IFAD – ICARDA - CIMMYT GRANT PROJECT

"Use of conservation agriculture in crop-livestock systems (CLCA) in the drylands for enhanced water use efficiency, soil fertility and productivity in NEN and LAC countries"

CLCA
Coordination meeting

Hammamet, Tunisia 25-26 April 2019.

IFAD
Investing in rural people

ICARDA
Science for resilient livelihoods in dry areas

CIMMYT
International Maize and Wheat Improvement Center

ITGC
المعهد التقني للزراعات الواسعة

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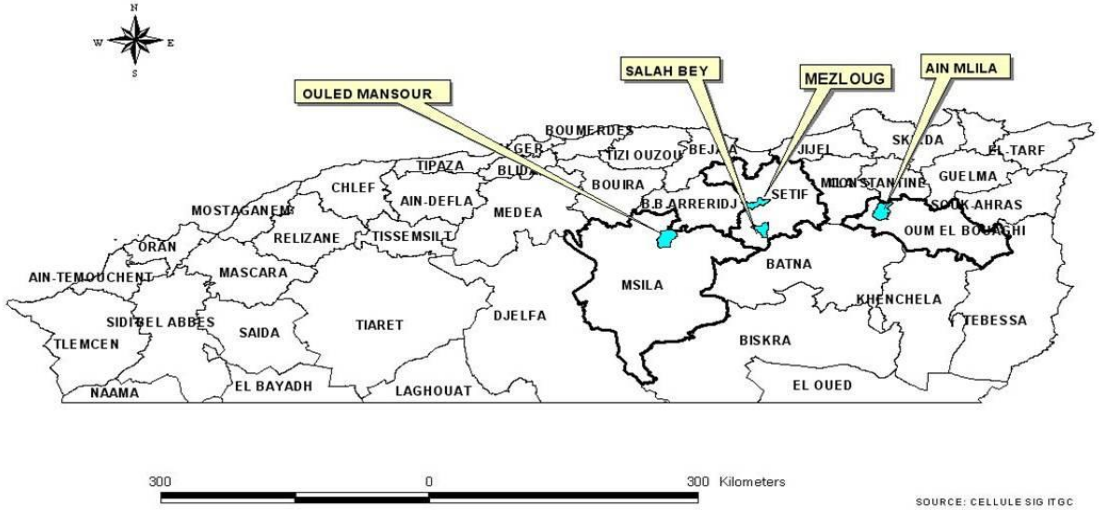
INSID

Activity 1.2. Assessment of the adoption of CLCA on soil erosion, SOM and WUE

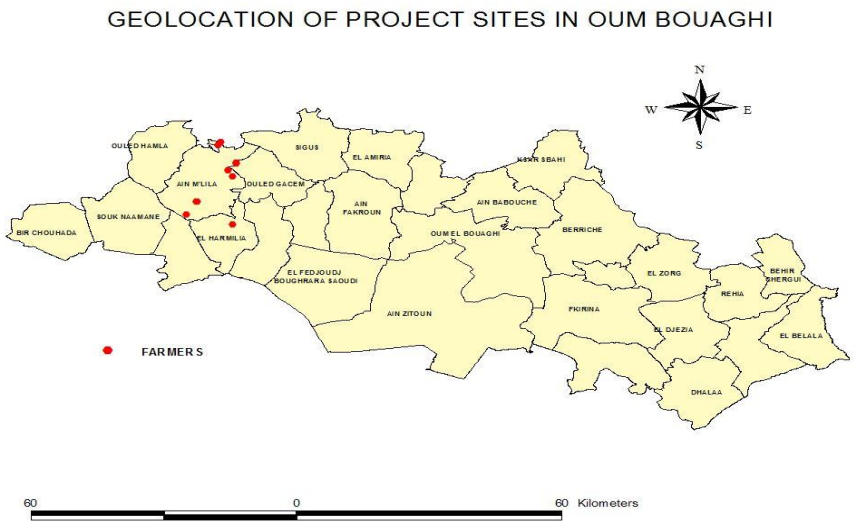
PROJECT SITES



Sites	Nbre	Area (ha)
M'sila	11	14,5
Setif	14	284,5
Ain M'lila	10	17,5
TOTAL	**35**	**316,5**

The project is achieved in four regions (Ouled Mansour, Salah Bey, Mezloug and Ain Mlila) respectively located at 03 wilaya of M'sila, Sétif and Oum el Bouaghi. The criterion of choice was based on the practice of the cereal / livestock activity.

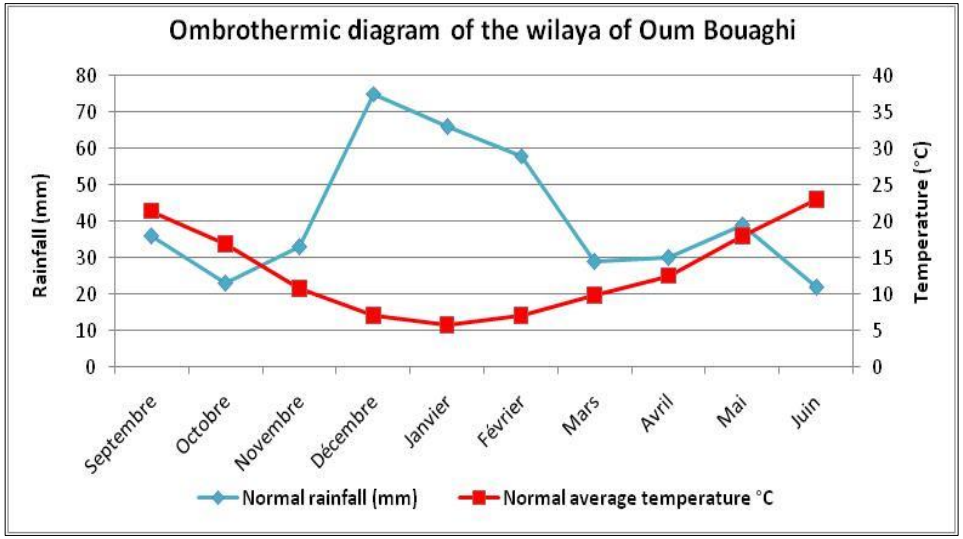
AIN M'LILA



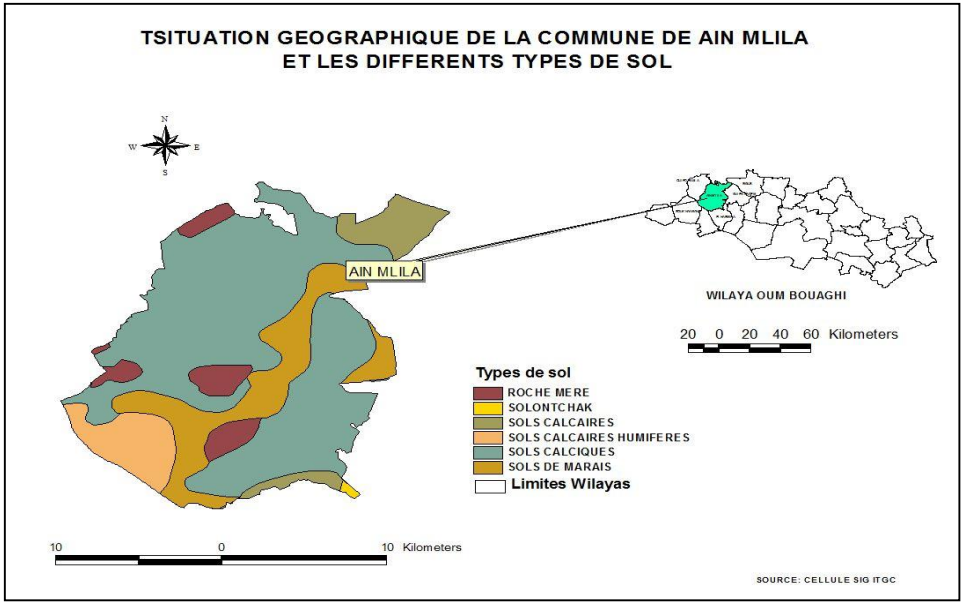
N°	Name of the farmer	Community	System	Area (ha)	Sowing species 2018/2019	latitude	Longitude
1	**Laadjal Ali**	**A.M'lila**	ZT	**1**	Barley - Vetch	36.04815	6.60540
2	**Benmhidi Salim**	**A.M'lila**	ZT	**1**	Wheat - Forage mixture	36.10960	6.58477
3	**Chibane Rafik**	**A.M'lila**	ZT	**1**	Barley - Forage mixture	35.94064	6.52171
4	**Benmhidi Mouhamed**	**A.M'lila**	ZT	**1**	Barley	36.11543	6.59194
5	**ITEV 1 - Station**	**A.M'lila**	ZT	**4**	Barley	35.97201	6.54134
6	**ITEV 2 - Station**	**A.M'lila**	ZT	**4**	Barley - Forage mixture	35.97228	6.54319
7	**Zoughmar Nabil**	**A.M'lila**	ZT	**2**	Barley	36.06394	6.62158
8	**Grabsi abd el moumen**	**A.M'lila**	ZT + MT	**1,5**	Forage mixture	36.06649	6.62315
9	**Laadjal Mouhamed**	**A.M'lila**	ZT + MT	**1**	Wheat	36.03408	6.61542
10	**Gouaoura Marzouk**	**A.M'lila**	ZT + MT	**1**	Wheat	35.91797	6.61563

The Ain M'lila's region is located in the northeastern region of the wilaya of OUM EL BOUAGHI on an altitude of 771 m with an area of 23600 ha, in a plain of fertile land surrounded by mountains that belong to the mountains of Aurès.

