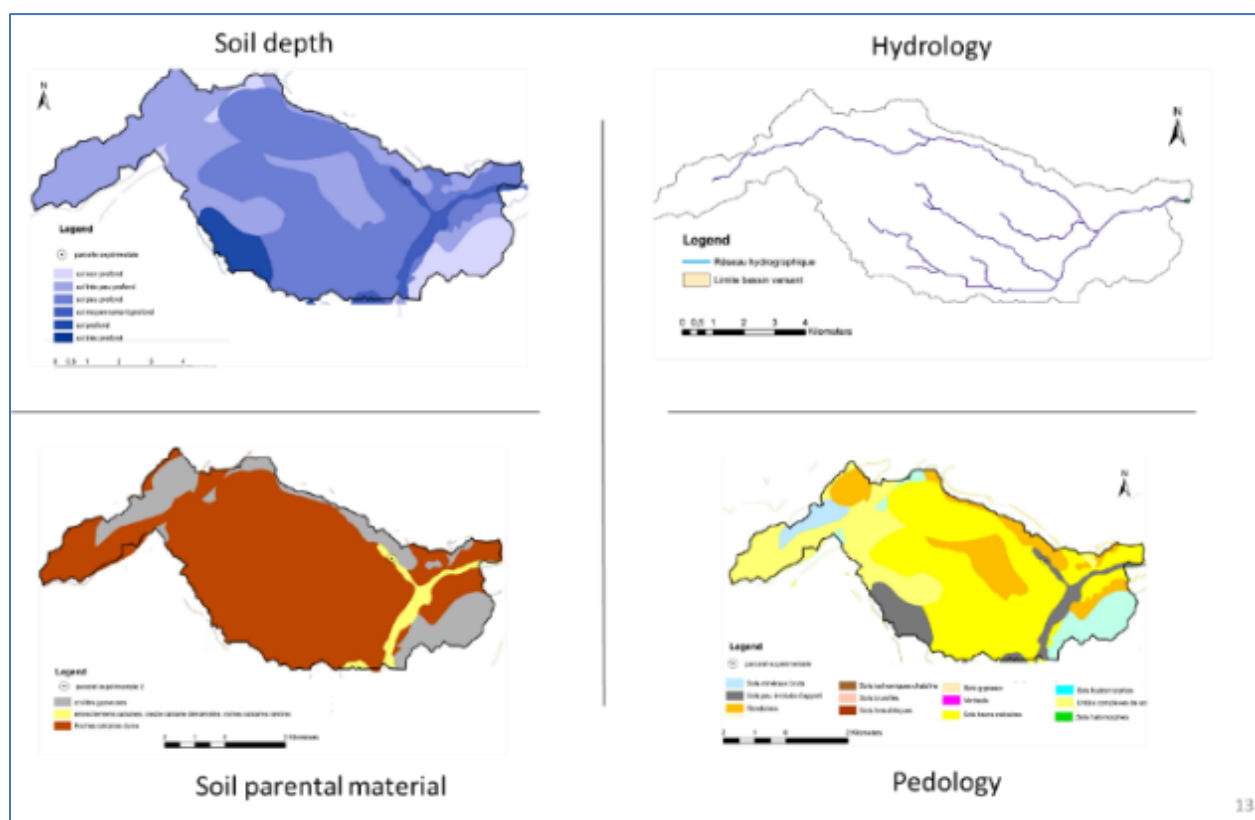


Figure 3. Main soil characteristics of the watershed of Kairouan site (Oued Elgsab) - (source: Own Elaboration)

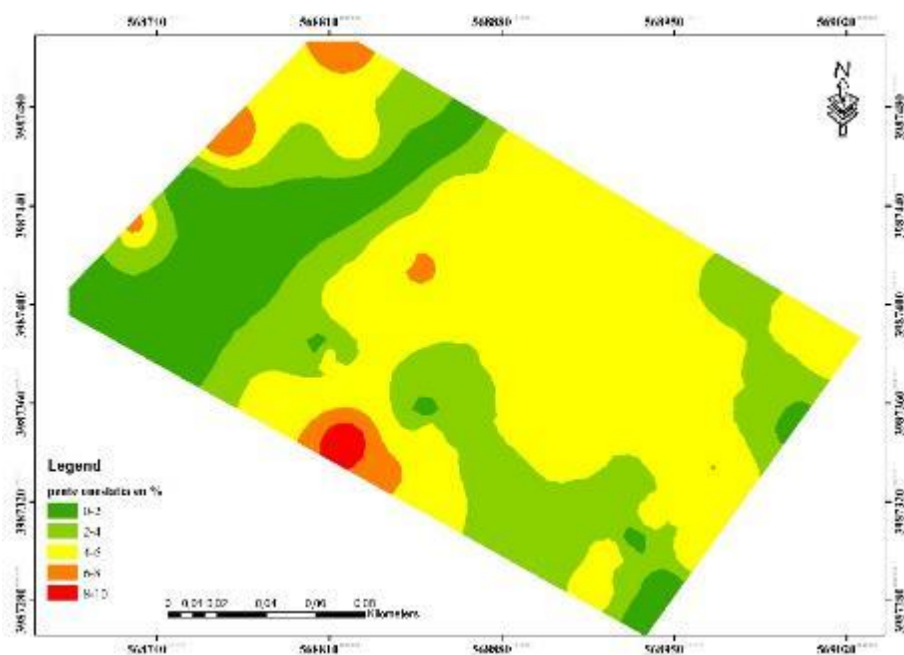


Figure 4. Slope map of the selected plot in Oued ElGsab site (source: Own Elaboration)

The project team proceeded with initial soil sampling from the selected experimental plot. Soil sampling was done according to the below illustration (Figure 5), with consideration of 0-15 cm, 15-30 cm and 30-45 cm soil depth. Sampling was done from two neighboring plots (plots with olive rows, and an open field plot, with no tree cultivations).

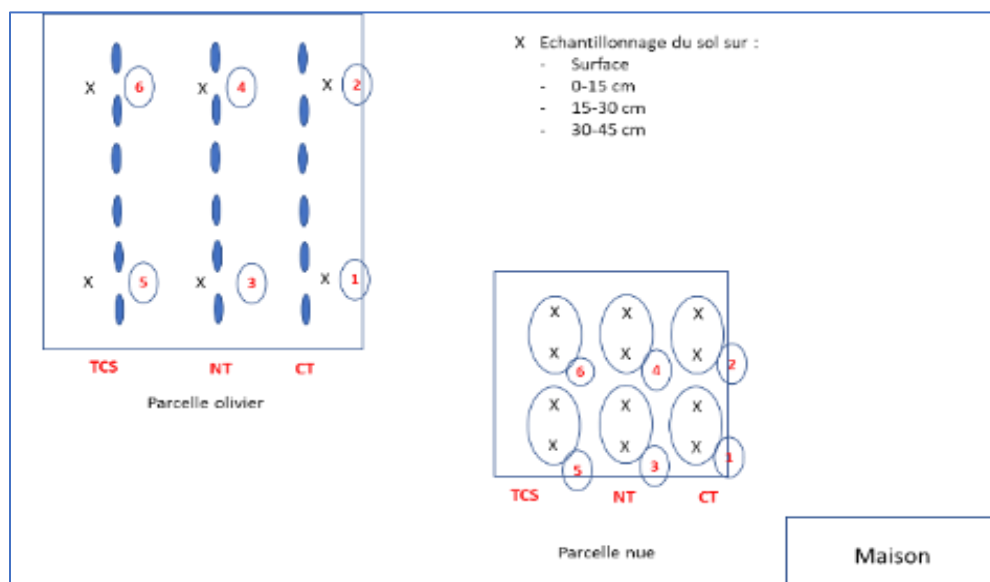


Figure 5. Illustration of soil sampling in the selected experimental plots in Kairouan site, Oued Elgsab - (source: Own Elaboration) (Blue lines refers to rows of olive trees)

An additional Wischmeier protocol for soil erosion measurement was installed in the (olive) experimental plots, where forage mixtures (vetch-triticale) are being cultivated under different ploughing methods (including control trial). The experimental design and the location of the Wischmeier protocol are illustrated in Figure 6.

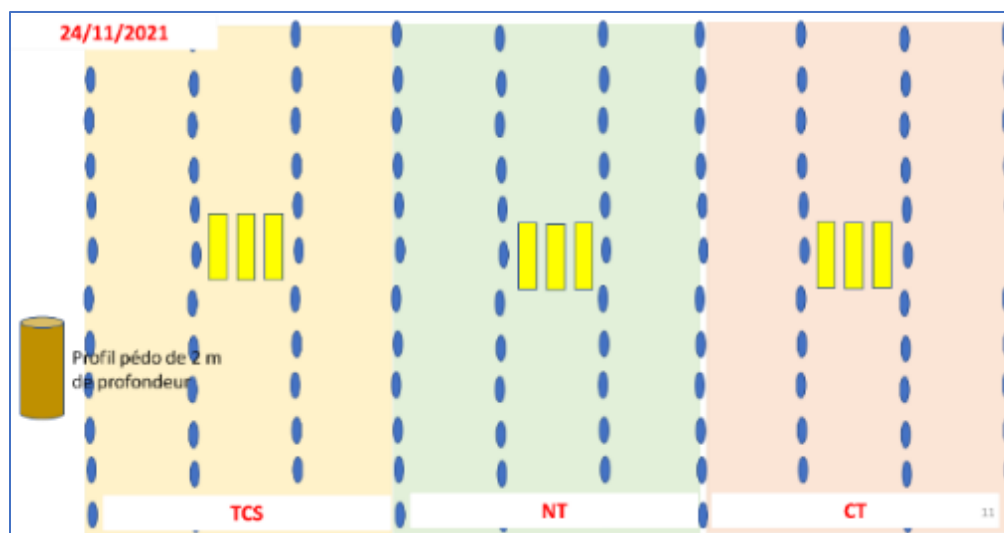


Figure 6. Illustration of the Wischmeier protocol for soil erosion measurement in Oued ElGsab site (Wischmeier are highlighted in yellow) – TCS (simplified soil ploughing techniques); NT (No tillage); CT (Conventional tillage); blue lines refers to rows of olive trees. (Source: own elaboration)

The photo series 2 show the process of installing the Wischmeier protocol in the experimental plot, and Photo 3 the pedological profile in the same location.



Photo 2. Installation of the Wischmeier protocol for soil erosion measurement in Kairouan (Oued Elgsab).



Photo 3. Pedological profile in the experimental plot of Kairouan, Oued Elgsab – Oueslatia Region

The second experimental plot was installed in the governorate of Siliana, the region of Gaafour, particularly in El Rhahla watershed. The plot has been jointly selected by the project team composed of INRAT, INRGREF, and ICARDA staff members. A google map screen shot of the plot is illustrated in Figure 7. Main soil characteristics of the watershed where this plot is installed in shown in Figure 8 while the topography map of the plot is shown in Figure 8.



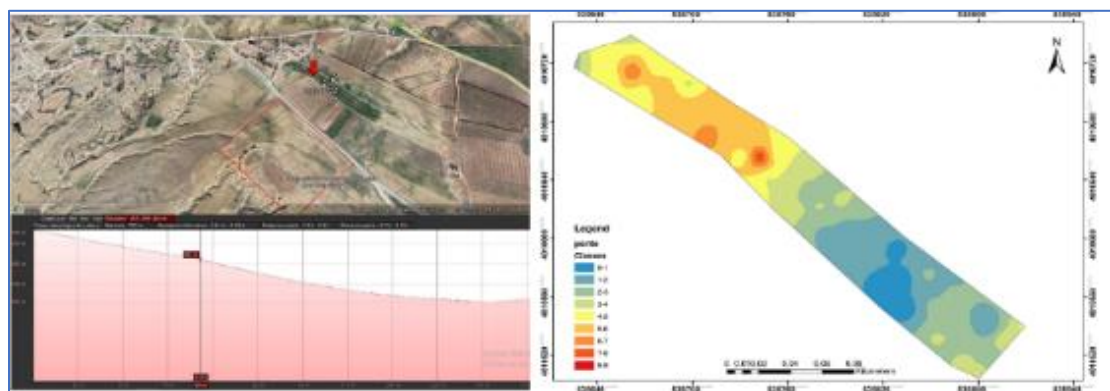


Figure 9. Main soil characteristics of the watershed in Siliana site (El Rhahla); (source: Own Elaboration)

As for the experimental plot of Kairouan, Oued Elgsab, a Wischmeier protocol for soil erosion measurement was also installed in the (cereal-wheat) experimental (and control) plots selected in El Rhahla site, where different ploughing methods are being tested. The experimental design and the location of the Wischmeier protocol is illustrated in Figure 10.

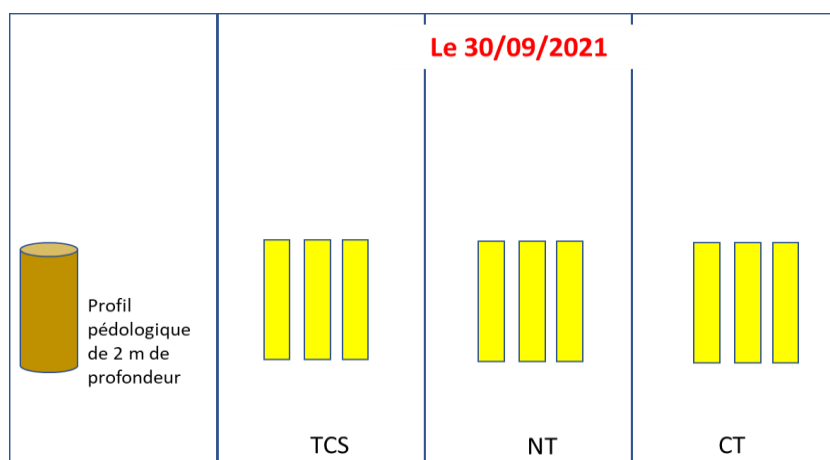


Figure 10. Illustration of the Wischmeier protocol for soil erosion measurement installed in a cereal plot in Rhahla site, Siliana (Wischmeier are highlighted in yellow) – TCS (simplified soil ploughing techniques); NT (No tillage); CT (Conventional tillage). (source: Own Elaboration)



Photo 4. Installation of the Wischmeier protocol (and soil pedology profile) for soil erosion measurement in a cereal plot in Rhahla site, Siliana

The research team organized a scientific brainstorming and discussion meeting early December 2021 to discuss and validate the selected research protocols and methods. Experts from ICARDA, DGACTION, INGRES, and INRAT were attending this scientific meeting.



Photo 5. Scientific meeting to discuss and validate the protocols implemented in both sites with INRAT, INGRES, and DGACTION project members.

1.2. Analysis and reporting of measurement results: Agronomic, environmental, and economic parameters

Appropriate measurements will be carried out in both the experimental and demonstration plots. For the agronomic and water/erosion parameters, weekly follow up and soil sampling are put in place by the project team. These results and others will be properly reported in the upcoming progress reports when more data will be collected. More agronomic and water/erosion results will be generated using modeling software. The modeling will help us assessing scenarios with and without project intervention (demonstration plots installed – see next section) and demonstrate the wider impact of the project in the selected watersheds. Finally, economic data will further be collected for each of the installed experimental and demonstration plots in both Kairouan and Siliana sites using the data collection sheets presented in Annex 1. These aim at collecting the proper data for the calculation of Partial Budget Analysis for each of the considered techniques and at demonstrating its economic relevance to the farmers, as well as to the local/regional managers and policy makers. Additionally, a technical methodological brief is being prepared (building on Dhehibi, 2021) on the specific theme of “Evaluation methods used for Economic and environmental evaluation of SWC techniques with some examples”. The note will be ready for reporting in the next progress report.

In terms of progress on monitoring parameters of the agronomic trials, the below can be reported so far:

i. Rhahla, Siliana site

- Soil sampling made before sowing for initial soil characterization
- Two crops implemented (durum wheat ‘Hadhba’ and forage mixture “vetch*oat”)

- Sowing date for both crops: 9/11/2021
- Sowing rate (durum wheat: 140 kg/ha; forage mixtures: 150 kg/ha)
- Weeding before sowing (glyphosate) for no-tillage and minimum tillage plots: 09/11/2021
- Fertilization before sowing for all plots: DAP (100 kg/ha ; 09/11/2021)
- Soil moisture monitoring for three soil depth (0-15 cm; 15-30 cm and 30-45 cm) at sowing date (9/11/2021) and at emergence stage and at 3-4 leaf stage of durum wheat
- Nitrogen fertilization (150 kg ammonium nitrate/ha equivalent to 50 kg N/ha) for no-tillage and minimum tillage plots of durum wheat at 3-4 leaf-stage (16/12/2021)



Photo 6. Sowing of durum wheat in the experimental plot using conventional and no till seeders

ii. *Oued Elgsab/Oueslatia site:*

- Soil sampling made before sowing for initial soil characterization
- Two crops planted (Oat 'Local' and forage mixtures vetch*triticale)
- Sowing date for both crops: 10/11/2021
- Sowing rate (Oat: 140 kg/ha; forage mixtures: 150 kg/ha)
- Soil moisture monitoring for three soil depth (0-15 cm, 15-30 cm and 30-45 cm) at sowing date (10/11/2021)



Photo 7. Sowing of forage mixtures between the row of olive trees in no-tillage plot using no-till seeder



Photo 8. Sowing of forage mixtures in pure stand in no-tillage plot using no-till seeder

The preliminary results of erosion measurement in Rhahla site show that NT practice reduced largely (-75 %) the soil loss during the rainfall event of November 17th compared to CT. The measured quantity of the soil loss for NT treatment after that event was about 1 t ha⁻¹, while it was about 4 t ha⁻¹ under the CT treatment located in the same plot. These are very preliminary and illustrative results and will be complemented with additional data and analysis in the coming report.

SCALING SECTION - 1

Component 2– Identification, selection, and characterization of SWCT for different agroecosystems

Act 2.1 Selection and description of SWCT (see the first 6-months report)

Act 2.2 Selection of SWCT sites (see the first 6-months report)

Act 2.3 Stakeholder and farming systems analysis in each site (reported in this section)

Act 2.4 Establish demonstration plots of SWCT on each site and organize field visits (reported in this section)



Photo 9. Landscape in Kairouan, El Khol, Hajeb Layoun scaling site.