The climate is homogeneous, is charact erized by a low cloudiness, great dryne ss of the air causing a warming of the s oil. The amount of rainwater is between 250mm - 350mm per year, the frequent frosts are spread from November to Apr il. The region of Ain M'lia is located bet ween the isohyets 350-400mm



The ombrothermic diagram of the region reveals the existence of a wet period that extends from November to mid-May.



The land of the wilaya is specific to agriculture, it is often found on the plateaus of the North-East region (Ain M'Lila) with the existence of ro cky areas where soils are generally classified b etween limestone and humus limestones .

In the high plains of Ain Mlila, poorly developed soils are developed on colluvial materials, with a silty-limestone texture, shallow depth with a large stony load.

Soil caracterisation result of Ain Mlila platform

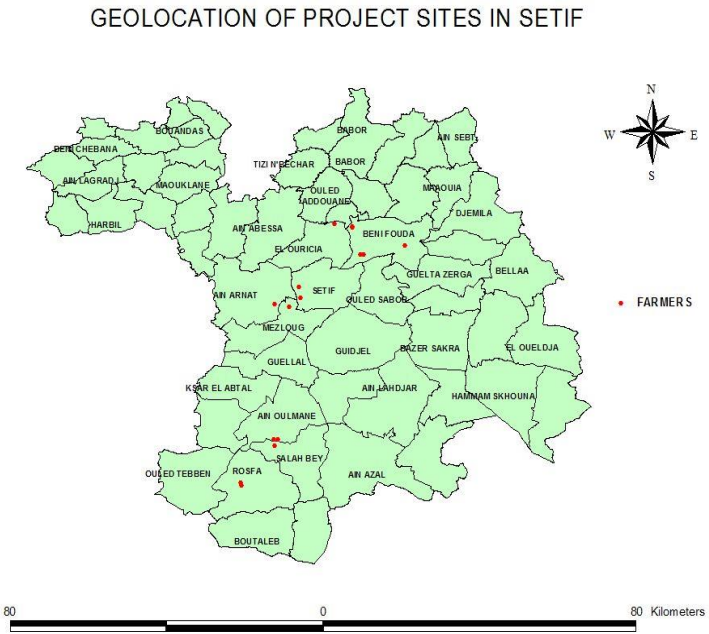
name of farmers	ITELV				BEN MHIDI		LAADJAL		CHIBANE	
	Rotation		Ovine charge	Ovine charge	Rotation		Rotation		Rotation	
Depth	0-10	10--20	0-20 (Barley)	0-20 (Oat)	0-10	10--20	0-10	10--20	0-10	10--20
pH	8,26	8,32	8,34	8,16	8,01	8	8,5	8,24	8,44	8,31
EC	0,42	0,62	0,62	0,5	0,46	0,47	0,58	0,8	0,55	0,75
CaCO3 T %	20,5	19	16	12,5	4	3	17	17,5	8,5	5,5
CaCO3 ACTIF %	14	20	13	16	/	/	21	22	9	8
phosphorus OLSEN	16,0	18,3	9,2	8,5	15,6	14,1	9,0	9,1	4,8	4,6
total Nitrogen %	0,22	0,23	0,26	0,21	0,23	0,27	0,18	0,17	0,16	0,18
Organic Mater %	2,96	3,38	4,23		1,27	2,12	1,48	1,48	1,27	1,27
Clay %	25	32,5	32	27,5	48	33	44	41,5	20,5	21
Silt %	52,26	41,96	51,09	52,73	13,68	30,06	39,62	40,66	35,77	37,92
Sand %	22,74	25,54	16,91	19,77	38,32	36,94	16,38	17,84	43,73	41,08
TEXTURE	limoneuse	argilo_limoneuse	limono_argileuse fine	limono_argileuse fine	argileuse	argileuse fine	argileuse	limono_argileuse	limoneuse	limoneuse
Real Density	2,50		2,44	2,47	2,44		2,48		2,60	
Bulk Density	1,22		1,19	1,12	/		1,14		1,29	
porosity	51,24		51,32	54,63			54,11		50,30	

farmers' soils are alkaline with a pH ranging from 8.01 to 8.44. they are moderately calcareous for all farmers except those of Ben M'Hidi who are very poor in limestone with rates not exceeding 4%. they are poor in organic matter except for the soils of the ITELV station which have an organic matter content of 4.23%. they are silty to loamy-clayey and have good porosity

	number of ewes	SOM %
Before grazing		4,23
After grazing	4 ewes	4,24
	8 ewes	4,24
	12 ewes	4,24
	16 ewes	4,45

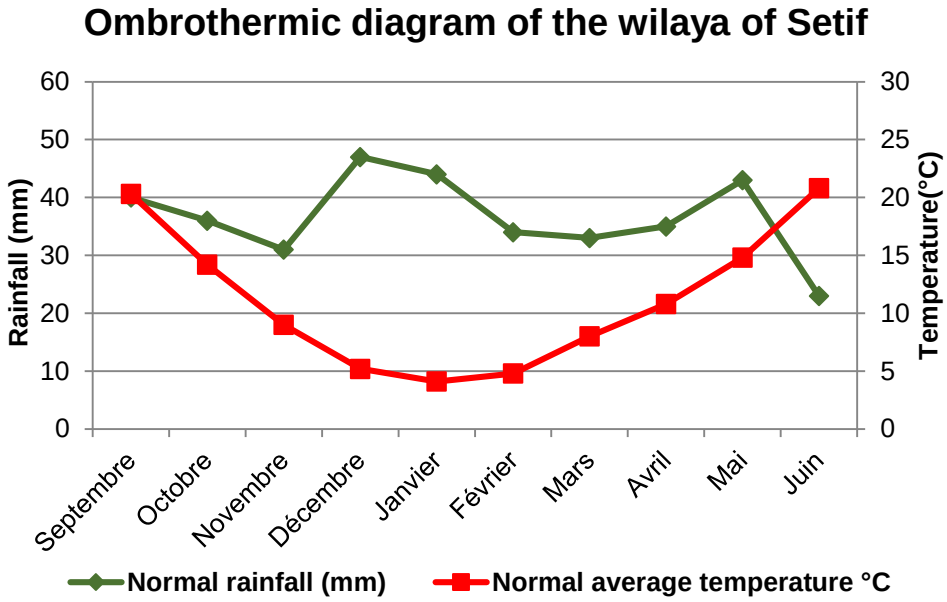
the first sampling was done at the end of July just before pasture, and the second at the e nd of August just after pasture. the results show a change in organic matter of **0.26%** bet ween the characterization and the first three charges increasing from 4.23 to 4.24%, and a remarkable evolution of **5.15%** between the characterization and the load 4 of 16 heads per hectare going from 4.23 to 4.45% of organic material.

Setif



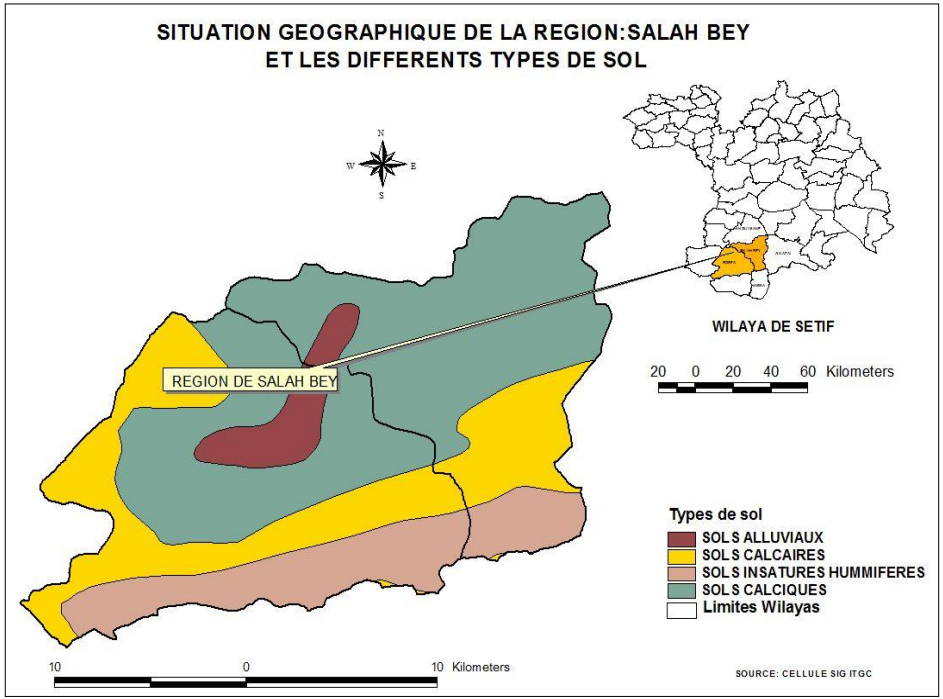
N°	Name of the farmer	Community	System	Area (ha)	Sowing species 2018/2019	latitude	Longitude
1	R'mada (station)	Sétif	ZT	4	Barley - wheat- vetch-Forage mixture	36.14542	5.33466
2	Khamej Houcine	S.Bey	ZT + MT	2,5	Barley - Forage mixture	35.87246	5.30839
3	Laala Kebaili	S.Bey	ZT + MT	1,5	Wheat - Lentil	35.77731	5.22509
4	Douhi saleh	S.Bey	ZT + MT	1	Barley - Forage mixture	35.78406	5.22366
1	Lazazga Rabeh	S.Bey	ZT + MT	1,5	Barley	35.87246	5.30022
2	Kharbich Fateh	S.Bey	ZT + MT	2	Barley	35.85935	5.30202
3	Hakimi Tebani	Sétif	ZT	60	Wheat - Pea - Forage mixture	36.16520	5.36125
4	Smata azzouz	Ain Arnet	ZT	35	Wheat - Pea	36.15210	5.30157
5	Salim khamet	Béni Fouda	ZT	38	Wheat - Vetch	36.25356	5.49769
6	Chakhchoukh Messaoud	Béni Fouda	ZT	10	Wheat	36.27148	5.60110
7	Maiza Sofiane	Ourissia	ZT	10	Wheat	36.31120	5.47985
8	Zouaoui badreddine	Ourissia	ZT	23	Wheat - Vetch	36.30977	5.47983
9	Abdelmoumen Rachid	Ourissia	ZT	40	Wheat	36.31663	5.43854
10	Boukhlif rachid	Béni Fouda	ZT	40	Wheat - Forage mixture	36.25286	5.50666
11	Felahi Azouz	Sétif	ZT	20	Pea	36.18704	5.35806