2.1. Activity 2.3 - Stakeholder and farming systems analysis in the project sites

Stakeholders' analysis and community characterization is a fundamental step for the understanding of the information requirements and flows within a given territory. Better knowledge and understanding of information and communication flows between actors will be important for setting proper scaling strategies (key capacity building activities, key actors' involvement in project activities, etc.). Qualitative (and quantitative) assessment of the considered farm systems (communities and farm typologies) through surveys for data collection (Annex 2) and typology analysis were undertaken in both sites. Furthermore, key stakeholders involved in information generation and sharing in the project sites was conducted using "Social Network Analysis" (SNA) and mapping. For doing so, the survey used is reported in Annex 3. Results reported in this section concern:

- Communities' characterization and farm systems typologies,
- SNA results showing the existing social networks in each site.

2.1.1. Communities and system characterization

i. Kairouan scaling site

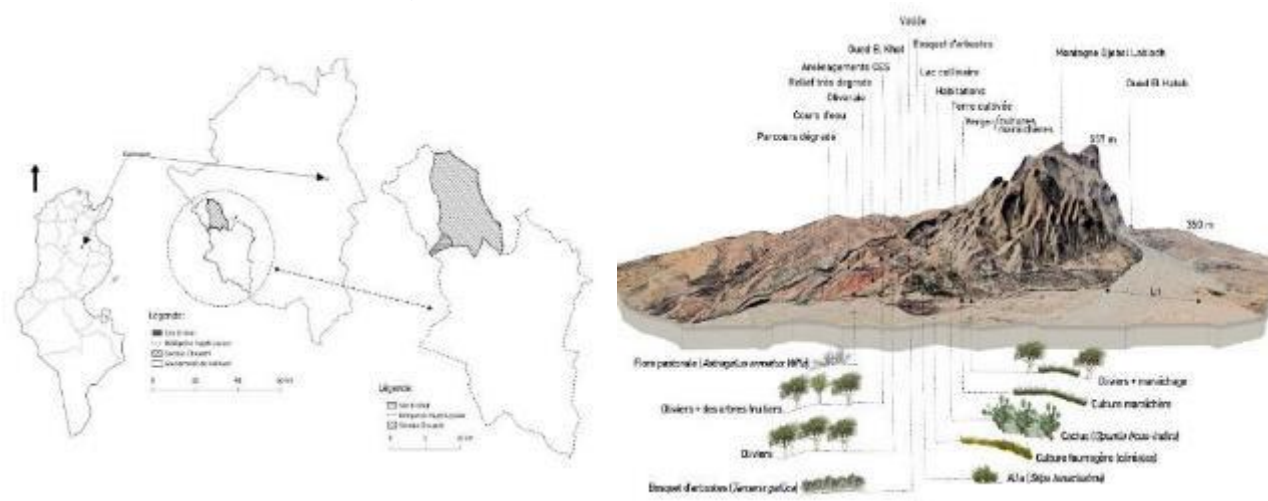


Figure 11. Location and topography of the El Khol scaling Site, Kairouan.

From the primary data collected using Annex 2, the following variables were extracted and used for a similarity analysis with the aim to generate farm typology in the considered site of Elkhoul, Kairouan: crops/trees areas, total land cultivated, existence of livestock activity, age of olive trees. The typology analysis generated three farm types as shown and described in Table 2.

Table 2. Main characteristics of the identified farming systems in El Khol, Kairouan

Overall system characteristics		Type 1	Type 2	Type 3
Cereals	No	63.6%	50.0%	
	Yes	36.4%	50.0%	100.0%
Forage crops	No	72.7%	50.0%	100.0%
	Yes	27.3%	50.0%	
Horticultural crops	No	9.1%		
	Yes	90.9%	100.0%	100.0%
Dry legumes cultivation		90.9%	100.0%	100.0%

	Yes	9.1%		
Olive trees	No	9.1%		
	Yes	90.9%	100.0%	100.0%
Fruit trees	No	72.7%	25.0%	100.0%
	Yes	27.3%	75.0%	
Livestock	No	27.3%	25.0%	
	Yes	72.7%	75.0%	100.0%
Total Area (ha)	Average	4.82	7.75	5.50
	Median	3.00	6.50	5.50
Newly planted olive trees (year)	Average	2.45	9.25	1
	Median	2	10	1
Aged olive trees (years)	Average	11.7	32.5	70
	Median	15	30	70

Farmers' perceptions about soil degradation problems in their area (plots) is also shown in the Figure 12. The figure shows that most farmers have sloppy lands, do practice some soil and water conservation techniques (mostly very simple), but they also realize that what they are doing is inefficient.

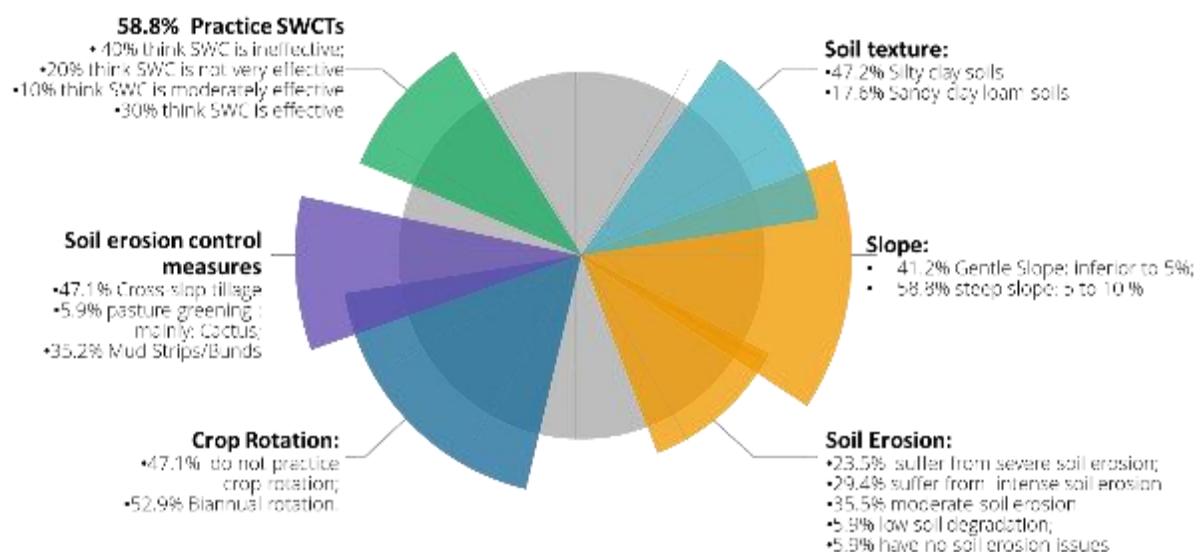


Figure 12. Farmers perception about soil degradation in Elkhoul, Kairouan.

Additional information on community and farms characterization in El Khol site can be found in annex 4.

ii. Siliana scaling site

A full characterization of Rhahla community and farm types can be found in Annex 5. The same survey (Annex 2) was used for collecting primary data in both Kairouan and Siliana. El Rhahla site is localized in the delegation of "Gaafour" (see map in figure 13) and is composed of a relatively small rural community of about 150 households. Face to face interviews were conducted with twenty-four farmers (24) from the region. These were selected in agreement with the community representatives and are farmers directly involved in our project through the different demonstrations installed on their farms. The survey is composed of five sections: i) Farmer's Identification, ii) Farm Identification, iii) Crop Production, iv) Livestock Production, and v) Farmer's perception about soil and land degradation and SWC Techniques. The identified farm types in Rhahla, Siliana are illustrated in table 3.

Table 3. Main characteristics of the identified farm types in Rhahla, Siliana.

Characteristics		Type		
		Type 1	Type 2	Type 3
Wheat	No	72.2%	20.0%	
	Yes	27.8%	80.0%	100%
Barley	No	16.7%	20.0%	
	Yes	83.3%	80.0%	100%
Oats	No	33.3%	20.0%	100%
	Yes	66.7%	80.0%	
Age (mean)		45.4	49.0	69.0
Useful Agricultural Area (mean in ha)		6.0	17.0	10.0
Ewes (mean)		18.9	60.0	100.0
Goats (mean)		1.5	4.8	0

Type 1 is characterized by limited agricultural areas compared to the other two types, with younger farmers who detain smaller flocks (small ruminants). These farmers are less interested in wheat and give more importance to barley and oats. Type 2 is characterized by larger areas compared to the other two types. These farmers keep larger herds compared to type 1 and give the same importance to the three cereals cultivated in the zone. Type 3 is characterized by an area of 10 ha on average, occupied essentially by wheat and barley. Farmer of this group are the oldest compared to other types. They also have larger herds. Overall, the three farm types are not highly different from each other considering the type of crops cultivated and the low integration of livestock – small ruminant – activity, as reflected by the lack of forage crops cultivation.

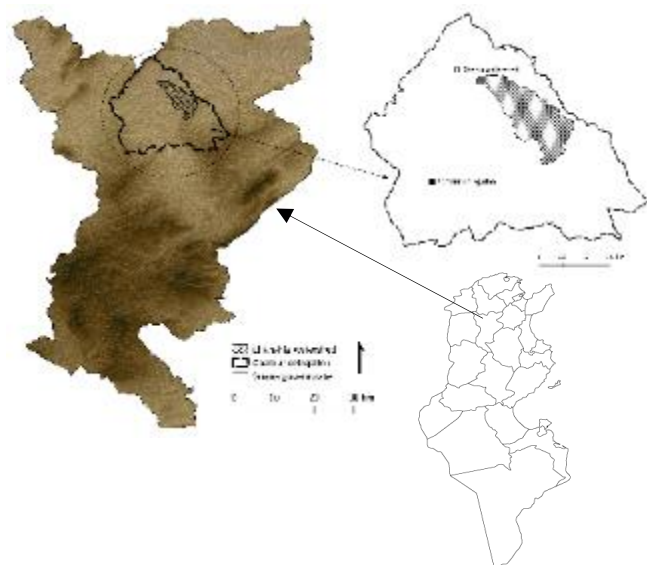


Figure 13. Location of the demonstration/scaling site in Rhahla, Siliana.

Farmers' perception about soil and land degradation problems in addition to problems of SWC Techniques/Practices adoption show that only few farmers are fully aware of the gravity of these problems. More than 50% of the interviewed farmers do believe that SWC practices are not difficult to implement, but most of them (83%) think that implementing SWC is very expensive, which means that most of them look

at SWC from a public investment perspective and not as a potential farm-level practice. Only one third of the respondents think that soil management techniques do not reduce their farmland area. Some farmers believe that SWC techniques, such as the mud strips, are a source of rodents, pests, and diseases for their crops. About 40% of farmers believe that these SWC practices are effective, while 37% doubt their effectiveness (see more details in Tables 4 and 5).

Table 4. Farmer's Perception on the SWC Techniques in Siliana, El Rhahla

Statement		Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
SWCT are difficult to implement	N	13	2	2	2	5
	%	54.2	8.3	8.3	8.3	20.8
SWCT reduce farmland area	N	7	1	2	4	10
	%	29.2	4.2	8.3	16.7	41.7
SWCT are a source of rodents and other pests/diseases	N	4	0	1	9	10
	%	16.7	-	4.2	37.5	41.7
SWCT are high labor demanding (workforce)	N	3	3	1	6	11
	%	12.5	12.5	4.2	25.0	45.8
Standards SWCT have limited durability	N	1	3	4	7	9
	%	4.2	12.5	16.7	29.2	37.5
SWCT are expensive	N	2	0	0	2	20
	%	8.3	-	-	8.3	83.3
Farmers doubt their effectiveness	N	10	1	1	3	9
	%	41.7	4.2	4.2	12.5	37.5

In this section farmers were asked to give a score from 0 to 100 for every SWC Techniques/Practices to reflect how far these practices suit their farmlands. Results shows that three (03) practices were highly ranked by farmers: manure application, crop rotation, and mulching with crop residue (straw of cereal crops left on the soil after harvest and summer grazing). These practices are easy to implement, relatively cheap, and known by all farmers. Other practices do have a high score, and theoretically suit the farming lands in the region, but they require a high level of knowledge and technicity such as contour cropping, grass strips, water ways, composting and check dams (Table 5). (See full El Rhahla site characterization in annex 4)

Table 5. Farm's preferences for different SWC Techniques

SWC Technique/Practices	N	Min	Max	Mean	St-deviation
Bunds	24	0	100	65.4	33.07
Contour cropping	13	0	100	70	38.73
Crop rotation	24	50	100	84	18
Area closure	23	0	100	48.5	38.24
Manuring	23	0	100	92	22.19
Check dam	23	0	100	57.4	38.4
Agro forestry	19	0	100	54.2	39.9
Grass strips	13	0	100	68.5	39.55
Composting	8	0	100	73.8	41.04
Water way	23	0	100	60.7	37.79
Intercropping	24	0	100	67.1	34.24
Crop residue (mulching)	22	30	100	85	23.25
0= Least suited Technique 100= Best suited technique					

2.1.2. Stakeholders and social networks analysis

The identified territories in both sites gather actors who manage, use, develop and influence the existing resources, each according to their own background. These actors can be classified according to their position in relation to the territory: internal actors (physically present within the territory where they carry out their activities) and external actors (not physically present within the territory but they do have some interactions, of different kind, within the territory). This identification is necessary to better understand the existing interactions needed for the proper implementation of an appropriate intervention. In depth analysis of these social networks was conducted in El Khol site, using data collected through survey in annex 3.

Results of this analysis in El Khol are shown in Table 6. One of the most relevant indicators to consider is the Eigen-centrality, which reflects the degree of connection a certain actor has in a given network, for a given aspect (information sharing in our case). The higher this indicator is (close or equal to 1) the more central is the given actor. We particularly can see the importance of the PROSOL project (ICARDA and NARES team intervention during the previous 6 months), the farmers' association (GDA), cross farmers exchange of information, and the importance of local agricultural input suppliers who are also acting as "suppliers of technical information".

Table 6. Results of Social Network Analysis (SNA) indicators in El Khol site, Kairouan

Label	indegree	outdegree	Degree	weighted indegree	weighted outdegree	Weighted Degree	Eigen-centrality
CTV	2	0	2	13	0	13	0.13
OEP	3	0	3	14	0	14	0.2
Centre AVFA (training)	0	0	0	0	0	0	0
CRDA	4	0	4	22	0	22	0.26
« Arrondissement CES »	2	0	2	4	0	4	0.13
Research institutes	0	0	0	0	0	0	0
Municipalité	2	0	2	6	0	6	0.13
GDA	15	0	15	173	0	173	1
Vetenerary	4	0	4	4	0	4	0.26
input sellers	5	0	5	60	0	60	0.33
APIA	0	0	0	0	0	0	0
UTAP	0	0	0	0	0	0	0
ProSol	15	0	15	180	0	180	1
other farmers	15	0	15	180	0	180	1
Average (a1-a15)	0	4.4	4.4	0	43.7	43.7	0

Figure 14 further highlights the strong dominance of local actors who take a central position (GDA, other farmers, the ProSol project). The higher the node size is, the more central and the more weight the actor has in terms of information sharing. The most connected actors are placed next to each other according to the calculated distance between them. Actors of the same type are colored with the same color. The obtained network can be described as follows: farmers form a cordon around the GDA and the ProSol project, the agricultural input providers are always important, while the public sector (CRDA, OEP, CTV) is

somewhat isolated and far from the network. For the rest of the actors (UTAP, APIA, research institutes, AVFA training center), no links were recorded with the surveyed farmers.

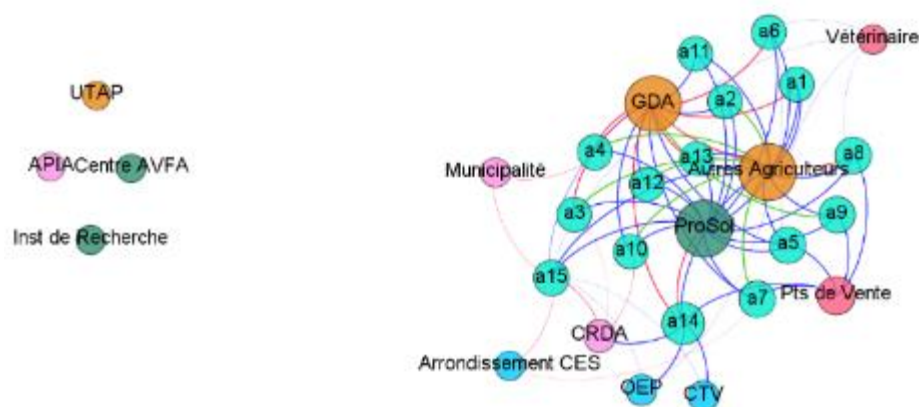


Figure 14. Map depicting the social network analysis (SNA) in El Khol area using the Gephi software

2.2. Activity 2.4 Establishment of agronomic trials, and demonstration plots of SWCT for the 2021-22 cropping season in both target sites

Building on previous ICARDA projects such as the [IFAD CLCA](#), the [Food Security project](#), the [Sustainable Silvo-pastoral Restoration](#), etc. and following existing national soil and water conservation practices, this project has focused on the identification of an “Integrated Soil-friendly Sociotechnical Package” mostly verified on-station and on-farm as well as on the technologies available at national and regional levels in the project target areas and validated under local contexts. During this cropping season, the current project identified suitable technologies, potential areas for their scaling and identification of the lead farmers (case of Oueslatia site) and hosting organizations (cooperatives, community) through stakeholder consultation meetings. The main technologies identified for scaling were, the introduction of legume (vetch, sulla) and legume-cereal mixtures (vetch-oat, vetch-triticale, vetch-oat-triticale, vetch-oat-triticale-Fenugreek) in the cereal and olive mono-cropping system for increasing the availability of quality forage and restoring soil health and fertility as well as green consolidation of mechanical benches with perennial forage legume and planting hardy native rangeland and forage shrubs and grasses such as cactus and Sulla that fix and improve the soil. This integrated soil management practices range from the farm to the landscape level to favour its context-specific adaptation under both cereal and olive farming systems. The demonstration plots were established as a learning/disseminate knowledge centre where farmers can evaluate the technology from seeding to harvesting and will be used as training support for different field days and on-farm trainings which will be planned for the next 6 months. In addition to the demo plots, the project team is conducting experimentation for finetuning some SWC practices for enhanced water use efficiency, improved soil carbon content & soil fertility, and productivity such as Conservation Agriculture and Simplified Cultural Technology (TCS) under both farming systems. The Project has also implemented on-farm multiplication plots for vetch, oat, triticale in each intervention area of the project. The objective is to create independence of forage seeds in each community targeted by the project and to guarantee the availability of forage mixtures for the next year. These multiplication plots have been established with lead farmers and representatives of both communities (El Rhahla – Siliana, El Khol – Kairouan) based on a participatory

consensus between the project and community leaders – where 60% of seeds production is planned for the lead farmers and 40% will be distributed to the community through the project-assisted cooperatives during 2022-23 cropping season. These multiplication plots also serve as learning tool to upgrade farmer's knowledge on good-quality forage seeds production.

Around 80 plots with a total area of 82.5 hectares were directly implemented by the project for almost 42 farmers in different intervention areas including El Rhahla community [26 farmers from which 2 are pioneer women farmers (47.5 ha)] in Siliana District and El Khol site/Hadjeb Layoun [14 farmers (25 ha)] & Oued Elgsab/Oueslatia [2 farmers (10 ha)] in Kairouan District. These plots (including experiment, demonstration, multiplication) will be monitored from sowing to harvest by the project team other strategic partners including the Agency of Livestock and Pasture (OEP), and the National Institute of Agronomic Research of Tunis (INRAT). A focus has also been made on private sector engagement mainly for forage seeds production.

Details about the number of the demonstration plots in each site, crops, and management practices implemented in each of them including the specific SCW “themes” and practices covered by these plots are summarized in Tables 7, 8, 9, and 10. The exact location of these plots within the respective watershed of El Khol is also shown in Figure 15. A similar figure is under preparation for the watershed of El Rhahla, Siliana (will be shared in the next progress report).

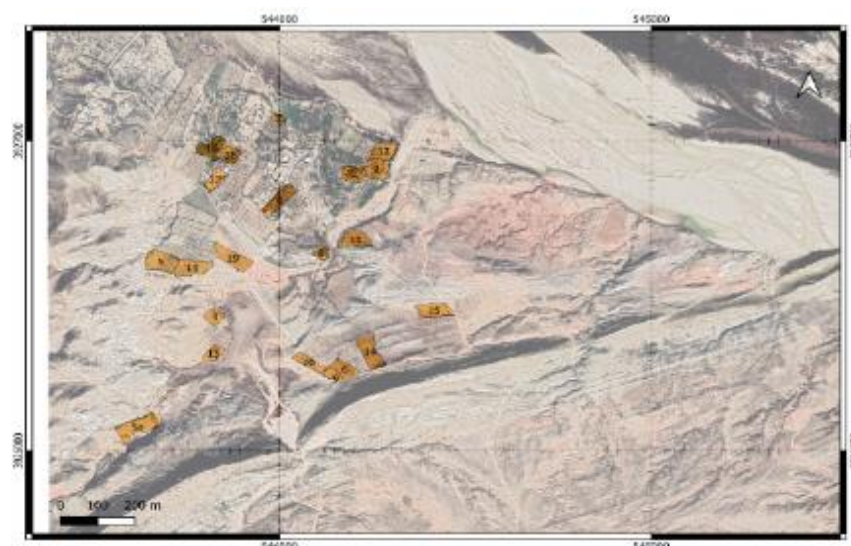


Figure 15. Demonstration plots installed in El Khol site, Kairouan.

Table 7. Demonstration plots implemented in both sites for training and field days purposes.

El Rhahal (Rainfed)-Demonstration plots					
	V-O	V-T	V-O-T	V-O-T-F	Sulla
Number of beneficiaries	14	13	1	-	4
Total area	12.5	11.5	1	-	10.5
Seed rate (kg/ha)	125	120	120	-	40
El Khol (Irrigated)-Demonstration plots					
Number of beneficiaries	7	4	3	3	7
Total area	5.5	3	2	2.5	7
Seed rate (kg/ha)	160	150	160	110	40

V-O: Vetch-Oat mixture; V-T: Vetch-Triticale mixture; V-O-T: Vetch, Oat, Triticale mixture;

Table 8. Plots for seeds multiplication of forage crops.

El Rhahal (Rainfed)- Seeds multiplication plots			
	Vetch	Oat	Triticale
Number of beneficiaries	3	2	2
Total area	6	2	2
Dose (Kg/ha)	65	130	120
El Khol (Irrigated)- Seeds multiplication plots			
Number of beneficiaries	2	2	2
Total area	2	1.5	1.5
Dose (Kg/ha)	75	130	140

Table 9. Additional (experimental and demonstration) plots established in Oueslatia, Oued El Gssab (Rainfed). Kairouan Experimental Site

		V-O	V-T	V-O-T	Vtech	Oat	Triticale
Multiplication Plots 1	Number of beneficiaries	0	0	0	1	1	1
	Total area	-	-	-	0.5	0.5	0.5
Demonstration Plots	Number of beneficiaries	1	1	1	0	0	0
	Total area	1	0.5	0.5	-	-	-
Experimental Plot	Number of beneficiaries	0	1	0	0	4	0
	Total area	-	3	-	-	-	-
Dose (Kg/ha)		130	120	140	80	100(Experimental) 130(Multiplication)	140

Table 10. SWC practices implemented in the different demonstration plots of the project.

SWC Practices	Farming System											
	Cereal based farming system (Siliana)				Olive based farming system (Kairouan)							
	El Rhahla Site				Oued Elgsab, Oueslatia				El Khol Hadjeb Layoun			
	State	# plots	# ha	# Farmers	State	# plots	# ha	# Farmers	State	# plots	# ha	# Farmers
Conservation agriculture in cereal-legume based system and integrating livestock in the farming system	√	01	01	01	☹	-	-	-	☹	-	-	-
Conservation agriculture in olive-legume based systems	☹	-	-	-	√	01	03	01	☹	-	-	-
Forage diversification to address feeding gap minimizing soil disturbance (adopting TCS practice) in olive-based farming system	☹	-	-	-	√	02	02	01	☹	-	-	-
Conventional forage cropping for biomass and seeds and community-based mechanization for feed and forage production	√	36	35	26	☹	-	-	-	√	19	18	14
Forage intensification and diversification under simplified cultural technology (TCS)	√	05	09	05	√	08	05	02	¥			
Green consolidation of mechanical benches with perennial forage legume (Sulla)	√	01	2.5	01	☹	-	-	-	☹	-	-	-
Planting hardy native rangeland and forage shrubs and grasses such as cactus and Sulla	¥	07	10	10	☹	-	-	-	√	7	7	7

Implemented practices are marked with √, planned practices are marked with ¥, non-planned practices are marked with ☹

SCALING SECTION - 2

Component 3: Co-design and implementation of scaling framework and activities for SWCT / 3.1 Scaling Framework

Act 3.1.1 Assessment of scalability / scaling vision of SWCTs

Act 3.1.2 Development of Lite version of the scaling scan tool

Act 3.1.3 Identification of scaling activities using scaling scan per SWCT (participatory workshops) -

Act 3.1.4 Co-implementation of the identified scaling activities for all SWCT -

Act 3.1.5 Assessment of farmers (and other stakeholders) responsiveness to the implemented scaling activities (will be reported in the next progress reports)



Photo 10. Working group implementing scaling scan tool in a project workshop, Hammamet, 1st December 2021.

3.1. Activity 3.1.2 Development of Lite version of the scaling scan tool

This activity has been successfully accomplished. After early interactions with local, regional and national stakeholders and identification of the overall scaling ambition in both sites (see first 6month report), the project team worked on the well-known [Scaling Scan tool](#) and further simplified it for rapid focus groups application. The resulting tool is well described in annex 6. Five (5) sets of questions reflecting five (5) scaling ingredients have been considered:

1. Awareness and Demand about the technology
2. Knowledge and Skills level of farmers
3. Value chain, business case and finance related to the promoted technology
4. Current collaboration with public institutions and other actors regarding the scaling of the technology
5. Leadership and public sector governance in the studied area.

Four (4) specific questions are included under each of the above themes. An online tool for data entry and results visualisation was also developed and can be accessed [here](#). This lite version of the scaling scan was successfully used during a participative workshop (Hammamet, 1st December) for scaling analysis of SWC practices in Siliana and Kairouan. [Click here to test the dashboard](#).

3.2. Activity 3.1.3 Identification of scaling activities (strategy) using scaling scan per SWCT

The project team gather 25 participants from different backgrounds (farmers, farmers associations, local and regional extension staff - CTV, regional agricultural administrations CRDA, URAP, representatives from GIZ and the ProSol PMU at DGACTA, etc.) from both sites to implement the Lite version of the scaling scan. Focus groups were organized separately for each site. The Rhahla group, Siliana, focused on the “minimum tillage” technology; while the El Khol group, Kairouan, focused on “forage mixtures” technology. Question sheets were distributed to each participant of both focus groups to gather their responses and appreciations. Average scores collected for the five scaling ingredients in both sites can be found in Tables 11, 12 and Figure 16 below. More information on the approach implementation and discussion of the obtained results can be found in annex 6.

Table 11. Scaling scan results for the “minimum tillage” technology in Rhahla, Siliana

Scaling Ingredients	Score
Awareness and Demand	4.9
Knowledge and Skills	4.4
Value chain, business case and finance	4.5
Collaboration with public institutions and other actors	4
Leadership and public sector governance	6.3

Table 12. Scaling scan results for the “forage mixtures” practice in El Khol, Kairouan.

Scaling Ingredients	Score
Awareness and Demand	3.3
Knowledge and Skills	3.1
Value chain, business case and finance	3.3
Collaboration with public institutions and other actors	3.4
Leadership and public sector governance	3.5

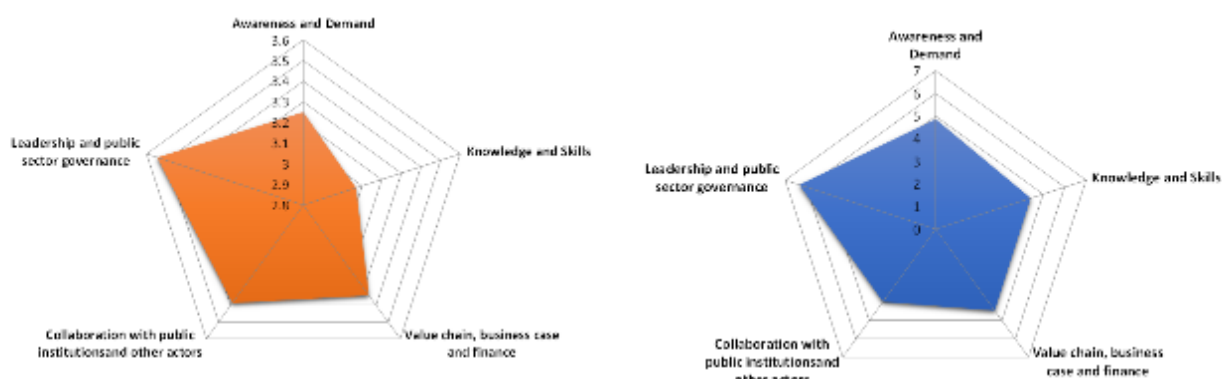


Figure 16. Results of the scaling scan application for “forage mixtures” in Kairouan (Left side) and “minimum tillage” in Rhahla, Siliana (right side).

Based on the obtained scores of the five scaling ingredients, priority scaling actions have been suggested to better guide the project investments towards leveraging the scaling ingredients which have been identified as bounding constraints for the large-scale dissemination of the selected technologies in both sites. The developed scaling strategies can be found in annex 6. Table 3 in annex 6 further provides in-depth details of the capacity development programs in both sites, issued from the scaling scan analysis and from the different focus groups and fields characterisation.

3.3. Activity 3.1.4 Co-implementation of the identified scaling activities for all SWCT

Based on the previous scaling diagnostics, the project team started the preparation for the launch of innovation platforms (IP) in the identified sites. The approach is to intervene in the project areas through implementation of an integrated sociotechnical package well suited for sustainable intensification and soil restoration in both sites (see figure 17 as an illustration of the sociotechnical bundle designed for Rhahla, Siliana). Part of these sociotechnical packages are devoted to capacity development through the implemented demonstration trials, others are related to enhancing farmers organisation, etc. It is important to consider SWC practices from a system perspective, and thus entry points for system change became very important. This is the case and rationale for integrating livestock-related activities within our implementation plan. All the below suggested interventions have been carefully co-designed and co-validated with local farmers and beneficiaries. The launch of field implementation of the scaling activities in Siliana happened on October 26th, where a large networking event was organized, and a set of presentations were made to better present and illustrate the project intervention approach and content to farmers.

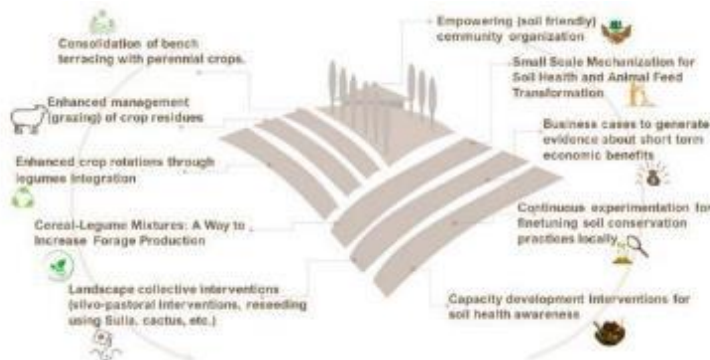


Figure 17. Integrated Soil-friendly sociotechnical package as a companion to scaling SWC techniques in Rhahla site, Siliana.

As partly illustrated in photo 11, interventions to strengthen farmers' organization is crucial for the successful and sustainable implementation of this project. The project has recruited a consultant specialized in “Organization -Management Accounting and Fiscality of Agricultural Professional Structures GDA-SMSA” to support and assist the community of El Rhahla to be organized under a local organization – (now called SMSA "Ankoud El Khaier") which is getting established with 27 Farmers from "Rhahla" & "Dhryaia" regions (neighboring to Rhahla). Three adherent/founder members are women farmers (adherents are core group of farmers who are contributing to the creation of the SMS and who are supposed to benefit from the services provided by this organization). All the administrative and financial procedures are now finalized. The SMSA has currently 290 shares with a preliminary rolling fund of 14,500 TND from a total of 29,000 TND which will be completed during the next year. The election of the Executive board members will take place on 24 January 2022 in El Rhahla Community (Figure 18), where the establishment of this cooperative will be officially announced. The creation of this cooperative will enhance the quality of services provided to farmers and facilitate access to agricultural inputs and information related to the integrated soil-friendly package for over 150 households in both neighboring communities. The project team will further support the SMSA to create its own soil-friendly strategy and action plans for the coming years. Early steps for the implementation of such an action plan will be incubated by this project through our 2022 scaling activities in the same region. More will be reported on this in the coming six-month report.

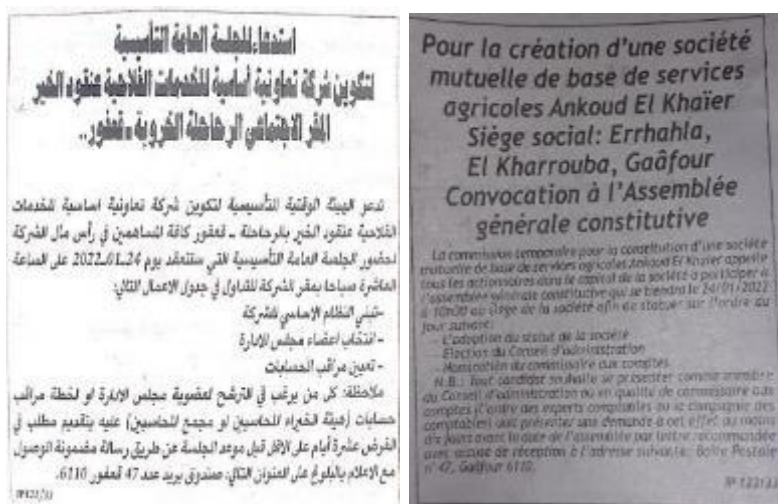


Photo 11. Public invitation to participate in the election of the executive board members of SMSA “Ankoud El Kaier” published on 06 January 2022 in two Tunisian newspapers (Al Chourouk, left – Le Quotidien, right)

3.2 Knowledge Sharing and Management

- Act 3.2.1 Identification and capacity assessment of potential organizations to host each of the knowledge hubs (see previous “6-month” project report)
- Act 3.2.2 Create and support knowledge hubs and innovation platforms (IP) around SWCT (partly reported in this section)
- Act 3.2.3 Develop e-learning modules on SWCT and initiate learning sessions (Partly reported in this section)
- Act 3.2.4 Develop and send technical SMS messages on SWCT (partly reported in this section).
- Additional knowledge products produced so far (progress reported in this section).



Photo 12. The launch of field activities in Rhahla, Siliana.

The objective of the Knowledge management approach of the SWC@Scale project is to develop a process of generating relevant information and upgrading knowledge through developing, testing and disseminating information related to the promoted “Soil-friendly sociotechnical packages” to key stakeholders (small farmers, farmers’ groups, rural women and youth, junior researchers, local extension agents, and public & private partners) in a participatory way. The first six months of the project helped identifying and assessing the capacities of potential organizations (already available or to be created/empowered with the selected communities) to host each of the knowledge hubs (refer to activity 3.2.1 in the first six months report of the project).

Participation sustains the effort to ensure proper contextualization and adaptation of different products and tools aiming at supporting the implemented scaling process in both intervention areas of the project. KM products intend to support the upscaling of successful field operations, best soil & water conservations practices (SWCP) and lessons learned through the production of evidence-based recommendations related to SWC practices for smallholder farmers, guidelines for decision makers, including extension and advisory services. The KHs established under the project are based on the lesson learned of previous ICARDA & national system experiences and focused on participatory research, capacity development, knowledge exchange, and dissemination events with strong integration of women and youth. Among the different knowledge products generated by the SWC@Scale project in 2021 are: a) printed materials and technical sheets and posters; b) Designing digital open data collection tools for rapid rural appraisal and scaling diagnosis; c) design of specific digital activities including videos, SMS messages, and e-learning modules, and d) face-to-face trainings and interactions.