The climate of the wilaya of Setif is characterized by cold winters and hot and dry summers. Precipitation is irregular in time and space. The southern and southeastern areas are the driest and receive an average of 300 mm per year. The regions of Saleh Bey and Mezloug are between the isohyets 350 and 400 mm.

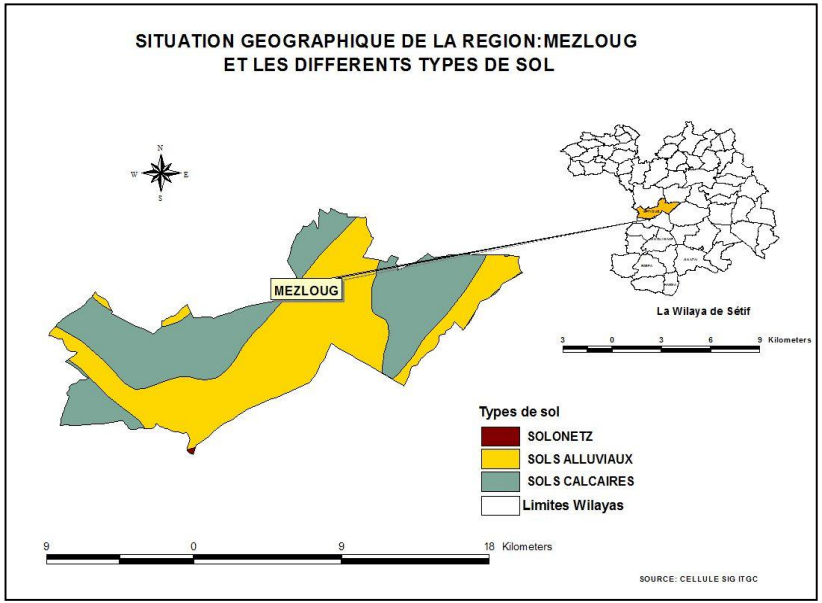


Average temperatures are very low in winter from December to February, but minimum temperatures remain very low until April with a significant risk of late spring frost.

The Saleh Bey region is located south west of the wilaya of Sétif, in the highla nds area with an area of 27400 ha. It is characterized by limestone soils whose quality is variable from one place to an other and a silty-clayey texture, these are moderately deep soils, with a gene rally thin surface horizon and low orga nic matter



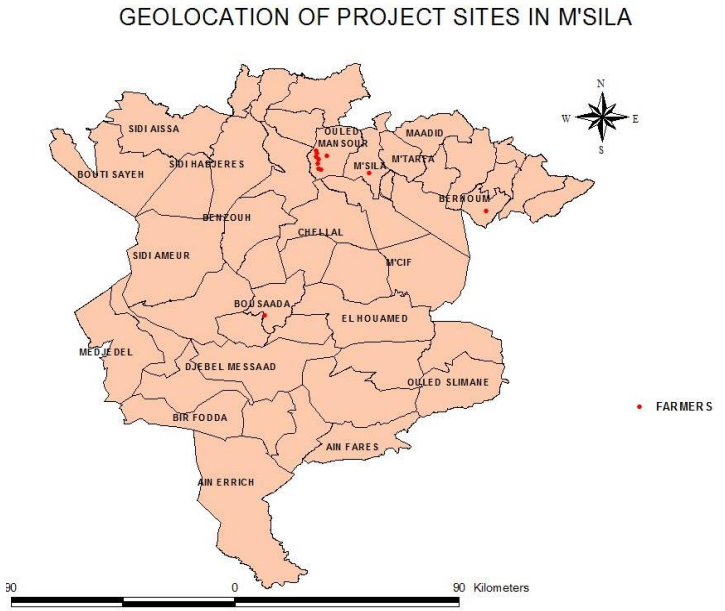
The region of Mezloug is located in the western center of the wilaya of Sétif, on an altitude of 950 to 970m with an area of 14174 ha. It is characterized by moderately deep stony soils with a fine clay to silty-clay texture and rich in limestone



name of farmers	LAAZAZGA		KEBAILI		KHAMEDJ	
	Rotation		Rotation		Rotation	
Depth	0-10	10--20	0-10	10--20	0-10	10--20
pH	8,35	8,2	8,21	8,18	8,46	8,35
EC	0,64	0,99	0,55	0,5	0,6	0,64
CaCO3 T %	15,75	15,5	28,5	28	18	17,25
CaCO3 ACTIF %	16	14	14	14	12	14
phosphorus OLSEN	12,8	14,7	7,9	9,6	5,1	4,2
total Nitrogen %	0,16	0,17	0,19	0,2	0,17	0,12
Organic Mater %	2,96	1,48	1,06	1,48	2,12	2,75
Clay %	13	20	22	23	24,5	27
Silt %	48,55	41,74	57,23	54,41	41,42	38,74
Sand %	38,45	38,26	20,77	22,59	34,08	34,26
TEXTURE	limoneuse	limoneuse	limoneuse fine	limoneuse fine	limoneuse	limono_argileuse
Real Density	2,55		2,46		2,55	
Bulk Density	1,42		1,32		1,3	
porosity	44,34		46,34		48,98	

The soils of the region are strongly alkaline with pH values ranging from 8.18 to 8.46, they are moderately to strongly limestone, poor to medium with organic matter not exceeding 2.96%. they have a silty texture and a slightly low surface porosity not exceeding 48.98%

M’sila



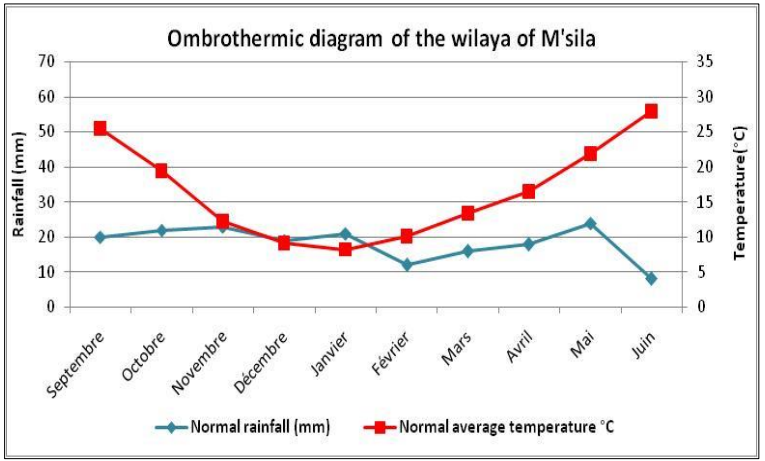
N°	Name of the farmer	Community	System	Area (ha)	Sowing species 2 018/2019	latitude	Longitude
1	Benyettou Lazhar	O.Mansour	ZT + MT	1,5	Wheat	35.70861	4.34396
2	Benyettou Lamri	O.Mansour	AC	1,5	Barley - Forage m ixture	35.67700	4.34556
3	Daoud Lakhder	O.Mansour	AC	1,5	Barley - Forage m ixture	35.73072	4.33828
1	Benyettou Ibrahim	O.Mansour	AC	2,5	Barley	35.69486	4.34110
2	Arioua Fouad	O.Mansour	AC	1	Forage mixture	35.73858	4.33402
3	Arioua Rabeh	O.Mansour	AC	1	Wheat	35.71946	4.37580
4	Ramli Farid	A.Khadra	ZT + MT	1	Barley	35.53007	4.94911
5	Adel Chaib	M'sila	ZT + MT	1,5	Wheat + Tritical	35.66028	4.52648
6	Bendaoud Athman	Maadhar	ZT + MT	1	Barley	35.16544	4.15067
7	Dheif Ammar	O.Mansour	ZT + MT	1	Wheat	35.71930	4.33489
8	Karfa Rabeh	O.Mansour	ZT + MT	1	Wheat	35.67356	4.35283

M'Sila's climate is a continental type subjected in part to the Saharan influences. Summer is dry and very hot, while the winter is very cold.