3.4. Activity 3.2.2 - Create and support knowledge hubs and innovation platforms (IP) around SWCT

The project has initiated the building of local knowledge hubs (KH) in both locations where scaling activities are being undertaken (Photo 13). The [knowledge hubs protocol](#) as defined by Frija & Idoudi (2020) is being implemented stepwise. One of the most important ideas behind this approach is to co-generate (with farmers and local stakeholders) new local knowledge from experiment and demonstrations established locally. In addition to that, proper knowledge management tools and knowledge products will be specifically developed and tailored to farmers and communities to better enhance their awareness and technical skills for the implementation of “soft” SWCP. The approach has effectively started in Rhahla site (Siliana) and the work is in progress in Khol region, Kairouan. Significant progress on this activity is expected for the first 6 months of 2022. In Khol, the existing GDA has been selected as potential host of the knowledge management activities to be undertaken around SWC in the region. In Siliana, a new SMSA is being created with the support of [the GIZ funded SWC@Scale project](#) and will serve as a host for the planned KH.



Photo 13. Building community leadership through farmers trainings

3.5. Activity 3.2.3 Develop e-learning modules on SWCT and initiate learning sessions

Three SWC e-learning modules have been developed in French, and made available on the e-learning platform of ICARDA. These were developed in collaboration with research partners, INRAT and INRGREF. These modules are in line with the GIZ funded ProSol Global Program and cover three specific topics namely Agroecology, Conservation Agriculture, and Soil Health. The exact titles of the modules are as follows:

- L'agriculture de conservation comme alternative pour limiter la dégradation des ressources naturelles (sol et eau) dans un contexte de changement climatique [\[can be accessed here\]](#)
- L'agroécologie ; Principes et Pratiques d'un Changement Incontournable [\[can be accessed here\]](#)
- Adopter de bonnes pratiques agricoles pour améliorer la santé des sols [\[can be accessed here\]](#)

The modules are publicly accessible for private actors in Tunisia (and perhaps other French speaking North African countries) as well as in other target countries of the ProSol Global Program (South-South-North Knowledge Exchange). The modules will be of interest to researchers, academicians, students, development stakeholders, public and private sectors, and policy makers as well as farmers including women and youth.

In 2022, the project team will organize few training sessions where local extension and administrative staff, junior researchers, and other leader farmers will be brought together and assisted to go through the modules' materials. The developers of the e-modules will provide assistance during these trainings.

3.6. Activity 3.2.4 Develop and send technical SMS messages on SWCT

In order to increase farmers' awareness about different problems and solutions to SWC in particular, and sustainable intensification of production systems in general, a set of SMS has been developed and introduced in the target areas of the project. As mentioned above, due to the low number of households and farms in the selected sites, the project team will be targeting wider geographies in the neighborhood of the selected sites (Transect of Siliana-Kef, Oueslatia & Hadjeb Layoun/Kairouan). Around two hundred technical SMS messages related to i) crop rotations and diversified cropping, ii) forage crops, iii) integrating livestock into the system, iv) actions that enhance soil cover, such as conservation agriculture, strategic tillage and enhanced management of crop residues, and v) collective action – are elaborated and will be reaching almost 600 farmers, of which 30 % will be women and young farmers. The sending of the messages starts early 2022.

3.7. Additional knowledge products

3.7.1. Technical Sheets & Posters

To provide technical information on the SWC soil-friendly integrated practices promoted by the project, eight technical sheets and posters were mostly designed in Arabic and French languages adopting a simplified text for a wide range of stakeholders including farmers, extension services and the other network stakeholders. The addressed topics cover: **i)** [Land degradation and water scarcity](#) in Tunisia, **ii)** [Diversified and integrated crop Rotation for sustainable production system](#), **iii)** [Reseeding using sulla, a native legume forage species \(Hedysarum Coronarium\) and its rhizobial inoculation process](#), **iv)** [Cereal-legume mixtures](#) as a way to increase forage production, diversify rotation system, boost yields, and improve productivity, **v)** [Small scale mechanization](#) for soil health and animal feed transformation, **vi)** [Soil health](#) as a foundation to sustainable food systems, **vii)** [Economic benefits](#) of applying soil health practices, and **viii)** [Involving rural community](#) in addressing soil degradation problems and restoring soil health and fertility – and one leaflet on the description of SWC@Scale project (in French). The main objective of all designed materials is to inform, raise awareness and support the work with smallholder farmers and partners to implement technical solutions to the challenges they are facing.

3.7.2. Online Communication: Blogs, Videos, Institutional Social Media Posts

On the occasion of “World Soil Day December 5th, 2021” – two short videos were produced by the ICARDA CODIS team to support the knowledge management component of the project. [The first one](#) was generated to inform and raise awareness on different improved SWC measures for sustainable management and use of soil and water and to achieve a healthy ecosystem. [The second video](#) was a simple illustration used to

highlight the significance of soil quality for human well-being and food security. Both materials are less than one minute long, and the project intends to produce more videos in the upcoming six months. Both views, and related links to inform about this SWC@Scale project were seen by about 500 persons so far.

Blogs and posts have also played an active role in disseminating the project activities and raising the awareness on “*social soil aspects*” via ICARDA websites and its social media channels including Fb, Twitter, LinkedIn, etc. below are some examples:

<https://www.icarda.org/media/blog/social-soil;>

[https://twitter.com/ICARDA/status/1466425299533504513;](https://twitter.com/ICARDA/status/1466425299533504513)

[https://www.facebook.com/166091433517809/posts/4328073987319512/.](https://www.facebook.com/166091433517809/posts/4328073987319512/)

3.7.3. Development, Use, and training on the use of Open Data Kits for data collection.

During this 1st Year, a field data collection form was designed by the project team to serve as generic tool for systems and communities’ characterization and for the timely follow up of the project demonstration/experimental plots, in SWC@Scale sites and beyond. Agronomic trials, demonstration plots and farmers’ data describing the management of crops, yields, costs, dates, and crop status, etc. will be thus collected through a friendly open-source tool for data collection called Open Data Kit “[ODK Collect](#)”. The developed form for the follow up of the demonstration plots can be found in annex 7. Data collectors will be the project team members themselves, in collaboration with local stakeholders and their extension agents in each intervention area – who can then work online and offline in the field. A training on ODK has been provided by other ICARDA projects, and two colleagues from the ProSol PMU at the DGACTA were invited and attended the training.

3.7.4. Foster Networking, Capacity Building, and Training for Key Actors on the Implementation of Sustainable SWC Practices and Technologies

Several face-to-face interactions including consultation meetings, field visits, information days, scaling scan workshop, field days, participation to international conferences, and on-the job training, etc. (Photo 14) were organized to better update all project stakeholders to the concept of the integrated soil-friendly sociotechnical packages and to further deepen the knowledge on SWC practices which are promoted by the project. These events were organized and implemented during the last six months of 2021, where about 300 participants (Table 13) including local farmers (women and youth), local extension staff, junior researchers, representative from public and private sector, policy-makers, and students have been provided with information and skills concerning: i) Research activities and establishment of experimental protocols of the project, ii) best agroecological practices (such as CA, TCS, green consolidation of mechanical benches with perennial forage legume) for addressing land degradation and water scarcity problems and increasing productivity in semi-arid rainfed crop livestock systems; iii) Reseeding and planting hardy native rangeland using Sulla, a native legume forage species (*Hedysarum Coronarium*) and its Rhizobial inoculation process, iv) Community-based mechanization for feed and forage production, v) communities organization and establishment of KH; among other themes. Furthermore, during this 1st Year, three Long-term degrees (MSc) were also supported by the project and successfully defended (2 women and 1 man).



Photo 14. Photo Overview of some CapDev events under SWC@Scale Project during the last six months of 2021

On October 26th, 2021 – a large [field kick-off meeting](#) was held at Rhahla site - Gaafour, Siliana district – to present the project objectives and rationale and to discuss the main critical issues and potential solutions for sustainable adoption of SWC practices. This networking event was implemented by ICARDA in collaboration with multiple national partners in Tunisia such as the Institution of Agricultural Research and Higher Education (IRESA), the National Institute of Agronomic Research of Tunisia (INRAT), the National Institute for Research in Rural Engineering, Water and Forests (INRGREF), the General Directorate for the Planning and Conservation of Agricultural Land (DGACTA), the Agency of Livestock & Pasture (OEP), the National Institute of Field Crops (INGC), and the Regional Department for Agricultural Development (CRDA Siliana). Representatives from private sector and GIZ were present as well. The objective was to get in direct contact with the target community, introduce the integrated soil-friendly sociotechnical package, understand the impact of each practice/technology selected on long-term sustainability of agricultural production (mainly for soil conservation and fertility restoration) under climate change and water scarcity, and explain the different interventions planned during the 2021-22 cropping season to strengthen this community and sustain the scaling of the promoted SWC practices. The event focused on the approach towards the establishment of a technical knowledge hub on SWC technologies and the different steps that guide us for creating self-sustained extension dynamics of the selected SWC practices at farm and landscape levels in the project intervention areas. Overall, sixty-three (63) multiple stakeholders (15 female, 48 male) – Scientists, Local extension agents, Private sectors, Research & Development institutions including thirty (30) Farmers from which five are women farmers participated [to this event](#).

ESA Mogran-IRESA with close support from ICARDA organized [an international scientific event](#) to contribute to the current scientific debate on problems of the transition of Tunisian agriculture sector towards sustainable intensified patterns of production. The target audience included national and international scientific community. The three long-term degrees (MSc) that were supported by the SWC@Scale project,

presented and discussed their work in the conference. Another intervention on “gaps between research and development” was also made by a SWC@Scale project members to illustrate the concept of scaling and suggest possible pathways for efficient implementation of R4D projects. Audience to these presentations reached 83 participants from the scientific community. The titles of the presentations are as follows:

- Temporality & projection of olive production, and territorialization of mountain olive groves located in El Khol, Hajeb Layoun/Kairouan District for a sustainable olive-based farming system,
- From integrated management to agri-landscape ecodevelopment: Agro-ecological practices for mountainous area of “El Khol site, Hajeb Layoun-Kairouan” to address soil degradation problems,
- Socio-economic approach of manure management at farm level in Kairouan district, Tunisia

See more information on the main CapDev of the SWC@Scale project, during the previous 6 months, in table 13.

Generated knowledge is now made available through the project [website](#) and/or the MEL open access [repository](#) and will be re-used during future technical and policy events when relevant. 2022 KM activities will continue to closely support the implementation of the planned knowledge hubs, training activities (based on the scaling roadmap in each target community), and functional knowledge products for local extension agents, farmers, and other stakeholders, with stronger focus on gender and youth.

Table 13. Summary of main Capacity Development (CapDev) events and the number of respective beneficiaries during the last six months of 2021

Type of event/CapDev	Target population	Location	Topic	# Attending
Consultation field visits, information days, fields days, on-the job training (different dates all over 2021)	Farmers	El Rhahla/Siliana, Hadjeb Layoun & Oued El Gsab/Kairouan INRAT – Tunis	- Forage crops and cereal-legume mixture. - Enhanced crop rotation through legumes integration. - Sustainable land management practices for enhancing water use efficiency, soil fertility and productivity (CA, minimum tillage). - Economic Benefits of Applying Soil Health Practices - Reseeding and planting hardy native rangeland using sulla, a native legume forage species (<i>Hedysarum Coronarium</i>) and its rhizobial inoculation process. - Soil health - Small-scale mechanization for soil health and feed production. - Strengthening Farmers' Organization for Common Interest.	50
Post-graduate students (January to November 2021)	MSc student	Kairouan	- Sustainable olive-based farming system. - Agro-ecological practices for mountainous area of "El Khol site, Hajeb Layoun-Kairouan" to address soil degradation problems. - Socio-economic approach of manure management at farm level.	3
Networking event: kick-off meeting for field activities of the SWC@Scale project (26 th October 2021)	Farmers; Local extension agents; Scientists; Research & Development institutions; Donor, Private sectors.	El Rhahla- Gaafour, Siliana District	Gender Inclusive and Soil Friendly Innovation Package for the Mixed Crop-Livestock Farming Systems.	63
SIAMAP (28 th October 2021)	Farmers; National Research & Development institutions; scientists; Private sectors; Students; Donor.	Tunis	- Self-sustained scaling hubs of agricultural innovations and technologies. - Encouraging entrepreneurship with small scale mechanization for soil health and feed transformation. - Agroecological practices for agri-landscape ecodevelopment. - Temporality & projection of olive production, and territorialization of mountain olive groves in Hadjeb Layoun, Kairouan	50
Training day & Ceremony to handle feed machines (30 th Nov 2021)	Farmers; Extension agents Private sector; Scientists.	Tunis	Small scale mechanization for soil health and feed transformation: - Animal feed and nutrition. - How to valorise by products using small feeding machinery?	20
Training (1 st December 2021)	Farmers; Local extension agents; Scientists; National Research & Development institutions; Donor; Private sectors.	Hammamet	Scaling scan for SWC Technologies in both cereal and olive farming systems	25
7th International Conference on Integrated Management of Natural Resources and Sustainable Agriculture– ESA Mogran/IRESA – ICARDA (15 th 16 th December 2021)	National and International Scientific Community	Tunisia, Hammamet	Integrated Management of Natural Resources and Sustainable Intensification of Agricultural Systems	83
Total				294

Component 4: Impact assessment, monitoring and evaluation

The MEL plan can be summarized as follow: i) define the project approach, roles, and responsibilities for the monitoring, evaluation and learning process, ii) provide a clear overview of the linkages between project's activities and the expected results, iii) support annual planning and facilitate reporting following GIZ requirements by providing guidance for the operationalization of the monitoring and evaluation system, and iv) contribute to ongoing learning processes that can support the ACTA 2050 strategy and the establishment of the national DGACTA Observatory.

During this 1st year, routine monitoring with partners was regularly implemented in order to follow up on implementation of activities, data collection for reporting and internal team meetings. During the first year, the ME team was mostly focusing on the structural design of the project's impact pathways and its M&E process (Figure 18). More deepening around M&E aspects and indicators will be done in the second year of the project. Discussions around a practical set of indicators used in "R4D" projects, in line with the Global ProSol program have been initiated. This will lead to an M&E Matrix and a Monitoring, Evaluation, and Learning plan for the project to be shared with stakeholders as well as with National Partners in the 2nd Year.

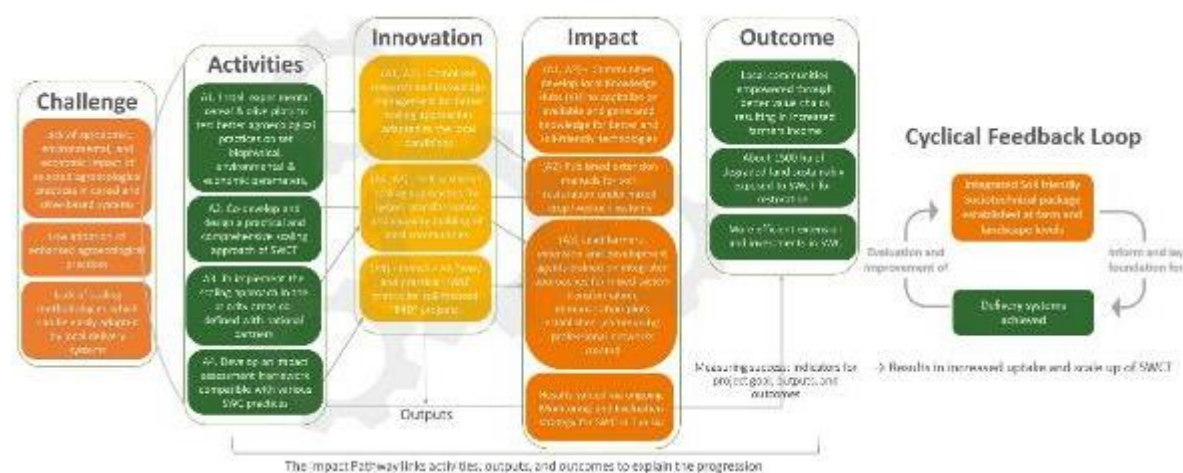


Figure 18. Impact Pathway for SWC@Scale Project

Given the diversity of the activities and agreements of the global ProSol program in Tunisia including the SWC@Scale Project, we believe there is a crucial need to clarify what target numbers stand for, e.g., direct and indirect beneficiaries and spillover and contamination effects to avoid possible interference and to ensure/guarantee complementarity in the implementation of different "ProSol" projects and activities (Figure 19). Okello (2019) defines a direct beneficiary as a unit (individual or household) that is directly reached by the project and/or its partners and who meets the eligibility criteria set by the project. Consequently, an indirect beneficiary is any household, whether eligible or not, that receives the intervention from sources other than the project and its partners, that is from the direct beneficiary through household-household relationships or social networks.

According to Germen et al. (2005) a spillover effect/benefit may therefore be defined as the spontaneous spread of an intervention, usually a technology, through farmer to farmer or household's social network in the absence of project/partner mediation. For some donor agencies (such as IFAD for example), a spillover effect is evident when the non-target population is indirectly affected by the intervention through social and economic interactions with the target population. A contamination effect is observed in a situation when the beneficiaries are being exposed to other interventions, for instance, from government (partners), other organizations and donors. –

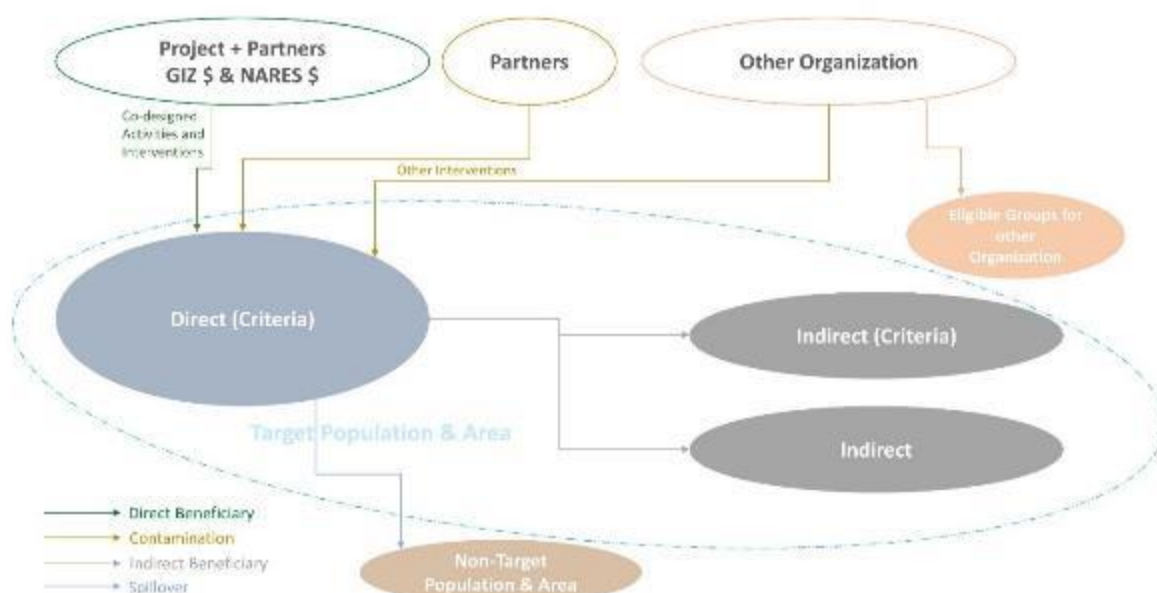


Figure 19. Tracking beneficiaries of complex research and development interventions

ICARDA will call for a technical meeting early 2022 with GIZ M&E team, project partners and other target stakeholders to discuss this terminology to standardize for all involved partners. The meeting will also discuss the early set of ME indicators which are being under development for the SWC@Scale project.

Annex 1. Sheets for data collection and calculation of partial budget analysis for the experimental and demonstration plots.

Table 14. Benefit-Cost Analysis of Technologies using Partial Budget Analysis

Without technology (e.g., farmers practices)				With technology option			
Costs	A	B	C	Costs	D	E	F
Inputs	Quantity	Unit price	Total	Inputs	Quantity	Unit price	Total
Seeds				Seeds			
Fert/pesticides				Fert/pesticides			
Labor				Labor			
Machinery/fuel				Machinery/fuel			
Water				Water			
Other costs				Other Costs			
Total Costs	XX	XX	XX	Total Costs	XX	XX	XX
Revenue				Revenue			
Main product				Main product			
Secondary product				Secondary product			
Total revenue	XX	XX	XX	Total revenue	XX	XX	XX
Indicators							
Net returns			C14-C9				F14-F9
% change in NR						(F17-C17)/C17	
% change in TC						(F9-C9)/C9	
IRR						Change NR/Change in TC	
Benefit-cost Ratio			C14/C9				F14/F9

Annex 2. Survey used for communities and systems characterization in both scaling sites.

Enquête de caractérisation des exploitations agricoles

Date	
Enquêteur	
Coordonnées GPS	

1. Identification de l'exploitant/chef de ménage

Nom et Prénom	
Age	
Genre	1=Homme, 2=Femme
Etes-vous le chef de ménage	1=Oui, 2=Non
Niveau d'instruction	1= Analphabète ; 2= Primaire ; 3= Secondaire ; 4= Formation professionnelle ; 5= Universitaire
Numéro de téléphone	
Est-ce que vous vivez sur l'exploitation	1=Oui, 2=Non
Est-ce que le chef de ménage est le propriétaire de la ferme ?	1=Oui, 2=Non
Le chef de ménage a-t-il un diplôme en agriculture / a-t-il étudié l'agriculture ?	1=Oui, 2=Non
Depuis quand vous gérez votre exploitation (Gérance Directe) [année]	

2. Composition du ménage

Taille de ménage [personnes vivantes plus de six mois par an]	
Nombre de filles/femmes	
Nombre des garçon/hommes	
Nombre de personnes travaillant sur l'exploitation	Hommes=Femmes=

3. Revenu du ménage

Source principale du revenu du ménage (%) [l'activité dont la survie du ménage en dépend]	1=Production végétale (Céréales/fourrage/culture maraichère)	
	2=Oléiculture	
	2=Elevage ovin	
	3=Elevage Bovin	
	4=Apiculture	
	5=Systeme Mixte	
	6=Revenu extra-agricole	
Type de revenu et transfert extra-agricole	1=Privé (mi-temps) 2=Privé (plein-temps) 3=Salarié (Etatique) 4=Transferts gouvernementaux (allocation familiale) 5=Retraite 6=Rémittences (Interne, de l'étranger) 7=Autres (à spécifier)	

4. Identification de l'exploitation

Superficie agricole Totale (SAT) [en ha]	
Superficie agricole Utile (SAU) [en ha]	
Superficie de terres incultes [SAT-SAU] [en ha]	
SAU en pluviale [en ha]	
SAU en irrigué [en ha]	
Nombre des parcelles	
Régime de propriété des terres exploitées	1= Propriété par héritage (Titre de propriété) 2= Propriété par achat (Titre de propriété) 3= Propriété par héritage communautaire (Sans titre mais exploitée et délimitée) 4= Terres louée du privé 5= Terre domaniale louée/exploitée 6=Forêt/clairière

Superficie propre [en %]	
Superficie louée [en %]	
Superficie en copropriété (avec un autre membre de la famille/personnes) [en %]	
Superficie en métayage [en %]	
Type des sols présent dans l'exploitation (estimation du propriétaire)	1= Argileux 2= Argilo-limoneux 3= Sableux 4= Sablo limoneux 5= Caillouteux (minéraux brut) 6= Autres
Fertilité des sols (majorité de la surface)	1=Très fertile 2=Fertile 3=Moyen 4=Peu fertile 5=Infertile
Pente	1=inférieur à 5% 2= 5 à 10% 3= Plus de 10%
Problème de dégradation des sols : Erosion hydrique	1= Nul 2= Faible 3= Moyen 4= Fort 5=Très fort
Problème de dégradation des sols : Erosion éolienne	1= Nul 2= Faible 3= Moyen 4= Fort 5=Très fort
Problème de dégradation des sols : Salinité	1= Nul 2= Faible 3= Moyen 4= Fort 5=Très fort
Problème de dégradation des sols : taux de matière organique	1= Nul 2= Faible 3= Moyen 4= Fort 5=Très fort
Problème de dégradation des sols : couvert végétale	1= Nul 2= Faible 3= Moyen 4= Fort 5=Très fort
Présence d'ouvrage CES dans la région	1= Oui 2= Non
Efficacité de ces ouvrages [perception de l'exploitant]	1= Non efficace 2= Peu efficace 3= Moyennement efficace 4= Efficace 5=Très efficace
Y a-t-il des techniques que vous adoptez pour freiner l'érosion (Par ordre d'importance)	1=Non 2=Minimum de labour 3= Semis-direct 4=Labour contre le sens de la pente 5=Banquette mécanique 6=Plantation (Cactus, Acacia, Atriplex) 7= Plantation de brise-vent 8= Autres (à spécifier)

Distance Exploitation, -Route goudronnée [m]	
Distance Exploitation-source d'eau [m]	

Distance Exploitation-Marché locale [m]	
---	--

5. Mécanisation

Machine	Nombre	Age	Valeur totale si vous avez décidé de vendre tout votre [Machine] aujourd'hui?
Tracteur			
Offset			
Canadien			
Charrue à soc			
Charrue à disque			
Herse			
Rouleau			
Semoir			
Epandeur d'engrais			
Presse-paille			
Faucheuse			
Pulvérisateur			
Remorque			
Citerne			
Moissonneuse-batteuse			
Pot-trayeur (machine à traite)			
Pick-up/camionnette			

6. Caractérisation du système de production : Diversification/Intégration

Qu'est-ce que vous avez cultivé durant les 5 dernières années (compagne agricole)	1= Céréales (Orge/Blé/Avoine/Triticale...) 2= Culture fourragères (Luzerne, Sulla, Bersim, Ray-grass...) 3= Cultures maraîchères (Tomates/Pastèques/Melon/Piment...) 4= Légumineuses à grains (Petit-pois/Pois-chiche/Fève/Féverole...) 5= Cultures industrielles (Betterave à sucre, Colza...) 6= Olivier 7= Arbre fruitier (Abricotier, Pêcher, Pomme, Agrumes...etc.) 8= Cactus (Pour production des fruits) 9= Palmier
Type d'assolement pratiqué	1= Monoculture (non) 2= Biennale 3=triennale 4=Quadriennale 5=Quinquennale
Age des plantations des oliviers	Les plus jeunes [années] Les plus âgées [années]
Densité de plantation des oliviers	Standard (Traditionnelle selon les normes de la région) Intensif Hyper-intensif
Pratique des cultures intercalaires	1=Oui, 2= Non
Espèces cultivées en intercalaires	1= Céréales 2=Légumineuse à graine 3= Légumineuses fourragères 4= Cultures fourragères 5=Cultures industrielles
Raison de cette pratique	1= Valoriser les superficies non-exploitées 2= Optimiser l'usage en eau d'irrigation 3= Création d'un agroécosystème résistant aux chocs biotique/abiotique 4= Diversifier les revenus des cultures 5= Création d'un système de production à faible apport en intrant agricole

<i>Si vous ne faites pas de cultures intercalaires, veuillez citer les raisons</i>	1= Ressources en eaux 2= Connaissances limitées en la matière 3= Diminution de la fertilité du sol (usage plus intensif d'un sol déjà peu fertile) 4= Cout économique (plus d'intrants) 5= Impact négatif sur les plantations arboricoles (maladies fongiques, pestes, diminution des rendements...) 6= Autres:
<i>Elevage</i>	1= Oui, 2= Non
<i>Type de cheptel présent</i>	1= Ovins 2= Caprin 3= Bovins 4= Camelins 6= Apicole (Abeilles) 7= Avicole (Volailles) 8= Cuniculture (élevage de lapin)
<i>Sources principales des fourrages (plus de 75% des besoins)</i>	1= Autoproduction 2= Achat (industrielle/commerciale) 3= Achat (d'autres exploitation agricole) 4= Parcours communs (foret, oued, terres communautaires incultes...etc.)
<i>Valorisation des sous-produits</i>	1= Sous-produits de la taille des arbres 2= Fruits non commercialisés 3= Grignons d'olive 4= Pâturage dans les parcelles après la récolte (tomate, pomme de terre, pastèque...etc.)
<i>Est ce que vous valorisez le fumier produit par vos animaux (épandage)</i>	1= Oui 2= Non 3= Parfois
<i>Est ce que vous l'utilisez sous forme</i>	1= Fumure de fond 2= Fumure d'entretien
<i>Est ce que vous vendez le fumier</i>	1= Oui 2= Non 3= Don gratuit pour d'autres exploitants
<i>Si oui, prix par tonne [Dt]</i>	
<i>Compostage des divers sous-produits de la ferme</i>	1= Oui 2= Non
<i>Vous utilisez ou bien vous vendez le composte</i>	1= Utilisation dans l'exploitation 2= Vente 3= Les deux

7. Production végétale

1. Production saison agricole passée

Culture	Variété	Superficie allouée (ha)	Production Totale (tons)	Prix de vente Unitaire (par ton)
Blé Dur				
Blé Tendre				
Orge				
Avoine				
Olivier	Chetoui Oueslati Zalmati Chemlali GerbouiChemchaliRkhami Zarrazi Meski Sayali Tounsi BesbessiMarsaline Beldi Fouji Autres			
Pomme de terre				
Fève				
Fèverole				
Pois-chiche				

Solanacées				
Cucurbitacées				
Liliacées (Ail, ..etc.)				

2. Fiche technico-économique-céréale

	Blé Dur	Blé Tendre	Orge	Avoine	Autre
Gros labour					
Prix/heures					
Nombre de labour simple					
Prix/h					
Recroisement					
Prix/h					
Date de semis					
Dose de semis [en kg]					
Type de semis	Mécanique (semoir) Mécanique (épandeur) Manuel				
Application de fumure de fond					
Dose Super 45					
Prix/qt					
Dose Ammonitre					
Prix/qt					
Dose DAP					
Prix/qt					
Application Herbicide					
Nombre de passage					
Cout total par passage					
Application fongicide					
Nombre de passage					
Cout total par passage					
Irrigation	1= Oui, 2= Non, 3= Parfois				
Nombre d'irrigation					
Date récolte					
Type	Mécanique Semi-mécanique Manuelle				
Cout/h					
Cout presse-paille/unité					

3. Produit et sous-produit des céréales

	Paille de blé	Paille d'orge	Foin d'avoine
Production totale			
Vente			
Autoconsommation			
Prix unitaire (jour de vente)			

4. Fiche technico-économique olivier

Nombre de plantation totale	
Superficie approximative [ha]	
Nombre de passage : labour	
Outil de labour	1= Canadien, 2=Offset, 3= Herse, 4= Sarclage traditionnel/manuel

<i>Cout/h (passage mécanique)</i>	
<i>Cout/j (sarclage traditionnel)</i>	
<i>Fréquence de la taille des arbres</i>	1=Annuel, 2=Bisannuel, 3=Plus que 2 ans
<i>Cout de taille/pieds</i>	
<i>Irrigation</i>	1= Oui, 2= Non
<i>Type de système d'irrigation</i>	1=Submersion, 2=Aspersion 3=Localisé 4=Collecte des eaux des crues 5=Mixte
<i>Fertilisation</i>	1= Non 2= Fertilisation azotée (Ammonitre) 3=Fertilisation double (DAP) 4= Application des NPK
<i>Système de distribution des engrais</i>	1= Standard 2= Ferti-irrigation 3= Les deux
<i>Utilisation des pesticides (Herbicides +fongicides + insecticides + acaricide)</i>	1= Oui 2= Non 3= Parfois (selon le niveau d'infestation)
<i>Si oui, nombre d'application par saison agricole</i>	1= Un seul 2= Deux passages 3= Trois passages 4= Plus que trois
<i>Date de récolte</i>	
<i>Type de récolte</i>	1= Manuelle traditionnelle 2= Semi-Mécanique 3= Mécanique (100%)
<i>Cout de main d'œuvre par jour [Dt]</i>	

<i>Vente Fruit [en Tonne]</i>	
<i>Autoconsommation : Fruit [en kg]</i>	
<i>Vente huile [en litre]</i>	
<i>Autoconsommation : Huile [en litre]</i>	

Structure du troupeau

	Nb jour de la visite	Nb Vendu	Nb Achat	Prix moyen
Ovins				
Brebis				
Bélier				
Agneau				
Agnelle				
Bovin				
Vache laitière				
Taureau				
Veau				
Vèle				

Annex 3. Survey used for collecting data used in the "Social Network Analysis".

Identification

Agriculteur :

Echantillonnage

<i>Veuillez identifier jusqu'à 10 organisations qui sont importantes pour vous :</i>	<i>Importance (X)</i>
CTV (PA) خلية الارشاد الفلاحي – الانتاج الحيواني	
CTV (PV) خلية الارشاد الفلاحي – الانتاج الحيواني	
OEP ديوان تربية الماشية و توفير المرعى	
Centre formation AVFA مراكز التكوين المهني الفلاحي	
CRDA (administration) المندوبية الجهوية للفلاحة (شؤون إدارية)	
CRDA (CES) المندوبية الجهوية للفلاحة (مقاومة الانجراف)	
Instituts de recherche (INRAT/INRGREF...) مؤسسات البحث	
Conseil municipal المجلس البلدي	
OPA(GDA/SMSA) المجمع	
Vétérinaire/inséminateur	
Point de vente (Intrants, matériels.)	
Technicocommerciaux	
APIA	
UTAP	
SynAgri	
ICARDA	
Autres agriculteurs	
<i>Listez jusqu'à 5 organisations que vous estimez absentes de notre liste de membres du réseau :</i>	
Org 1 :.....	
Org 2 :.....	
Org 3 :.....	
Org 4 :.....	
Org 5 :.....	

Informations de connexion

Agriculteur :

Acteur :

Pour chaque acteur potentiel ce bloc se répète.

Collaboration : Sélectionnez le mode de collaboration avec cet acteur (cochez toutes les réponses qui s'appliquent):
A développer une relation informelle
Rencontrer régulièrement
Échanger des informations / connaissances
Prendre part à la prise de décision collective
Autre 1 :.....
Autre 2 :.....
Autre 3 :.....

Communication : Pour chaque acteur, cochez la case qui décrit le mieux la fréquence à laquelle elle vous a fourni des informations que vous utilisiez pour effectuer votre travail (p. Ex. Nouvelle idée, rapport, informations de contact, etc.).

0 fois /an

1 fois /an

2-4 fois/an

5-10 fois/an

1 fois/ mois en moyenne

Relation, Quels types d'activités la relation entre vous et cet acteur :

Aucun

Chercher l'information en relation avec la production agricole

Chercher l'information en relation avec les programmes/ subvention

Demande de prix d'intrants / prix de vente

Recherche de nouvelle technologie/innovation

1. El Khol Site Characterization

1.1. Study Area

Localized in the delegation of "Hajeb Layoun" (Kairouan Governorate)"El Khol " site is a relatively small rural community which includes around 20 households.

The dominant climate in Hajeb Layoun is an arid climate. The region belongs to the natural steppe region of central Tunisia with an annual rainfall of 308 mm. The distribution of rainfall is seasonal with rainy and stormy autumn period and a wet winter season characterized by low rainfall.

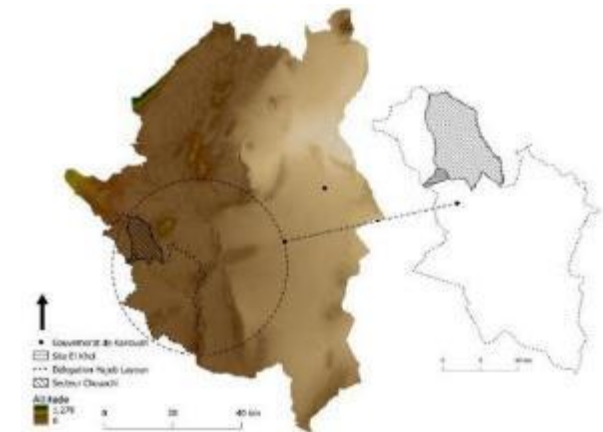


Figure 1. El Khol Site, Hajeb Layoun

1.2. Data Collection Methodology

Face-to-face interview was conducted with seventeen farmers (17) from the region which have been co-selected with the help of leading farmers representing the community and heading the local farmers association. The surveyed farmers are mostly those involved in the different activities of the project (provided their plots for demonstration, seeds multiplication, etc.).

The survey is composed from five sections: i) Farmer's Identification, ii) Farm Identification, iii) Crop Production, iv) Livestock Production, and v) farmers perceptions about land and soil degradation. Microsoft Excel and SPSS were used for DATA entry and analysis.