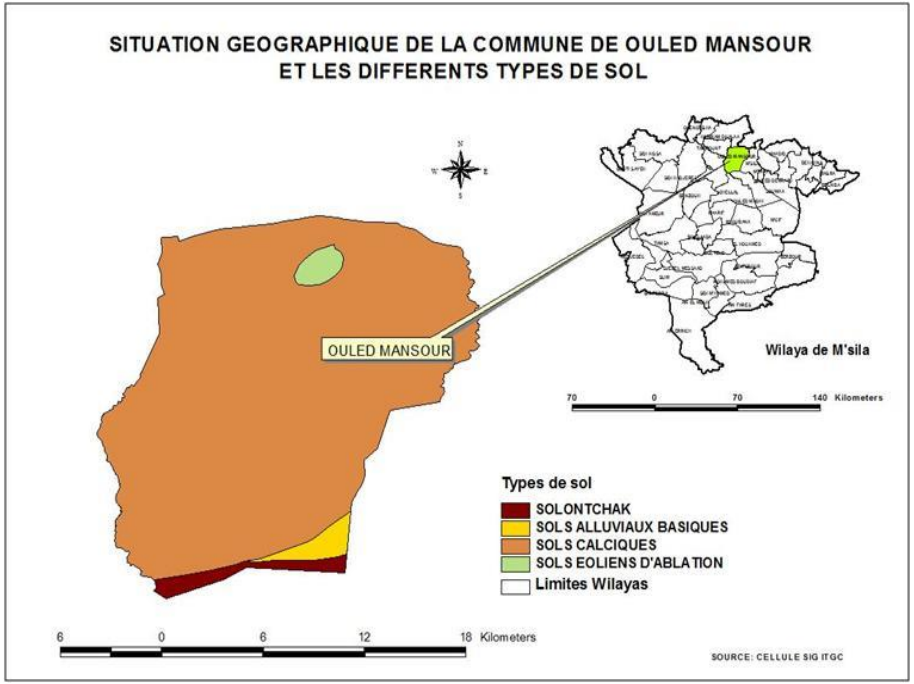
In terms of rainfall, the region is located in the bioclimatic stage 150mm-300mm. The normal of the average rainfall is 192 mm.

The region is characterized by low and irregular rainfall.

The Ombrothermic diagram shows that the dry season is spread almost all year long except the period December-January which is a wet season at the level of the region.

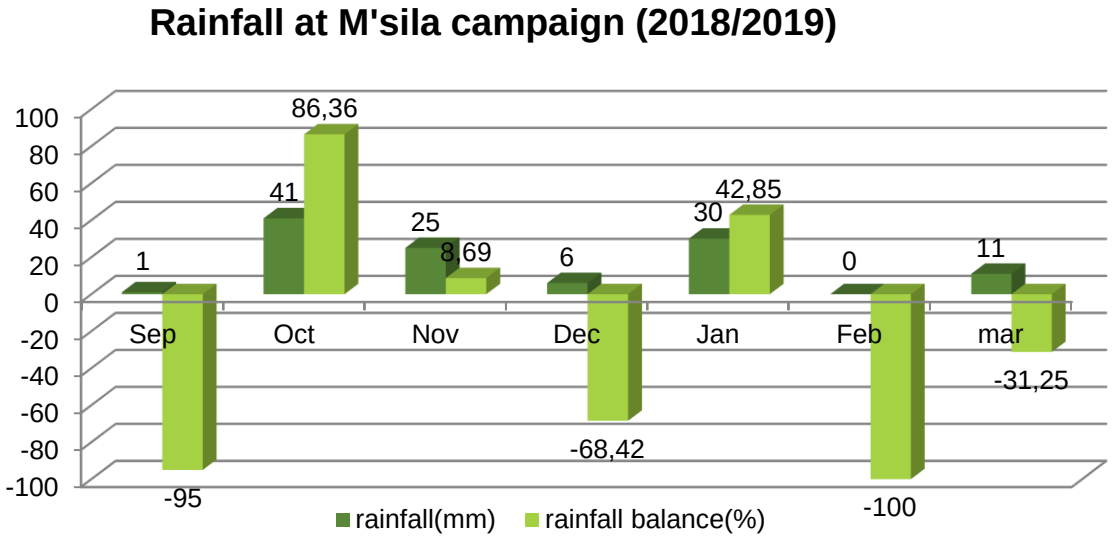


The region of Ouled Mansour is located in the western region at the level of plain zone of the wilaya of M'Sila, on an altitude of 400 meters with an area of 26750 ha. The soles in this region are limestone soils characterized by the presence of a single differentiated, shallow horizon with a pH> 7 in the north and south and by a saline soil rich in soluble salt



name of farmers	DAOUD		BENYETTOU LAMRI			BENYETTOU ABDELKADER		
	Rotation		Rotation			Irrigation		
Depth	0-10	10--20	0-10	10--20	20-30	0-20	20-40	40-60
pH	8,15	8.04	8.87	8.90	8.63	8.26	8.27	8.17
EC	1	2,3	1.86	1.95	1.79	1.20	2.47	2.19
CaCO3 T %	20,25	19,5	10.25	9.43	8.2	10.66	9.84	11.89
CaCO3 ACTIF %	14	17	12	12	13	15	14	11
phosphorus OLSEN	4,3	4,0	2.65	4.55	3.94	3.26	3.11	4.55
total Nitrogen %	0,1	0,11	0,09	0,14	0,08	0,09	0,08	0,09
Organic Mater %	0,63	1,27	2,05	1,79	1,97	2	1,63	10,6
Clay %	37	40	44	47,33	45	41,66	40,33	29,66
Silt %	49,66	46,1	51,51	49,54	50,15	49,39	44,67	42,17
Sand %	13,34	13,9	4,48	3,12	4,84	8,94	14,99	28,16
TEXTURE	Silty-clay loam	Silty clay	Silty clay	silty clay	silty clay	silty clay	silty clay	clay loam
Real Density	2,48		2,54			2,53	2,61	2,59
Bulk Density	1,33		1,26			1,35	1,39	1,3
porosity	46,33		50,39			46,64	46,74	49,81

the soils are strongly alkaline with a pH of 8.90. they are salty with an EC that ranges from 1 to 2.47 mmohs / cm3. they are moderately calcareous, poor in organic matter and mineral elements, they have a silty-clay texture and have a low porosity which does not exceed 50%



The Wilaya of M'sila had a low rainfall during this campaign, it was more or less important at the beginning of this campaign, especially during the month of October which marked a surplus rainfall of the order of 86% with a However, these conditions were favorable for loosening the soil and preparing the seedbed. The seedlings were made in November in good humidity conditions.

On the other hand, the winter season was very exceptional in the month of February, which recorded a negative rainfall record of 100%; this requires several irrigation inputs to fill the water deficit.

Influence of conservation agriculture on water infiltration

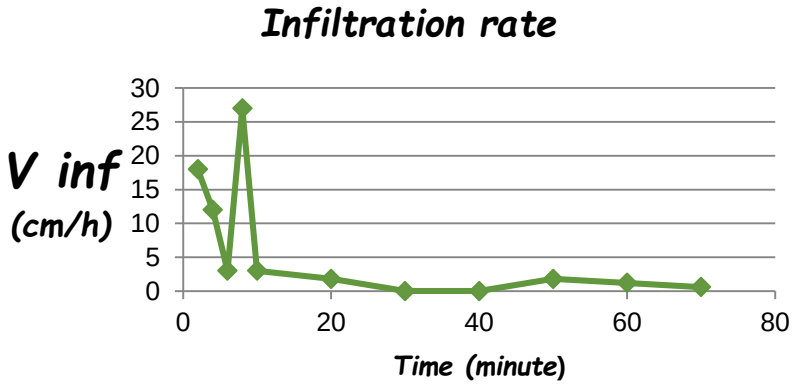
Permeability or rate of infiltration will be determined by t he methode double ring, this parameter allows us to:

- See the influence of CA on the rate of water infiltration, and the comparison between the two modes of tillage.
- Calculate the irrigation time for the gravity method.
- Compare this speed with rainfall for the winder case

Determination of the infiltration rate

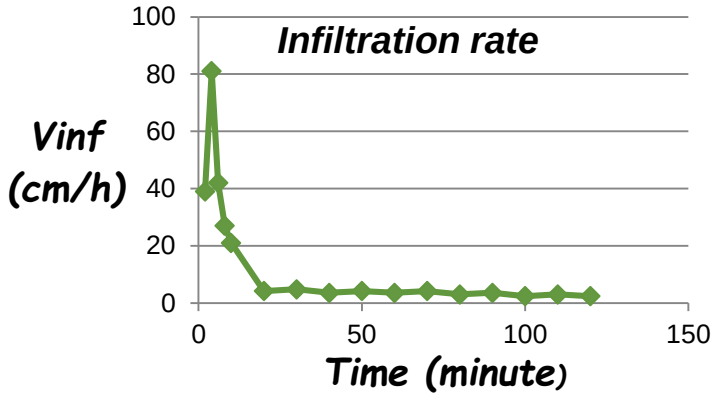
- **Conservation agriculture**

temps t (mn)	h(cm)	h(mm)	Δ h(mm)	vitesse d'infiltration (mm/h)	V (cm/h)
0	7,5	75			
2	8,1	81	6	180	18
4	8,5	85	4	120	12
6	8,6	86	1	30	3
8	9,5	95	9	270	27
10	9,6	96	1	30	3
20	9,9	99	3	18	1,8
30	9,9	99	0	0	0
40	9,9	99	0	0	0
50	10,2	102	3	18	1,8
60	10,4	104	2	12	1,2
70	10,5	105	1	6	0,6



conventional seeding

temps t (mn)	h(cm)	h(mm)	Δ h(mm)	vitesse d'infiltration (mm/h)	V(cm/h)
0	9,5	95			
2	10,8	108	13	390	39
4	13,5	135	27	810	81
6	14,9	149	14	420	42
8	15,8	158	9	270	27
10	16,5	165	7	210	21
20	9,7	97	7	42	4,2
30	10,5	105	8	48	4,8
40	11,1	111	6	36	3,6
50	11,8	118	7	42	4,2
60	12,4	124	6	36	3,6
70	13,1	131	7	42	4,2
80	13,6	136	5	30	3
90	14,2	142	6	36	3,6
100	14,6	146	4	24	2,4
110	15,1	151	5	30	3
120	15,6	156	4	24	2,4