1.3. DATA Analysis

1.3.1. Social Characterization

- Age and Gender

All of the interviewees were men. In fact, the access and control over the household assets in the region are mainly controlled by men. Nevertheless, focus group discussions were also organized with women to ask for their perception of land degradation and suggestions of functional changes that can be brought to the existing production system to make it more ecologically functional and financially viable. Results from this gender-oriented analysis can be found in Shiri (2021).

The average age of the interviewed farmers is 51 years old; the youngest interviewed farmer is on his early thirties.

Table 1. Respondents' age

	Min	Max	Mean	St-deviation
Age (Years)	31	68	51.6	13.01

41.2% of the interviewed farmers are adult aged more than 60 years old, and only 11.8% are young farmers.

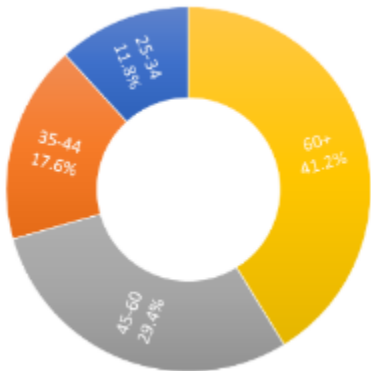


Figure 2 Respondents' age groups (%)

- Literacy level:

The illiteracy rate in the community of El Khol is very high, 47.06 %. The illiterate farmers are usually the oldest ones. More than 35% of the interviewed have successfully completed their primary education, and only 17.6% followed a secondary education. This indicates the overall education level in the site is very low.

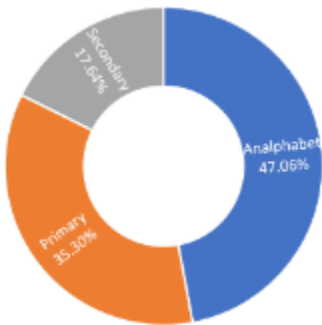


Figure 3 Household Head educational level (%)

• Main source of income

Most interviewed farmers have at least two sources of agricultural income: Annual crop (vegetables) and Olives. About half of the farmers are keeping livestock (small herd of small ruminants) which can thus be considered as additional main component of the local production systems.

Table 2. Household: Main source of income

	N	%
Annual Crops & Olives	7	41.3
Mixed System	9	52.9
Off-farm income	1	5.8

1.3.2. Land Use

All farmers can be considered as small holders owning in average 7.6 hectares. Some farmers do have a total area which can reach 20 hectares. About half (53.0 %) of the surveyed farmers have a total agricultural area smaller than 5 hectares. Around 30% of them are owning an agricultural area ranging between 5 and 10 hectares. Most of the agricultural area in the site is irrigated. Almost all farmers do have access to one of three irrigation water sources: hill dam, Oued, private wells.

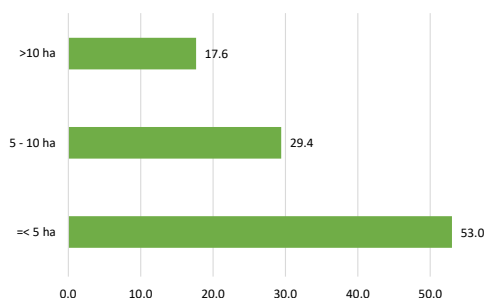


Figure 4. Owned Farm Land Groups (%)

We also identified two (out of the 17) farmers who are renting other farmers land for a few cropping seasons. The latter ones are no longer living in the village or abandoned the agricultural activity because of lack of profitability.

Table 3. Farming Lands (in hectares)

	N	Min	Max	Mean	St-deviation
Total Agricultural Area	17	1.5	20	7.6	6.5
Useful Agricultural Area	17	0	20	5.5	5.3
Total Irrigated Area	17	1	20	5.8	5.1
Plots Number	17	1	10	3.5	2.9

1.3.3. Cultivated Crops

"Hajeb Layoun" region is well known for growing Olives and annual crops (Vegetables: potatoes, tomatoes,

peppers) and "El Khol" region is no exception for this practice.

Annual crops (vegetables) are the most grown crops because of their valuable market prices and their match with olive plots (integrated between olive trees).

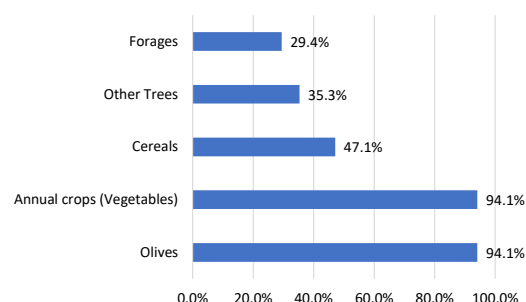


Figure 5 Plots description during the last 5 years (%)

Almost 47,1 % of farmers do not apply crop rotations, thus growing each season and on the same plot the same vegetables. Only nine (9) farmers were identified as practicing biennial rotations, thus alternating between cereals (sorghum or barley) and vegetable crops.

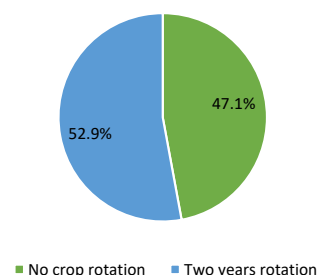


Figure 6 Adopted Crop Rotations (%)

1.3.4. Soil fertility and land management

• Soil types and fertility

Many soil textures are found in the region: slit and clay soils are the most common in the region, the poor quality of the soil is very clear even through visual observation.

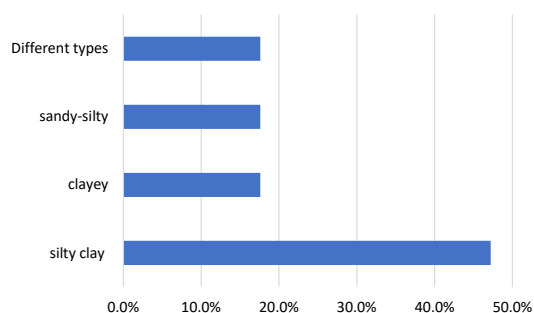


Figure 7 Soil Types (%)

Despite the fact that none of the farmers have been doing soil analysis for their plots, still most farmers

perceive their soils to be fairly fertile, 5.9% look at their soils as very fertile and 64.7% consider their soils as fertile.

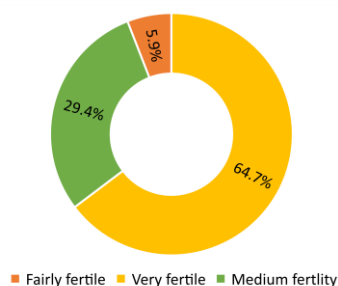


Figure 8 Soil Fertility (%)

• SWC Techniques

Land degradation is a very serious issue in the region. In fact, the landscape is characterized by many slopes and several ravines especially around the lake (see Ouerghemmi., 2021; Shiri 2021, for more detailed maps and territory analysis). In terms of slopy plots, around 40% of the interviewed farmers have land with a slope less than 5% and the remaining 58.8% have lands with a slope between 5 and 10%.

In terms of soil erodibility, most of the farmers interviewed affirm that their soils are weakened by water erosion. Around 23% of the farms mentioned a very strong erosion of their land, 29.4% mentioned their land is subject of strong erosion; 35.5% of the farms believe their soils are moderately eroded; 5.8% of the farms mentioned their soils are very lowly eroded, and only 5.8% of farmers denied the existence of water erosion in their farms. Farmers also recognize the relative importance of wind erosion as well as moderate and low salinity problems (see below figure 9).

For the Soil Organic Content (SOC), 64.7% of the farmers consider their SOC as low, while 29.4% see it as medium and 5.9% as high.

Regarding the degradation of vegetation cover, 6.3% of the farmers believe it doesn't exist; 31.3% of them judge this degradation as weak, and 37.5% believe the vegetation cover has been moderately degraded on their farms. About 25% of farmers mentioned the degradation of vegetation cover in their lands are high and very high.

SWC infrastructure have been already installed on 58% of the farms. About 40% of the farmers see these SWC structures as ineffective, 20% think they are not very effective; 10% of farmers think these are moderately effective while 30% see them as effective.

To deal with soil erosion, 88.2% of farmers use other techniques as fallows; 47.1% of farmers use ploughing against the direction of the slope; 5.9% use plantations (such as cactus), and 35.2% install mechanical benches in addition of ploughing against the direction of the slope.

Tableau 4 SWC techniques adopted

		Yes	No
		%	%
SWC Infrastructure		58.8	41.2
SWC Techniques	No Till	-	100
	Contour Farming	-	100
	Cross Slope Farming	47.1	52.9
	Strip Cropping	0	100
	Planting Windbreaks	0	100
	Crop Rotation	47.1	52.9
	Buffer Strips	0	100
	Rock Strips	0	100
	Bunds (Mud Strips)	35.2	64.8
	Reforestation	-	100

Olive Trees Management

For agricultural practices in relation to olive trees, most farmers (87.5%) use the superficial ploughing "canadien" method while the rest use traditional methods. Pruning is practiced every year by 20% of farmers and the majority (80%) prune every two years. 92.3% of farmers proceed with supplemental irrigation of olive trees, of whom 9.1% irrigate with submersion, 9.1% use sprinkler irrigation, and 81.8% use a mixed irrigation system.

For inputs, only 6.7% of farmers do not add any nutrients to their soils. Most farmers (60%) use manure, while 26.7% of them use nitrogen fertilization and 6.6% use double fertilization (DAP).

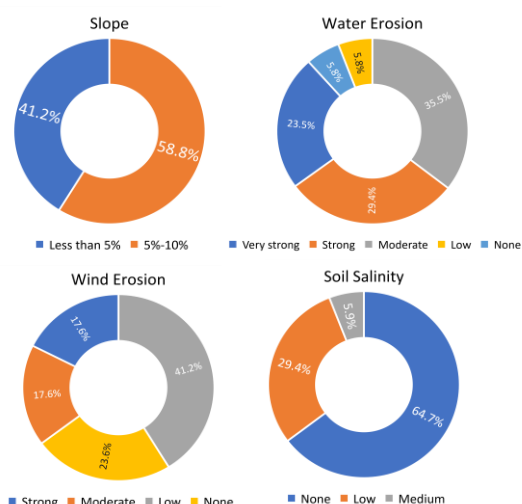


Figure 9 Slope and Soil degradation problems (%)

The majority of farmers (62.5%) apply these fertilizers directly to the soil, 12.5% distribute them by fertigation and the remaining 25% use both at the same time. About 53% of farmers use pesticides, with 85.7% applying them once a year and 14.3% twice a year.

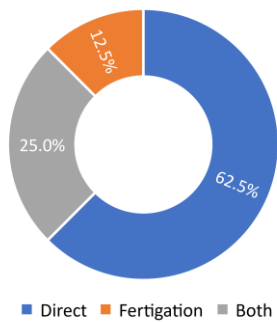


Figure 10 Fertilization methods

2. Rhahla Site Characterization

2.1. Study Area

Localized in the delegation of "Gaafour" (Silianna Governorate)"El Rhahala" site is a relatively small rural community which includes between 100 and 150 households.

The dominant climate in Gaâfour is semi-arid steppe climate. The average annual temperature in Gaâfour is 17.3 °C. The average annual rainfall is 441 mm ([Climate DATA.org](#))

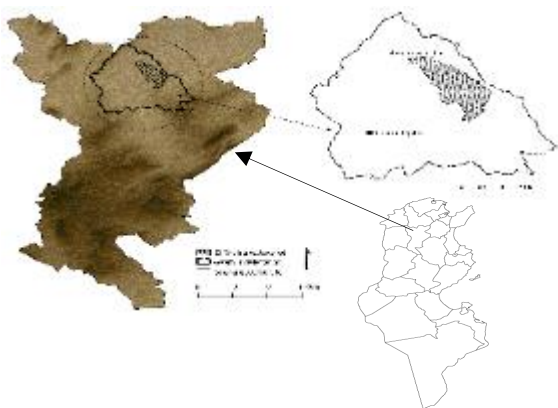


Figure 1. El Rhahla Site, Gaafour

2.2. Data Collection Methodology

Face to face interviews were conducted with twenty four farmers (24) form the region which have been co-selected in collaboration with the leading farmers representing the community and heading the local farmers association (recently created).

The survey is composed of five sections: i) Farmer's Identification, ii) Farm Identification, iii) Crop Production, iv) Livestock Production, and v) Farmer's perception on the SWC Techniques. Microsoft Excel and SPSS were used for DATA entry and analysis.

2.3. DATA Analysis

2.3.1. Social Characterization

- **Age and Gender**

Most of the interviewees were men and only two women managing their own farms were part of the survey. As in the other project site, the access and control over the household assets, including agricultural land, are mainly controlled by men.

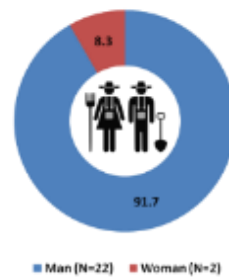


Figure 2. Respondents' Gender (%)

The average age of the interviewed farmers is 47 years; the youngest interviewed farmer is on his early thirty's.

Table 1. Respondents' age

	N	Min	Max	Mean	St-deviation
Age (Years)	24	30	69	47.13	11.778

Half of the interviewed farmers are adult aged between 45 to 60 years old, and only 16% are young farmers.

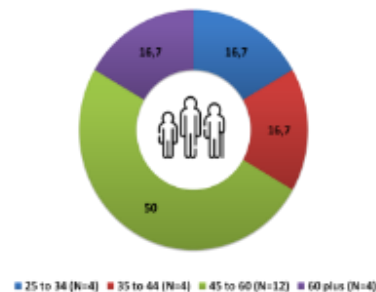


Figure 3. Respondents' age groups (%)

- **Literacy level:**

The illiteracy rate in the community of El Rhahla is relatively high (20.8%). These are usually the oldest farmers. More than 45% of the interviewed have successfully completed their primary education, and only 8% are graduated from the university.

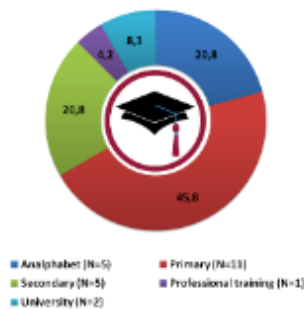


Figure 4. Household Head educational level (%)

- **Main source of income:**

All the interviewed farmers have at least two sources of agricultural income: crop and livestock production. Two third of farmers believe livestock production is their main source of income, which illustrates the importance of this activity as entry point for system

transformation. About 25% of farmers have an off-farm income of different type (public officials, private small businesses, etc.).

Table 2. Household: Main source of income

	N	%
Crop Production	2	8.3
Livestock Production	16	66.7
Off-farm income	6	25

2.3.2. Land Use

In general, all the community farmers are small holders owning in average 8.8 (rainfed) hectares. The highest agricultural areas found in the region is 30 hectares. About 33% of surveyed farmers have a total agricultural area lower than 5 hectares. Almost 46% have a land size ranging between 5 and 10 hectares.

All the owned land in the region is rainfed. None of the surveyed farmers had access to an irrigation water source.

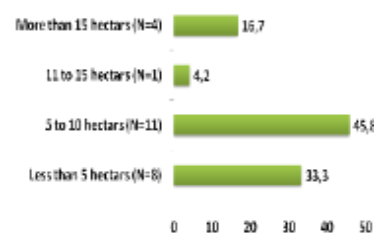


Figure 5. Owned Farm Land Groups (%)

Table 3. Farming Lands (in hectares)

	N	Min	Max	Mean	St-deviation
Total Agricultural Area	24	1	30	8.83	7.68
Useful Agricultural Area	24	1	30	8.46	7.56
Owned Area	24	1	30	8.71	7.73
Rented in Area	24	0	28	2.17	5.92
Rented out Area	24	0	0	-	-
Plots Number	24	1	8	4	1.93
Total Irrigated Area	24	0	0	-	-

2.3.3. Cultivated Crops

"Gaafour" region is well known for growing cereal crops: wheat, barley, and oat and "El Rhahla" region is no exception for this practice. Barley is the most common grown crop because of its use as fodder for the livestock and for human feeding. Oat in the other hand is grown to be mainly exploited as hay. While Wheat and common wheat are cultivated as the main sources of income usually sold to the private or public collecting centers near the region.

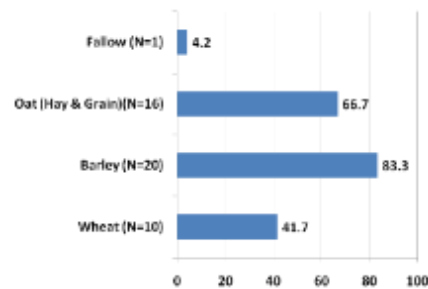


Figure 6. Crops grown last season (2020-2021). (%)

Almost 80% of the farmers do not practice crop rotations, thus growing each season and on the same plot one of the three cereals previously mentioned (Wheat, Barley, and Oat). Only five (5) farmers are practicing a biennial rotation based on cereal crops: fallow-Cereals or legume crops-cereals as explained in the next section.

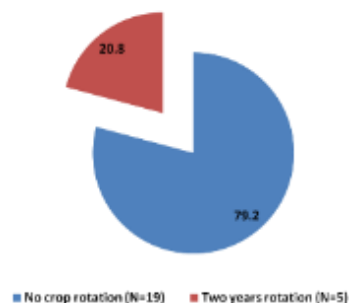


Figure 7. Crop Rotations (%) in the study area

Three quarters (75%) of the interviewed farmers have never grown any legume crops since they started to manage their own farms. Only two farmers have grown legume crops the past season (2020-2021) and two others chosen to cultivate legume this season.

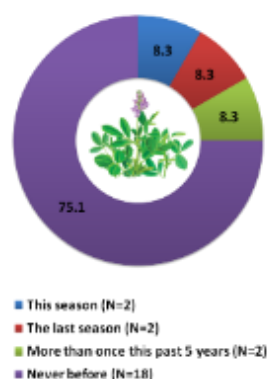


Figure 8. Planting frequency of legume crops (%)

The grown legumes in the region could be divided essentially to two types: i) forage legumes (Sulla, Medics, and Forage Mixtures), and ii) food legumes essentially peas, which are well adapted to the region's climate and soils.