Maximum value
CS = 81cm/h ; ZT = 27 cm/h
Average value > 10
CS = 42 cm /h ; ZT = 19 cm/h
Value at 30 mn
CS = 4.8 cm/h ; ZT = 0 cm/h

- *The actual decrease in infiltration rate started from: 10 minutes for direct seeding and 20 minutes for conventional seeding.*
- *The infiltration is greater in conventional seeding than in direct seeding because the porosity in conventional seeding is more important this is due to the reversal of the soil during the plowing which increases the porosity of the grounds.*

b) Détermination de l'efficience d'application

$$h_{mm} = Hm_{\%}\ z_{mm}\ da\ 10^{-2}$$

nom de l'agriculteur	PROFONDEUR	DENSITE REELLE	DENSITE APPARENTE	porosité
BENYETTOU LAZHAR (irrigation)	0-20	2,53	1,35	46,64
	20-40	2,61	1,39	46,74
	40-60	2,59	1,3	49,81

Humidity before irrigation to a depth of 60 cm			
SC		SD	
H en %	H en mm	H en %	H en mm
15,4	41,6	16,62	44,874
20,14	56,0	19,56	54,3768
18,23	47,4	18,47	48,022
17.92	103,4	18.21	147,3

Humidity after irrigation to a depth of 60 cm			
SC		SD	
H en %	H en mm	H en %	H en mm
31,54	85,158	25,94	70,038
22,29	61,9662	22,95	63,801
23,12	60,112	24,37	63,362
25,65	207,2362	24,42	197,201

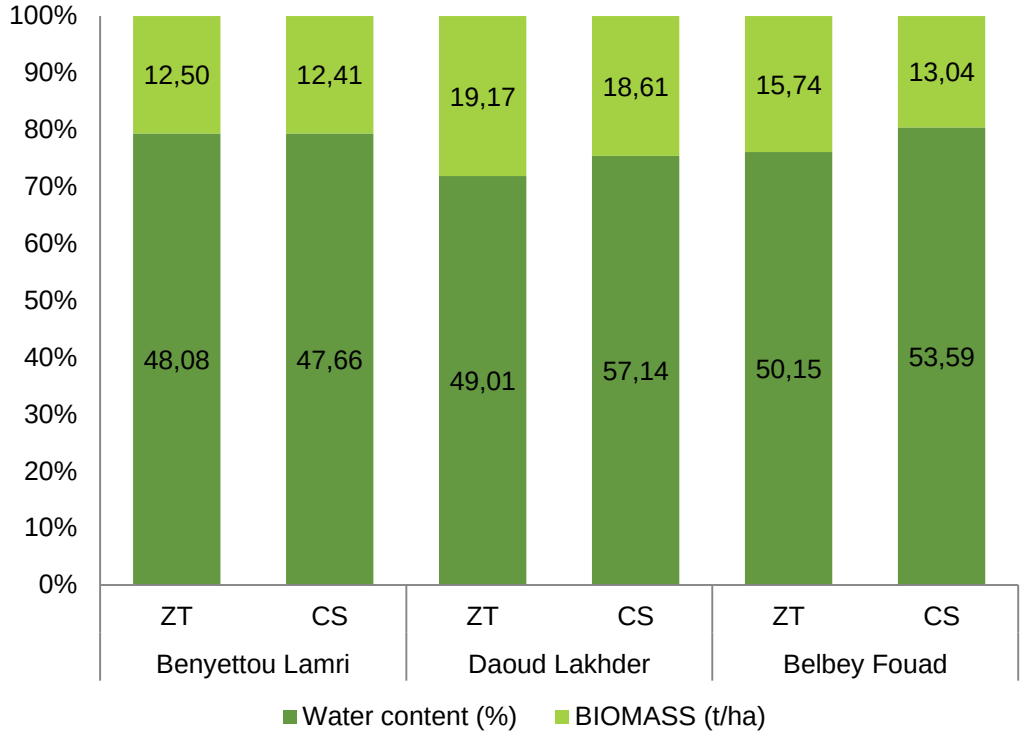
before irrigation the soil of the test conducted in direct seeding was wetter the soil conducted in conventional sowing with a difference of 43.9 mm. after irrigation the conventional sowing soil is slightly wetter than the direct sowing soil this is due to the infiltration rate and the greater sow porosity in conventional testing than in no-till

Behavior and productivity of forage mixtures

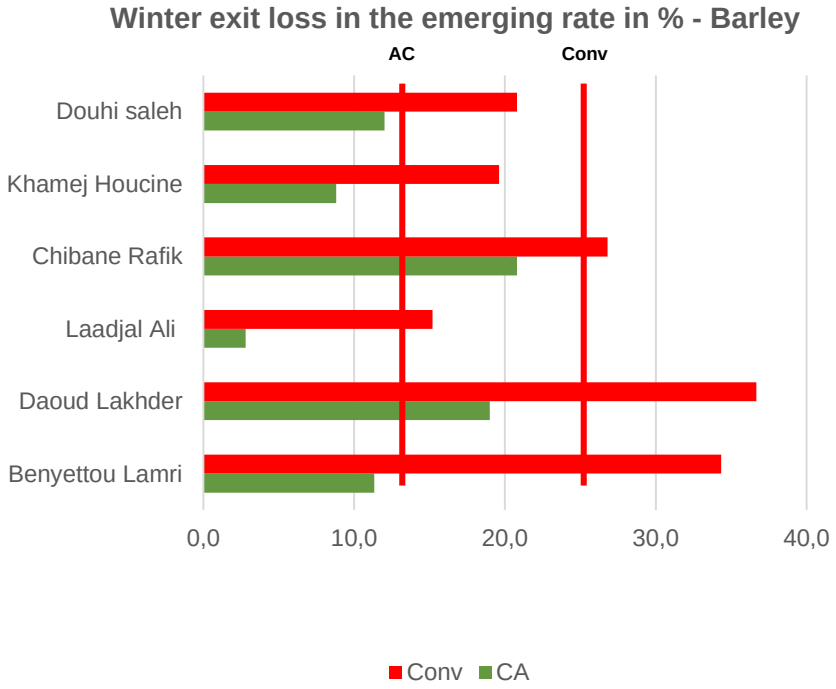
- The largest biomass was obtained in ZT with an average of **15,80 t / ha** however conventional is **14.69 t / ha.**

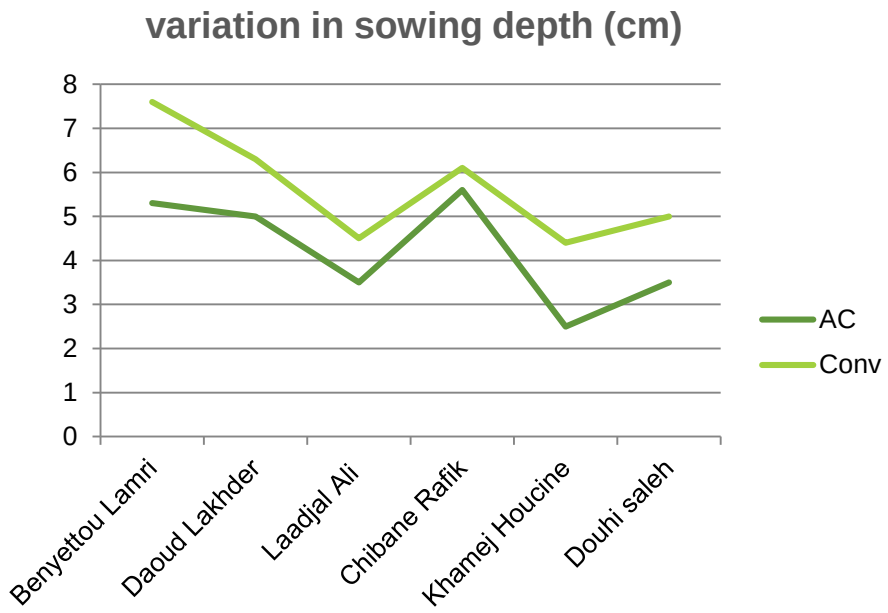
- ZT brings about 1.11 t / ha

- The highest water content was observed in conventional with **52.80%**



Behavior and productivity of some crops

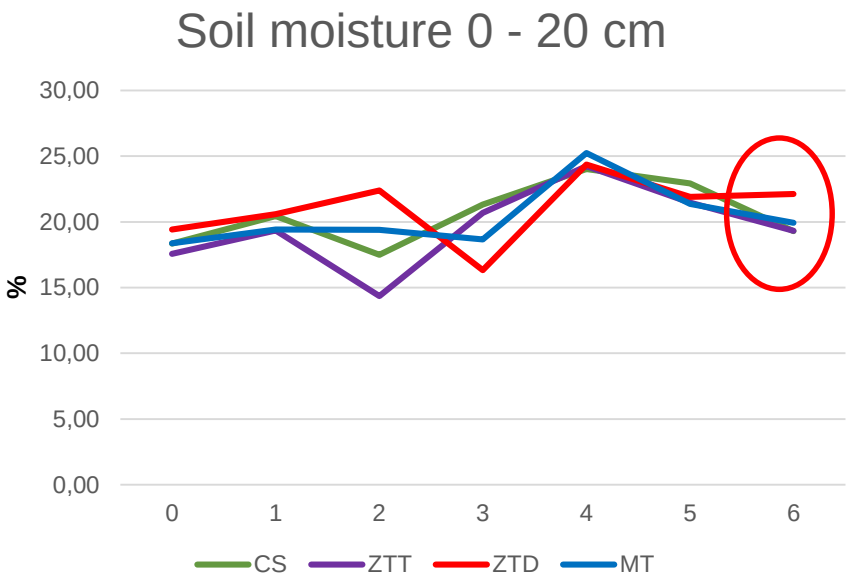


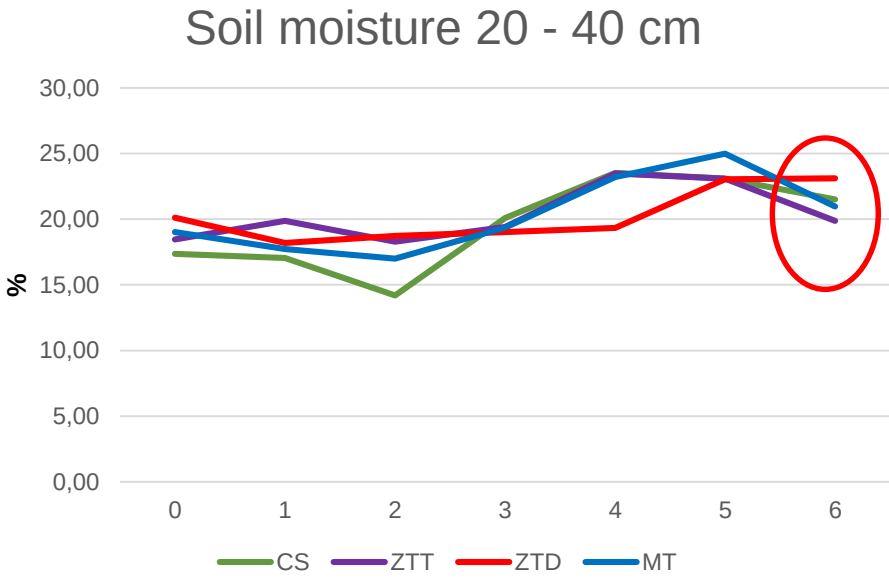


- Average for AC is 12.5%
- Average for Conventional is 25.6%

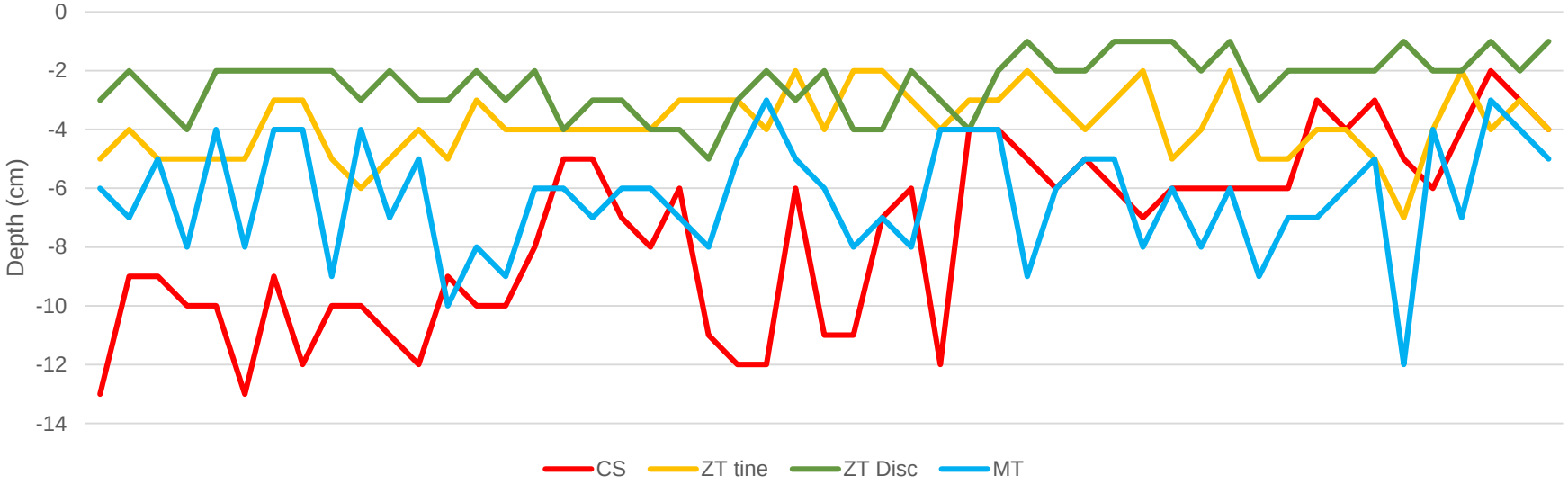
- Average for AC is 4.23 cm
- Average for Conventional is 5.65 cm (difference of 1.42 cm)

Comparaison between four seeding modes – Soil moisture



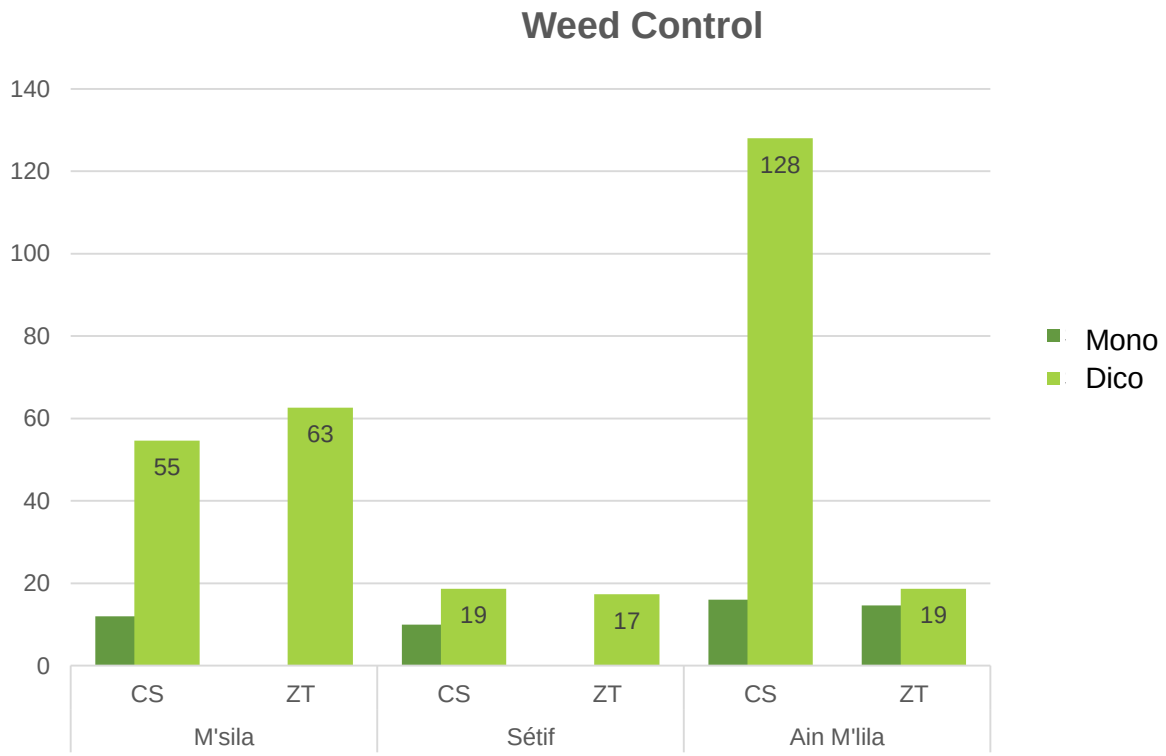


Comparaison between four seeding modes – sowing depth (cm)



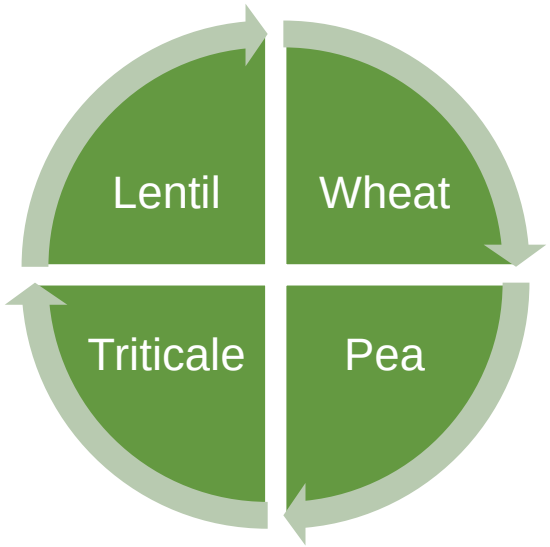
CS	ZT tine	ZT Disc	MT
7,55	3,82	2,41	6,27