Tableau 4. Grown Legume Crops

Crops	N	%
Sulla	1	20
Peas	1	20
Medics	1	20
Forage Mixtures: Vetch-Oat	2	40

Various reasons are behind the non-adoption of legume crops in the region: the lack of seeds availability and its high cost are the most common causes stated by farmers. Other farmers believe these crops require additional labor force which they can't afford (it's done simultaneously with the olive trees). The variable market price of these commodities and the absence of governmental structure regulating the prices is also one of the serious concerns of farmers.

Tableau 5. Reason for non-adoption

	N	%
Seeds Unavailable	6	31.6
Seed Cost	7	36.8
Labour Force	2	10.5
Diseases	2	10.5
Instable Selling Price	2	10.5
Harvesting techniques	1	5.3
Knowledge	3	15.8

2.3.4. Soil fertility and land management

• Soil characteristics

Many soil textures can be found in the region: peat soils black and relatively rich on organic matter, slit and clay soils which are the most common, and the poor chalky soils easily identified through their white color.

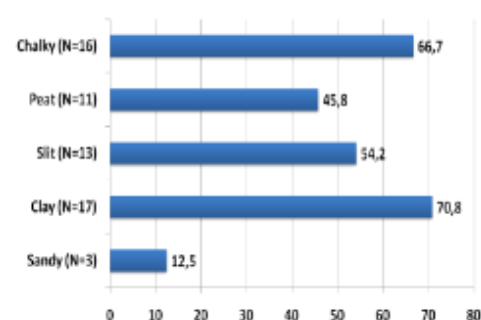


Figure 9. Soil Types (%)

When asked about the fertility of their lands, most respondents consider their soils to be moderately fertile (41.7%). Others think the region soils are no longer fertile due to the erosion (29.2%). Only three farmers (12.5%) believe that their land is very fertile.

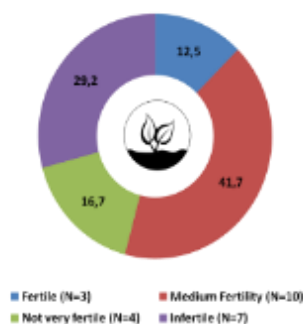


Figure 10. Soil Fertility (%)

Almost all interviewed farmers never did soil analysis. This was due to many reasons: some do not know where this type of analysis could be done; others never heard about such analysis and its usefulness. Some farmers further consider soil analysis as useless since they know the fertility of their soils by assessing the annual crop production, according to them.

Tableau 6. Soil Analysis (Pas five cropping seasons)

		N	%
Soil Analysis	Yes	2	8.3
	No	22	91.7
Reasons not to	Do not need one	6	26.1
	Collecting Sample Protocols	6	26.1
	Do not know where to go	8	34.8
	Expensive technique	6	26.1
	Do not know the technique	7	30.4

• SWC Techniques

Land degradation is a very serious issue in the region. In fact, the landscape is characterized by steep slopes and several ravines caused by all types of erosion.

As matter of fact, 62% of the respondents are suffering from a very high-water erosion issues each year especially during the autumn rainy season. Wind erosion is also perceived as a problem but at a lower extend compared to water erosion. About 42% of farmers consider wind erosion as having similar impact on their land degradation especially during summertime when the soil is totally "uncovered" and exposed to the seasonal hot southerner winds.

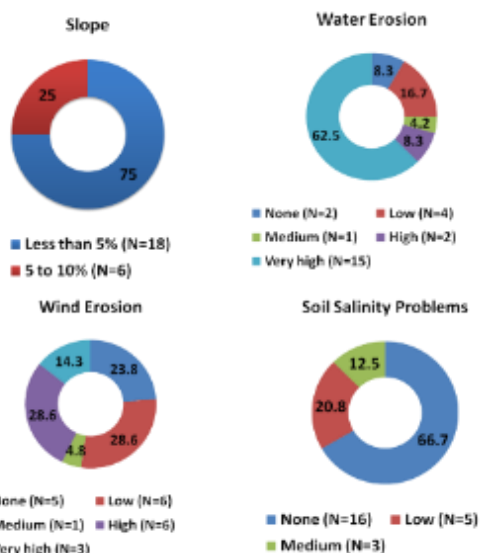


Figure 11. Slope and Soil degradation Issues (%)

More than half of the farmers (58%) have adopted measures/practices to minimize the impact of the erosion on their soils. The most common are bunds or mud strips which are relatively easy to implement by these small holders. Other techniques are less frequent. Easy practices such as the cross-slope farming are not very common because of their indirect economic cost. Almost all farmers lease a tractor for the soil preparation interventions (plowing, weed and disease control, harvesting...etc.).

Tableau 7. SWC techniques adopted

		Yes		No	
		N	%	N	%
Adopting Measures to reduce land degradation		14	58.3	10	41.7
SWC Techniques	No Till	0	-	16	100
	Contour Farming	0	-	16	100
	Cross Slope Farming	1	6.2	15	93.75
	Strip Cropping	1	6.2	15	93.75
	Planting Windbreaks	2	12.5	14	87.5
	Crop Rotation	0	-	16	100
	Buffer Strips	0	-	16	100
	Rock Strips	1	6.2	15	93.8
	Bunds (Mud Strips)	7	43.75	9	56.25
	Reforestation	0	-	16	100

Some farmers in the region believe that these SWC practices are ineffective, very expensive, a governmental issue. Others just reduce the small area of land they already have and accept land degradation as a fact.

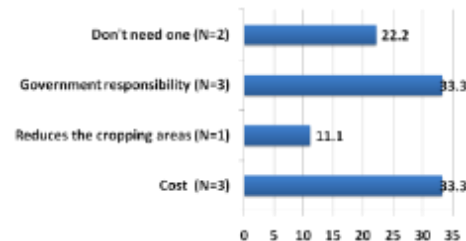


Figure 12. Reason for not adopting SWC techniques (%)

Land Management

The number and frequency of tillage are different for each crop and usually done based on the crop precedent. In "Rhahla" region, the minimum number of plowings for the cereals is two and some farmers make four (04) repetitions before sowing. This is especially common for wheat. Plowing usually starts after the first autumnal rains.

Tableau 8. Average number of tillage by crop

Crops		0	1	2	3	4
Wheat	N	0	0	3	5	2
	%	-	-	30	50	20
Barley	N	0	0	10	10	2
	%	-	-	45.45	45.45	9.1
Oat	N	0	1	5	5	2
	%	-	7.7	38.5	38.5	15.4
Olive Trees	N	0	2	2	0	0
	%	-	50	50	-	-
Fallow land	N	1	0	1	2	3
	%	100	-	-	-	-

The type of machines used for ploughing is also very important since these have different effects on the soil layers. Two types of plows are mostly used by all farmers: the Off-set and the Cover-crop ones. This is due to the wide availability of the machines for lease and also because of their high cost-effectiveness (heavy and deep ploughing usually cost more).

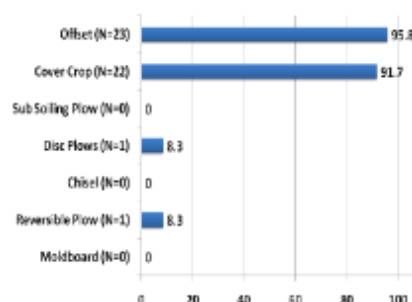


Figure 13. Types of plows used for tillage (%)

One of the cost-effective practices that cereal farmers in the region are used to is the manuring their lands at

the beginning of each cropping season. This practice allows the restoration of part of the organic matter that has been lost during the previous season. However, only 58% of the region's farmers are doing it on a yearly basis. Quantities applied per hectares are also not usually sufficient.

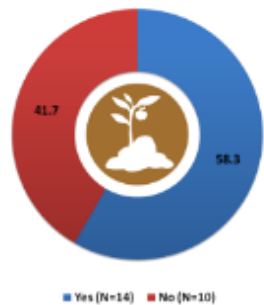


Figure 14. Manure Application (%)

Manuring is usually made for the forage crops especially oat harvested as hay; this is because of its direct effect on the annual weeds which quickly multiplies thus making the hay "richer", according to farmers. Usually, the wheat is not manured since this will increase the cost of weeding interventions.

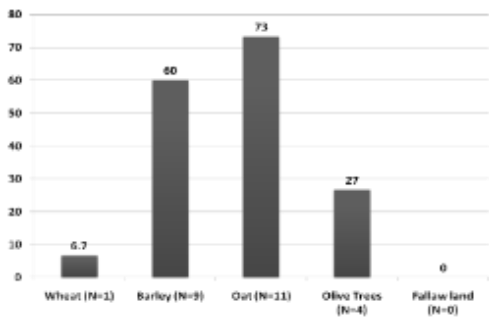


Figure 15. Manure Application by Crops (%)

We should also mention that all farmers are using their own manured produced by their animals. Often, manuring is done only once per cropping season, but some farmers do it twice or even three times per season, depending on their rotation and most importantly the seasonal rain.

The manure application is a two steps procedure. At first the farmer collects and transports it to the targeted plots. Then, he scatters the residue all over the plot. After which, the manure will be incorporated during the first plowing operations.

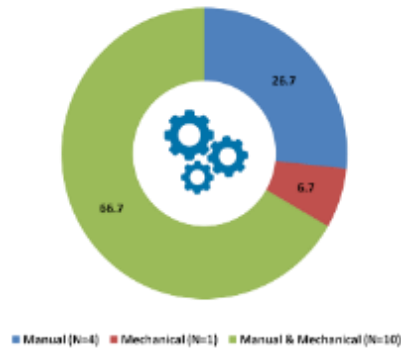


Figure 16. Manure application methods (%)

2.3.5. Crop Management

Numerous cereal varieties are used by the region's farmers. Some are improved varieties and others are self-produced (in case seeds are expensive or unavailable during the sowing season).

Tableau 9. Grown varieties of cereal crops (2020-2021)

Crop	Variety	N	%
Wheat	Razzek	2	40
	Maali	2	40
	Karim	1	20
Common Wheat	Utique	3	60
	Salambo	2	40
Barley	Rihane	16	76.2
	Local	7	33.3
	Manel	4	19
	Kounouz	1	4.8
Oat	Local	16	66.7

The cultivated land is usually divided across three major cereals, with prioritization of barley and wheat for their strategic relevance to household income; Barley is used as a main source of livestock feed, and wheat as a main source of income. All farmers do not sell their barley production unless the quality of the product is very low. This also applies to the oat crop generally harvested as hay to be stored as fodder, with small quantities harvested as grain for use as seeds.

Tableau 10. Area, Yields, and selling prices by crop

		Wheat	Common Wheat	Barley	Oat
Allocated Area (ha)	N	6	5	21	16
	Min	1.25	0.6	1	0.5
	Max	7	3	28	12
	Mean	4.21	1.82	4.6	2.53
	St-Deviation	2.25	0.87	5.93	2.84
Yields (Grain) (Qt/ha)	N	6	5	21	2
	Min	0	10.6	0	20
	Max	40	34	40	30
	Mean	16.33	20.18	17.81	25
	St-Deviation	13.88	10.95	8.95	7.071
Yields (Hay) (Qt/ha)	N	0	0	0	16
	Min	-	-	-	0
	Max	-	-	-	150
	Mean	-	-	-	73.13
	St-Deviation	-	-	-	46.606
Selling Price (TND/Qt)	N	4	2	3	0
	Min	60	0	55	
	Max	85	65	60	
	Mean	76.25	32.50	57.33	
	St-Deviation	11.087	45.96	2.517	

2.3.6. Livestock Management

- **Sheep Breed**

Farmers in the "Rhahla" community prefer the "Thin Tail of the west" breed which is estimated, by farmers, to generate a higher offtake than the "Barbarine" breed. They also attribute this preference to the lower intervention needed by the "Thin Tail" from the shepherd during the mating season. Crossbreeding between the 2 breeds are fairly common because of the high demand in the market for the resulting lambs.

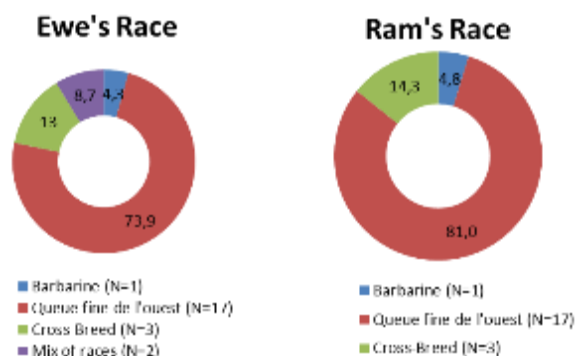


Figure 16. Sheep breeds (%)

- **Herd Structure (past 12 months)**

The table 11 bellow highlights the herd structure during the last twelve months dating from the day of the interview *i.e.* from October 2020 to October 2021. In average, the sheep herd is composed of 31 ewes, 3 breeding rams, six male and 4 female sheep aged between 12 to 14 months (replacement animals or for fattening?), and 11 newborn lambs. Some farmers in the region do not have any sheep and they prefer to raise goats for the household needs or as a "reserve of cash". Some famers have a large flock reaching 100 sheep.

"El Rhahla" farmers have the same economic strategies as the majority of the north-western Tunisian livestock keepers; they sell their annual production during the "El Aid El Kbir" season when the demand is on its highest level. The average prices for a full grown lamb aged between 12 to 14 months is 520 TND, and 300 TND for the ones aged between 6 to 12 months. Usually, all the fully grown male lambs are sold during this season, and the female lambs are sold during the remaining periods of the year to be slaughtered or as a resource of cash in time of need. The flock is considered as an in-kind cash reserve that could be used for numerous reasons: purchasing new household assets, agricultural inputs mainly fodder and fertilizers, and in some cases of health issues the household head will sell some sheep or goats in order to cover these expenses.

Table 11. Herd Structure for the last 12 months

		N	Min	Max	Mean	St-Deviation
Ewe	Number	24	0	100	30.8	24.27
	Number of sales	23	0	10	2.3	3.59
	Selling Price (TND/head)	8	250	550	350	92.58
	Number of purchased animals	23	0	10	0.6	2.15
	Purchasing Price (TND/head)	3	450	650	550	100
	Auto-consumption	23	0	0	0	-
Rams (genitor)	Number	24	0	4	1.7	1.08
	Number of sales	23	0	4	0.7	1.23

	Selling Price (TND/head)	6	350	980	630	273.5
	Number of purchased animals	23	0	4	0.2	0.83
	Purchasing Price (TND/head)	1	800	800	800	
	Auto-consumption	23	0	0	0	-
Ram Lambs	Number	24	0	40	3.6	8.57
	Number of sales	23	0	40	12.5	8.84
	Selling Price (TND/head)	22	400	1100	521.1	149.94
	Number of purchased animals	23	0	14	0.9	3.12
	Purchasing Price (TND/head)	3	350	700	473.3	196.55
	Auto-consumption	23	0	0	0	-
Ewe Lambs	Number	24	0	15	5.6	5.25
	Number of sales	23	0	50	4.7	10.57
	Selling Price (TND/head)	10	250	450	335	62.58
	Number of purchased animals	23	0	0	0	-
	Purchasing Price (TND/head)	0	-	-	-	-
	Auto-consumption	23	0	0	0	-
Male Lambs	Number	24	0	33	6.4	8.3
	Number of sales	23	0	15	1.6	3.8
	Selling Price (TND/head)	5	250	350	300	35.36
	Number of purchased animals	23	0	0	0	-
	Purchasing Price (TND/head)	0	-	-	-	-
	Auto-consumption	23	0	1	0	0.21
Female Lambs	Number	24	0	20	5.5	4.5
	Number of sales	23	0	15	2	4.3
	Selling Price (TND/head)	5	250	320	284	32.09
	Number of purchased animals	23	0	0	0	-
	Purchasing Price (TND/head)	0	-	-	-	-
	Auto-consumption	23	0	0	0	-
Goat (Adult Female)	Number	24	0	12	2.1	3.35
	Number of sales	10	0	0	0	-
	Selling Price (TND/head)	0	-	-	-	-
	Number of purchased animals	10	0	0	0	-
	Purchasing Price (TND/head)	0	-	-	-	-
	Auto-consumption	8	0	0	0	-
Goat (Adult Male; Buck)	Number	24	0	2	0.4	0.58
	Number of sales	9	0	0	0	-
	Selling Price (TND/head)	0	-	-	-	-
	Number of purchased animals	9	0	0	0	-
	Purchasing Price (TND/head)	0	-	-	-	-
	Auto-consumption	8	0	0	0	-
Goat (Kids)	Number	24	0	12	1.4	3.05
	Number of sales	11	0	10	2.1	3.75
	Selling Price (TND/head)	3	220	300	256.7	40.41
	Number of purchased animals	11	0	0	0	-
	Purchasing Price (TND/head)	0	-	-	-	-
	Auto-consumption	10	0	0	0	-

- **Feeding Calendar (Last season)**

The feeding resources in the region are not diversified. The main ration is composed from: Barley grain, commercial feed pellets, cereal bran, straw and hay. This composition is almost the same for all seasons

except for the spring when grazing is the main source of feed for the flock; some farmers state that they do not use any other forage resources other than rangelands, during the spring season. What should be highlighted is the excessive use of the energy-rich feed such as barley grain, cereal bran, oat grains, wheat, and even cactus. Only some farmers have adopted a more balanced ration for their flocks based on some trials conducted by some research and development projects previously conducted in the region.

Table 12. seasonal use of feeds resources in past breeding season

Forage Type	Autumn		Winter		Spring		Summer	
	N	%	N	%	N	%	N	%
Barley Grain	21	87.5	22	91.7	6	25	18	75
Common Wheat	4	16.7	6	25	1	4.2	3	12.5
Wheat	3	12.5	2	8.3	2	8.3	1	4.2
Cereal Bran	18	75	17	70.8	4	16.7	12	50
Straw	23	95.8	23	95.8	7	29.2	16	66.7
Hay	14	58.3	16	66.7	4	16.7	12	50
Commercial Feed Pellets and concentrates	10	41.7	9	37.5	2	8.3	7	29.2
Oat Grain	2	8.3	1	4.2	1	4.2	2	8.3
Cactus	1	4.2	1	4.2	0	-	1	4.2
Grazing	1	4.2	1	4.2	21	87.5	6	25

Approach and results for Scaling Scan application in the project site

First step - Lite version of scaling scan

- The first step was to develop a lite version of the scaling scan tool, which was then used in focus groups aiming at analyzing scaling ingredients to reach the scaling ambitions of the project in both locations.
- The five scaling ingredients considered in the Lite version of the scaling Scan are: Awareness and demand for the technology, Knowledge and competence, Value chain, profitability and financing, Collaboration with public institutions and other stakeholders and, Public sector leadership and governance (see tables 1 and 2 in this annex).