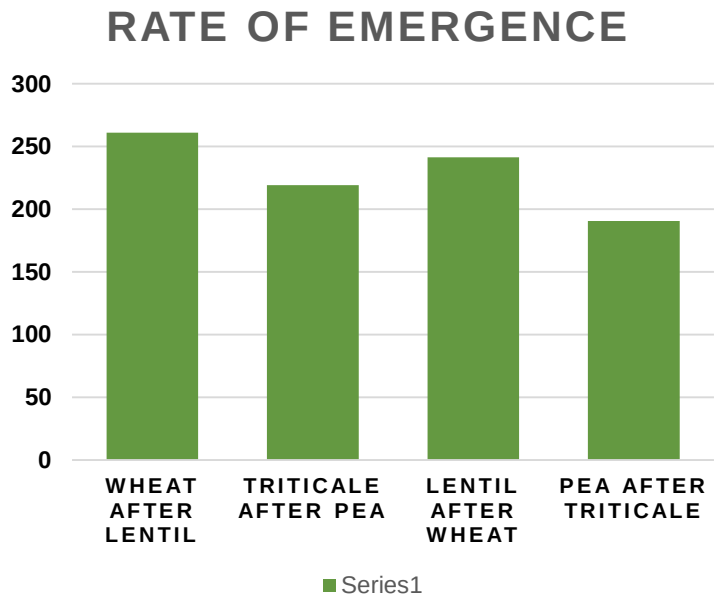
Effect of Chemical Weed Control



Effect of different types of rotations on improving wheat and barley yields

The results of the long-term rotation test at Setif (2012-2019) are :





socioeconomiques activities

2.1. Activity 1: Development of M'sila farm typology

•Objective:

• To understand the structuration of farms and to bring out the different categories of farms according to integ ration level of the crop-livestock system in the region of M'Sila.

Methodology

• A sample of 122 farms

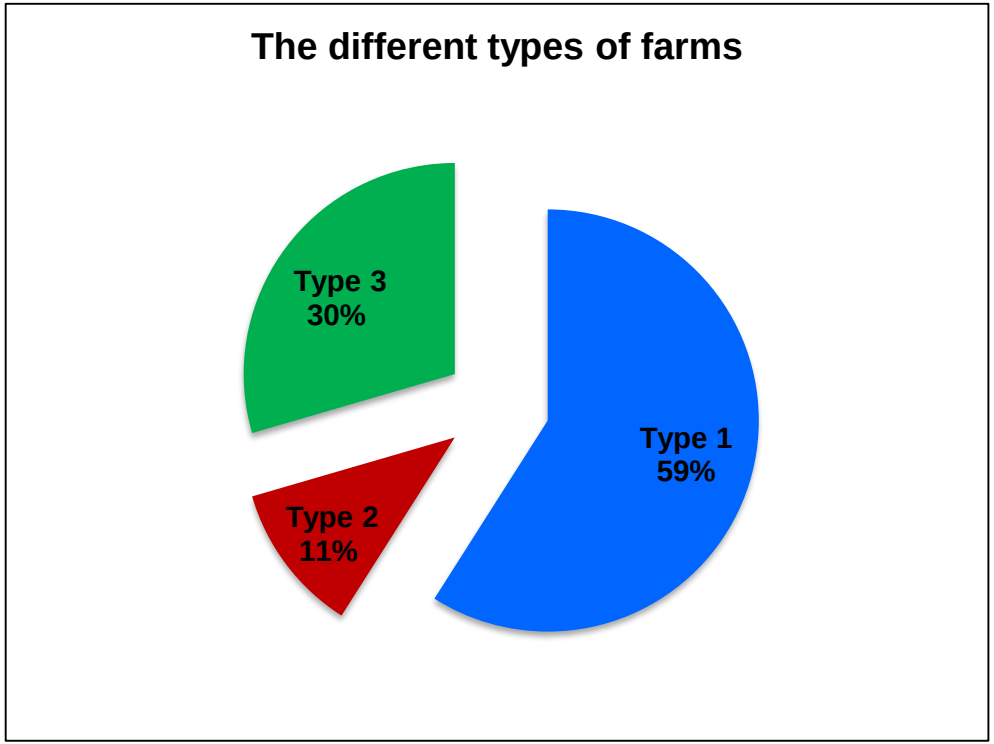
• The farms selection is based on livestock activities on farm and the different types of feeding.

• For all farms 18 variables were selected to establish the typology, according to their nature and their releva nce for crop-livestock integration. it's about:

Structural Variables: Useful Agricultural Area (SAU), Area rented area, Sheep Livestock Size, rangeland, r ation natural grazing/head, ration stubble grazing / head, Percentage area barley / SAU, family labor, seas onal labor.

Performance variables: Total income, percentage rangeland/total feeding, percentage grain/total feeding , percentage straw/total feeding, percentage concentrate/ /total feeding , percentage forage/ total feeding , r ation barley straw / total straw, ration total straw / head, durum wheat yield.

•The classification of components by the use of K_Means cluster method (spss tool) revealed three types of farms:



<u>Type 1:</u> Small breeders with intensive system livestock and average agricultural area. 59 % of surveyed farms

- Average area (SAU) :21 ha
- average rented area: 4.5 ha.
- Barley represents 48% of the Usable land
- Main crops are barley and durum with an average yield of 17 q/ ha and 14 q / ha respectively.

- Average **size of livestock** is **73 heads.**
- Livestock feeding is diversified: straw (29%), forage (25%) and barley grain (23%). The food ration practiced at this type of farm is intended for fattening .

- **Livestock income represents 72%** of the total income of the farm.

- family labor average is 02 people and seasonal labor one person

Type 2: large mixed farms (livestock-crops) with high integration of fodder and grain into the livestock feeding:11% of surveyed farms

- Average Usable land : 117 ha
- Average rented area :49 ha.
- Barley represents 62% of usable land
- Average cereal yield is 17q/ha for durum,16q/ha for barley and 12q/ ha for bread wheat.
- Average size of livestock:308 heads
- Feeding ration is based on forage (hay) 46% and straw (31%) and barley grains (29%).
- The tendency of this type of farm is to commercialize the agricultural production,
- Livestock income represents 57% of the total farm income.
- **This type group of farms are considered as advanced and are on the path of diversification of economic activity.**

Type 3 : Large breeders with an extensive system based on stubble and natural pasture grazing. 30% of the sample farms

- average useful agricultural area (SAU) :17.9 ha
- average rented area : 3.6 ha
- Rangeland average area: 8.7 ha.
- Barley represents 62% of usable land
- Main cereal crops are barley and durum with an average yield of 15 q/ha and 9 q/ha ha respectively.
- average livestock : 179 head.
- Livestock feeding is based on rangeland grazing 46% with a ratio of 14 heads / ha and supplement ation forage 27%. , land leasing is often requested to guarantee livestock feeding
- The average family labor : 03 people.
- The farm income is generated essentially on livestock income : 82%.

2.3 . Activity 3: Economic evaluation of conservation agriculture practice in comparison with the conventional system under the crop-livestock system

M'Sila site (under irrigation)

Benefit-cost analysis at M'Sila 's region (in irrigated)

	Simplified farming techniques			Zero Till			Conventionel Agriculture		
Inputs	**farm inputs**	**Work force**	**Cost (DA)**	**farm inputs**	**Work force**	**Cost (DA)**	**farm inputs**	**Work force**	**Cost (DA)**
Tillage							368,96	4800	5168,96
Simplified farming techniques	737,92	5400	6137,92				461,2	3000	3461,2
Weeding	1324,12	400	1724,12	4193,3	1000	5193,3	1324,12	400	1724,12
sowing	3778	600	4378	3360	3000	6360	3778,36	600	4378,36
Fertilization	19569,18	1500	21069,18	19707,54	900	20607,54	19569,18	1500	21069,18
Irrigation	4040,54	16500	20540,54	4040,54	16500	20540,54	4040,54	16500	20540,54
Harvest		11500	11500		12000	12000		11500	11500
Transport		800	800		800	800		800	800
agicultural inputs			**66149,76**			**65501,38**			**68642,36**
Vaccination		168	168		168	168		168	168
livestock gazing		490	490		490	490		490	490
livestock feeding	840		840	1680		1680	840		840
livestock inputs			**1498**			**2338**			**1498**
Total inputs			**67647,76**			**67839,38**			**70140,36**
Revenues									
Agricultural revenues			**105000**			**119500**			**122500**
Livestock revenues			**15000**			**17500**			**15000**
Total revenue			**120000**			**137000**			**137500**
Indicators									
Net returns			**52352,24**			**69160,62**			**67359,64**
% Change in NR						0,321			0,027
% Change in TC						0,003			-0,033
IRR						113,345			-0,815
Benefit-cost ratio			1,774			2,019			1,960

	Minimum tillage	CA	Conventional agri.
BENEFIT-cost ratio	1.774	**2.019**	1.960

Sétif Site (rainfed area)