Second step: Validating the Lite version of scaling scan and determining the scaling ambition

- The project team were meeting few times to discuss and adjust the Lite Scaling Scan version developed. These meeting also aimed at identifying the scaling ambitions (target numbers) in each site. The target numbers discussion was due to the fact that the communities object of the project are small and will not allow reaching the total number of beneficiaries planned by the project. Thus, discussions have been undertaken regarding which additional regions (transects) can be added. In Kairouan, the project teams will target the larger region of Oueslatia and Hajeb Layoun in addition to El Khol. In Siliana, some project scaling awareness activities will expand to the communities of Chouarnia and Sers in the transect Kef-Siliana.

Third step: Focus groups for Scaling Scan implementation

- For each technology/project site, a group of (10) persons who already have a good understanding of the fields covered by the scaling ingredients, were called for participation to a focus group.
- Participants were from different research and development backgrounds. Each participant provided his appreciation score to a list of 20 scaling-related questions (four under each of the 5 ingredients). Average scores for each technology/group/site were calculated and reported in the below tables.

Fourth step: Identifying key strength and challenges in reaching the scaling ambition of the considered technologies.

- Depending on the results of the SS, interpreting them will be useful to identify the needful actions that the project needs to program in the future steps of scaling process.

MINIMUM TILLAGE TECHNOLOGY IN SILIANA

Scaling scan results

- Results of scaling scan workshop presented in the below table show that public sector, leadership and governance have been qualified as strong factors which can be seized by the project team to further strategize the scaling of the considered technology.
- Collaboration with public institutions and other stakeholders, knowledge and competence are the principal constraining factors for the good scaling of the “minimum tillage” technology in Rhahla site.

Table 1. Scaling scan results of minimum tillage technology

Ingredients	Overall Score
Awareness and demand for technology	4.8
Knowledge and competence	4.42
Value chain , profitability and financing	4.45
Collaboration with public institutions and other stakeholders	3.9
Public sector leadership and governance	6.3

Key strength and challenges

- Public sector leadership and governance is highly ranked (a score of 6.3). The team can build on this strength to further lobby for policy change in favor of conservation agriculture and minimum tillage practices.
- The survey shows the weakness in term of network between public institutions and other actors and stakeholders. Thus, networking event of the targeted community will be planned.
- In term of knowledge and competence, more trainings will be provided to local extension services and leader farmers in the region. Field days will be organized for this regard.

Elements for a scaling strategy

- Preparing capacity building programs that focus on minimum/zero tillage.
- More involvement of key actors (extension agents, farmer organization and leader farmers) in the project activities and specifically the trainings about the technology,
- Enhance the network of the local community by engaging the leader farmers into the organization of the different field days which will bring existing expertise to the local farmers.
- Improve farmers organization into cooperatives and engage the created association into system transformation actions, such us seeds multiplication, forage processing (pellets), etc. to ensure the sustainability of engaged project activities.

FORAGE MIXTURES TECHNOLOGY IN KAIROUAN

Scaling scan results

- Results of the Scaling Scan in Kairouan shows that scores are much lower than the score obtained for “minimum tillage” in Siliana, which can be understood given the different contexts and technologies.
- The most limiting factor for scaling of forage crops/mixtures in Kairouan is the “Knowledge and competences”, showing that

farmers are lacking awareness and technical skills about the production processes for these crops.

Table 2. Scaling scan results of forage mixtures

Ingredients	Overall Score
Awareness and demand for technology	3.25
Knowledge and competence	3.06
Value chain , profitability and financing	3.34
Collaboration with public institutions and other stakeholders	3.38
Public sector leadership and governance	3.54

Key strength and challenges

- Results of the scaling scan show that all five scaling ingredients are weak and thus project investments need to be taken in all of them.
- The existence of a regional forage seeds multiplication center (belonging to the OEP) is an asset for the farmers of Kairouan. The involvement of OEP Kairouan into possible networking event can enhance the access of farmers to such seeds and sustain their adoption,
- The partially irrigated systems of the region of El Khol (Kairouan) are also a strong point that can help in the successful installation of demonstration plots of the project, and thus documenting successful business cases for farmers from the region.

Elements for a scaling strategy

- “Knowledge and competence” are the most constraining scaling factors: the demand for the technology is low and need to be enhanced through awareness activities.
- Local development agencies and extension staff have limited information, materials, and capacities to promote the suggested forage mixtures technology in their regions. Knowledge products need to be planned by the project teams for this purpose.
- Seeds multiplication and forage transformation will be needed, among others, to sustain the project interventions.
- Better networking of farmers association in addition to regional level policy dialogues need to be planned to support the enabling environment of the scaling of forage mixtures in Kairouan.

More detailed description of the scaling activities to be undertaken in each site can be found in the below table 3. These have been carefully designed based on the results obtained from the scaling scan exercise, diagnostic of farmers systems and farmers preference, and other information which documented the “entry point” for system transformation (farmers priorities and preferences).

Table 3. Causes of soil degradation, entry points for system transformation, and actions planned by the project for the scaling strategy of the promoted technologies in both sites.

Main causes of soil degradation	Problem Level	Problems of the production systems	Project activities (Direct effect on the problem)	Indirect effect on								
				P1	P2	P3	P4	P5	P6	P7	P8	
Slope, frequent tillage, poor soil cover	Soil	P1: Erosion	Training on minimum tillage techniques (Siliana)		X						X	
No crop rotation, Lack of knowledge		P2: Fertility	Soil analysis (Organic/Mineral) (Both sites)	X		X		X	X			
			Training on crop rotation and intercropping (Both sites)	X		X		X		X		
			Training on organic soil fertilization measures (Kairouan)					X				
			Training on compost production (Grinder introduction) (Kairouan)	X			X	X	X			X
Poor pastoral resources, Lack of knowledge, high feed prices	Production system	P3: Livestock feeding	Training on forage mixtures and feeding technics (both sites)	X	X							
Introducing of pellet machine and training on feed processing (Both sites)						X					X	
Lack of knowledge, no herd monitoring		P4: Livestock management	Training on herd management and by-product valorisation (both sites)					X	X			
			Installing a Manure collecting area (Kairouan)		X							X
Pests, poor soil organic matter, irrigation problems, crop rotation		P5: Annual crop productivity	Training on soil cover and mulching/grazing practices (Siliana)	X	X	X			X	X		
			Training on potatoes cropping techniques (Kairouan)		X							
			Introduce hand held sowing machine as instrument for enhancing minimum tillage (both sites)	X	X	X						X
			Forage seed multiplication trainings (both sites)		X	X						X
Lack of knowledge, poor soil organic matter		P6: Trees productivity	Capacity development for olives pathologies (Kairouan)									
			Training on tree pruning and by-products valorisation (Kairouan)		X	X	X					
irrigation technics and practices	P7: Water management		Training on irrigation scheduling (Kairouan)	X	X			X	X			
Weak famer organisation	P8: Structural		Creation and empowerment of farmer organisations (materials, administrative and communication skills, functionality) (Both sites)	X	X	X	X	X	X	X		
Total				8	10	7	4	7	6	4	5	

Table 4. Questions asked under each scaling ingredient of the Lite Scaling Scan version.

Nom:.....	Organisation:	
Question	note (1-10)	Raisons / preuves
1. Sensibilisation et demande de la technologie		
i) Les agriculteurs de la région sont-ils au courant de la technologie (la connaissent-ils)		
ii) Existe-t-il une réelle demande pour la technologie permettant de résoudre les problèmes existants ?		
iii) Les agriculteurs seront-ils prêts à payer pour la technologie et pourront-ils la financer ?		
iv) Les agriculteurs ont-ils accès à l'information (canaux d'information) sur la technologie ?		
2. Connaissances et compétences		
i) Les agriculteurs ont-ils les connaissances nécessaires pour utiliser la technologie ?		
ii) Les formateurs locaux (CTV, AVFA, agriculteurs leader, etc.) ont-ils les connaissances nécessaires et le matériel de formation adéquat pour faire évoluer l'innovation ?		
iii) Les établissements de formation publics (y compris l'université) ont-ils la technologie dans leur programme d'études (curricula)?		
iv) Les bons acteurs sont-ils impliqués dans la formation à la technologie ?		
3. Chaîne de valeur (CdV), rentabilité et financement		
i) Les intrants nécessaires à la technologie sont-ils disponibles à proximité de la communauté (accès aux semences, pièces détachées)?		
ii) Existe-t-il des analyses de rentabilité viables pour la technologie ?		
iii) Existe-t-il des mécanismes financiers disponibles ? (Crédit, subvention)		
iv) Le risque financier est-il acceptable pour l'acteur de la CdV concernant la technologie ?		
4. Collaboration avec les institutions publiques et autres acteurs		
i) Tous les acteurs concernés par la mise à l'échelle de la technologie sont-ils activement impliqués ou un acteur manque-t-il ?		
ii) Les rôles et responsabilités des acteurs clés sont-ils clairs et acceptés ?		
iii) Existe-t-il des réseaux et des plateformes efficaces ?		
iv) Existe-t-il des liens efficaces avec d'autres projets /programme pour faire évoluer l'innovation ?		
5. Leadership et gouvernance du secteur public		
i) Y a-t-il des agriculteurs leaders qui peuvent soutenir le processus de mise à l'échelle de la technologie ?		
ii) L'OPA du scaling-hub est-il suffisamment organisé et équipé pour le processus de scaling (rôles clairs des membres, enregistrés, documentation, salle de réunion) ?		
iii) Existe-t-il une institution publique ou un acteur de CV qui joue le rôle de leader du processus de mise à l'échelle ?		
iv) Le gouvernement soutient-il activement la technologie (subvention, stratégie nationale, programmes de formation)		

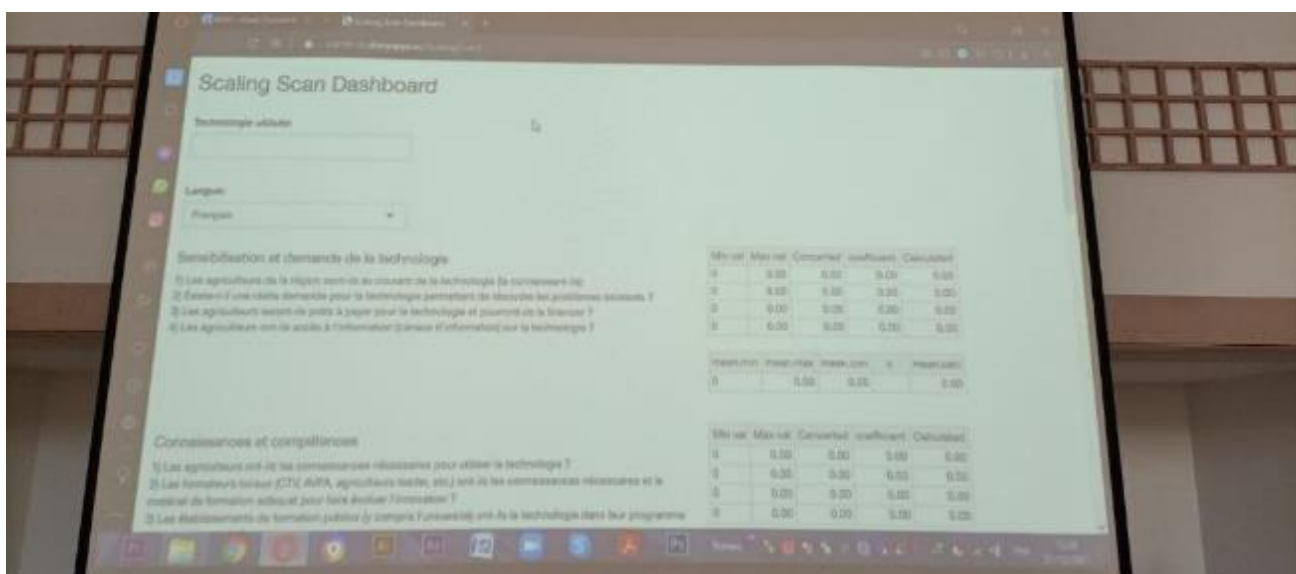
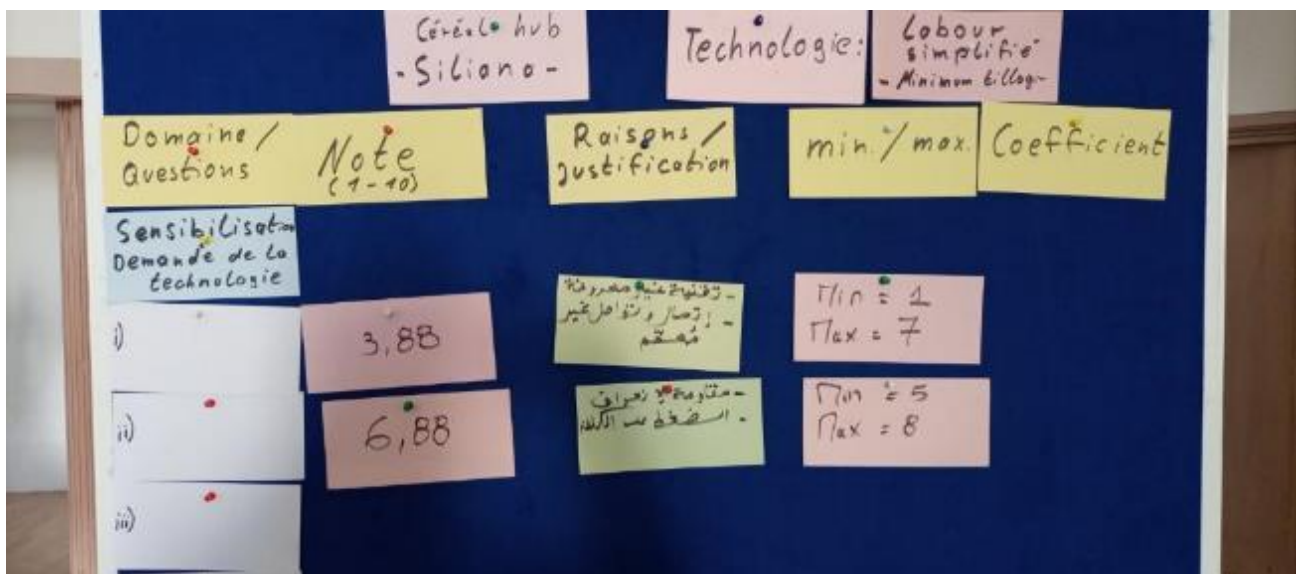


Photo 15. Overview of the scaling scan meeting of the project, Hammamet, 1st December 2021.

SWC@Scale Project
Follow-up sheet

Name				
Surname				
Age				
Cell-phone number				
ID Card Number				
Total area				
Crop	☐ Forage Mixtures	☐ Sulla	☐ Seed Multiplication Plot	
Forage Mixtures Type	V-O ☐	V-T ☐	V-O-T ☐	V-O-T-F ☐

Plowing					
Date of plowing					
Number of hours/ha					
Cost per hour					
Cost					
Total plowing Cost					
Sowing					
Sowing date					
Sowing dose/ha					
Sowing method	☐ Mechanical ☐ Manual ☐ Semi-Mechanical ☐ All Methods				
Mechanical cost/ha					
Labor cost/day					
Sowing total cost					
Fertilization					
DAP quantity used/ha					
Date of use					
Fertilization method	☐ Mechanical ☐ Manual				
Labor cost/day					
Mechanical cost/ha					
Purchasing price per quintal (TND/qt)					
Total cost					
Ammonium nitrate quantity used/ha					
Date of use					
Fertilization method	☐ Mechanical ☐ Manual				
Labor Cost/day					
Mechanical Cost/ha					
Purchasing price per quintal (TND/qt)					
Total cost					
Weed Control					
Weed control (Date of application)					
Quantity used/ha					
Price per unit					
Mechanical cost/ha					
Labor cost/day					
Weed control Total cost					
Disease control					
Disease Control (Date of application)					
Quantity used/ha					
Price per unit					
Mechanical cost/ha					
Labor cost/day					
Disease control Total cost					

Irrigation					
Number of irrigations					
Dates of irrigations					
Cost/Cubic meter (TND)					
Cost of fuel/ha (TND)					
Labor Cost/day					
Harvesting					
Date of harvest					
Harvesting method	[] Mechanical [] Manual [] Semi-Mechanical [] All Methods				
Mechanical cost/ha					
Straw press cost/bale					
Labor cost/day					
Total cost					
Production					
Total grain production					
Total straw production					
Total hay production					
Total Silage production					

	Sold (Quantity)	Date of sale	Where?	Price	Auto-consumption
Grain					
Straw					
Hay					
Silage					

List of references

- Dhehibi, B. (26/10/2021). الفوائد الاقتصادية لتطبيق ممارسات زراعية ذكية وبسيطة للحفاظ على صحة التربة. /Economic Benefits of Applying Soil Health Practices. Beirut, Lebanon: International Center for Agricultural Research in the Dry Areas (ICARDA). <https://dx.doi.org/20.500.11766/66851>
- Frija A, Idoudi Z. (18/12/2020). Self-Sustained “Scaling Hubs” for Agricultural Technologies: Definition of Concepts, Protocols, and Implementation. Lebanon: International Center for Agricultural Research in the Dry Areas (ICARDA). <https://hdl.handle.net/20.500.11766/12248>
- German, L., Mowo, J., Kingamkono, M., and Nuñez, J. 2005. Scaling out strategically: A methodology for understanding patterns and impacts of the spontaneous spread of technological innovations. Convenor: John Dixon, 73.
- Okello, J. 2019. Tracking indirect beneficiaries of complex development interventions in agriculture. International Potato Center. 21 p. <https://hdl.handle.net/10568/101113>
- Ouerghemmi H. 2021. Temporalité et projection des productions oléicoles et territorialisation des oliveraies de montagne (sises à El Khol, Hajeb Layoun) pour une gestion durable. Master thesis. INAT, Tunis, Tunisia.
- Shiri Z. 2021. De la gestion intégrée à l'écodéveloppement agri paysager face aux dégradations des sols : Des applications agro écologiques pour une zone montagneuse d'El Khol (Hajeb Layoun-Kairouan). Master thesis. INAT, Tunis, Tunisia