Benefit-cost analysis atSétif 's region

	Simplified farming techniques			Zero Till			Conventionel Agriculture		
Inputs	**farm inputs**	**Work force**	**Cost (DA)**	**farm inputs**	**Work force**	**Cost (DA)**	**farm inputs**	**Work force**	**Cost (DA)**
Tillage							368,96	4800	5168,96
Simplified farming techniques	461	2 700	3 161				553	3 600	4 153
Weeding	5 510	400	5 910	8 379	1 000	9 379	5 509	400	5 909
sowing	4 618	600	5 218	7 408	3 000	10 408	138	4 480	4 618
Fertilization	27 939	2 100	30 039	24 570	1 200	25 770	27 939	1 200	29 139
Harvest		10 000	10 000		11 000	11 000		12 000	12 000
Transport		800	800		800	800		800	800
agicultural inputs			**55 128**			**57 356**			**61 789**
Vaccination		164	164		198	198		350	350
livestock feeding	545		545	1 320		1 320	1 167		1 167
livestock inputs			**709**			**1 518**			**1 517**
Total inputs			**55 837**			**58 874**			**63 306**
Revenues									
Agricultural revenues			**120 600**			**173 700**			**177 300**
Livestock revenues			**15 000**			**20 125**			**33 333**
Total revenue			**135 600**			**193 825**			**210 633**
Indicators									
Net returns			**79 763**			**134 951**			**147 327**
% Change in NR						0,692			-0,070
% Change in TC						0,054			-0,070
IRR						12,719			1
Benefit-cost ratio			2,428			3,292			3,327

	Minimum tillage	CA	Conventional agri.
BENEFIT-cost ratio	2.428	**3.292**	**3.327**

2.3 Activity 3: Economic evaluation of the practice of conservation agriculture in comparison with the conventional system under the crop-livestock system

Setif site

Rotations	Wheat/wheat	Wheat/ forage pea	Wheat/ vetch oat	wheat / lentil
Total Charge (DZD /ha)	51260,82	45674,02	45834,02	45974,02
Total Revenu (DZD /ha)	81939,18	141925,98	99665,98	142125,98
Net Returns (DZD /ha)	30678,36	96251,96	53831,96	96151,96
% change in NR		2,1	0,8	2,1
% change IN T C		-0,11	-0,11	-0,1
IRR		-20	-7	-21
Ratio Benefit / Cost	1,6	**3,1**	2,2	**3,1**

Rotations	Barley/barley	Barley/ pea foraging	Barley / vetch
Total Charge (DZD /ha)	32360,82	33924,02	32524,02
Total Revenu (DZD /ha)	62689,18	133825,98	131476
Net Returns (DZD /ha)	30328,36	99901,96	98951,96
% change in NR		2,3	2,3
% change IN T C		0,05	0,01
IRR		46,0	230
Ration Benefit / Cost	0,9	**2,9**	**3,0**

Economic valuation of rotations under conservation agriculture of Barley

M'sila site

Rotations	Barley/barley	Barley /Pea-triticale	Barley / vetch-oat
Total Charge (DZD /ha)	62 806,96	64 261,55	63 961,60
Total Revenu (DZD /ha)	112 000,00	111 000,00	121 000,00
Net Returns (DZD /ha)	49 193,04	46 738,45	57 038,40
% change in NR		-0,05	0,16
% change in T C		0,02	0,02
IRR		-2,2	8,7
Ratio Benefit / Cost	**1,8**	**1,7**	**1,9**

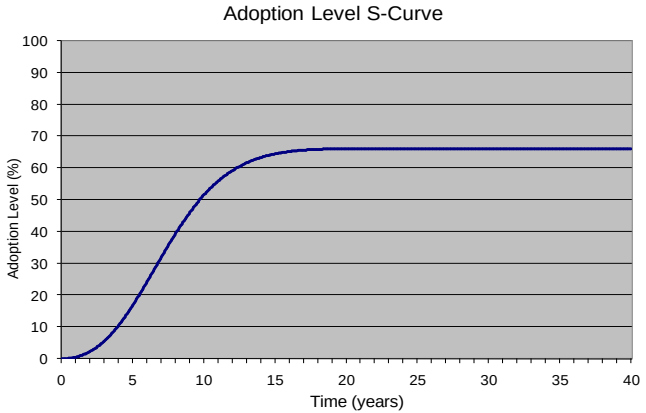
2.5 Activity 5: Adoption of conservation agriculture under crop-livestock farming systems

Focus groups with researchers and extension services at Sétif and M'Sila

•Adoption of conservation agriculture under irrigation at M'SILA

Farmers focus group

Predicted years to peak adoption	**20,5**
Predicted peak level of adoption	**66%**
Predicted adoption level in 5 years from start	**17%**
Predicted adoption level in 10 years from start	**51,6%**



the results of the focus groups obtained by using ADOPT software, on the level of adoption of this system by farmers indicate that the rate would be :

- 66% in20.5 years
- 17% in 05 years
- 51.6% after 10 years

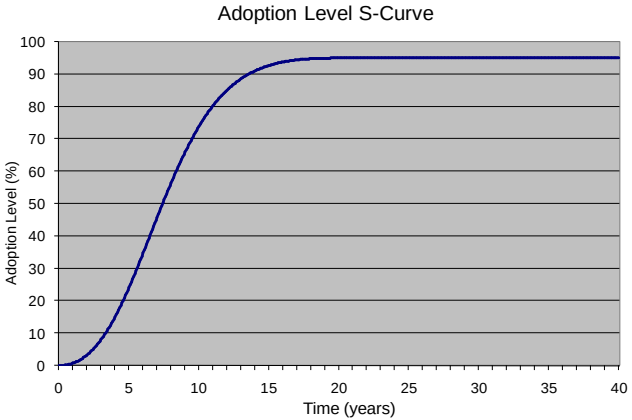
According to some farmers their reluctance is due to the fact that:

•the area soil texture is silty and when its irrigated there is a formation of a layer of fine elements and the soil becomes hard and compact, which requires tillage

•A major share of the sheep's diet in Msila is based on stubble grazing and leaving a vegetative cover will induce farmers to buy food to compensate for the deficit caused by the absence of grazing.

Researchers and extension agents focus group

Predicted years to peak adoption	**13,7**
Predicted peak level of adoption	**95%**
Predicted adoption level in 5 years from start	**51,4%**
Predicted adoption level in 10 years from start	**92,8%**



The predicted years for adoption of conservation agriculture is about:

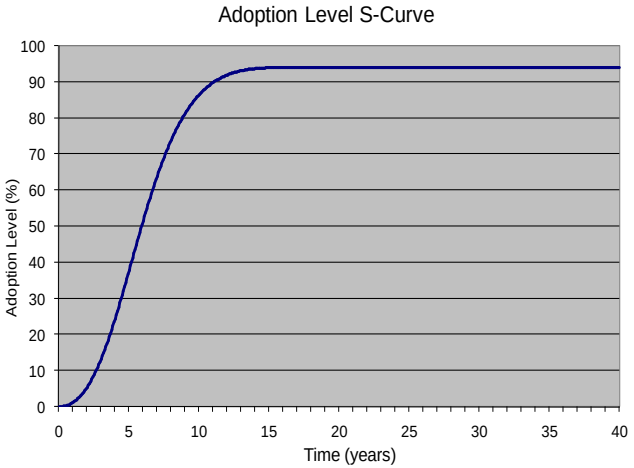
- 95% in13.7 years
- 51.4% in 05 years
- 92.8%.after 10 years

For researchers the issues of CA adoption are related to the lack of profitability during the first years and the environment (the use of glyphosate.)

•Adoption of conservation agriculture (Setif rainfed area)

Farmers focus group

Predicted years to peak adoption	**16,3**
Predicted peak level of adoption	**94%**
Predicted adoption level in 5 years from start	**37,8%**
Predicted adoption level in 10 years from start	**86,5%**



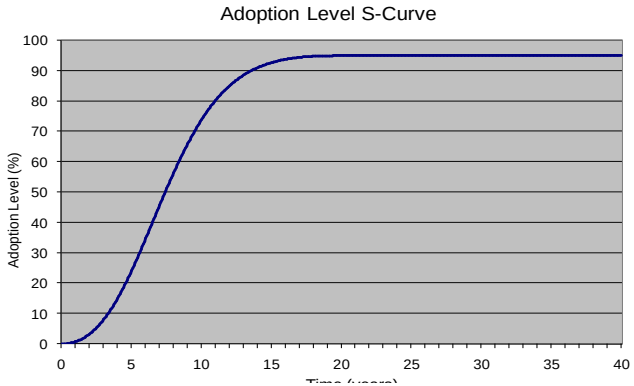
Conservation agriculture was introduced in the region of Setif. in 2006, it has a remarkable evolution from the 2009-2010 crop year with the acquisition of specific direct seeders.

The results of the focus groups obtained by the ADOPT software on the level of adoption of this system by farmers indicate that the years planned for the adoption of conservation agriculture would be :

- 94% in 16 years
- 37.8.4% in 05 years
- 96.5%.after 10 years

Researchers and extension agents focus groups

Predicted years to peak adoption	**20,6**
Predicted peak level of adoption	**95%**
Predicted adoption level in 5 years from start	**24,2%**
Predicted adoption level in 10 years from start	**73,9%**



for researchers and developers, the results are similar to farmers,
the predicted years for adoption of conservation agriculture would be:

- 95% in 20.6 years
- 24.2% in 05 years
- 73.9%.after 10 years

- The adoption rate is influenced by the benefit of the innovation and what it can bring to the farmers.

2.6 Activity 6: Key decision makers assessment /perceptions (CLCA technologlies).

At the regional level

Constraints	solutions
• Absence of a concrete strategy for the development of conservation agriculture. • High cost of direct seeders • Non-availability of direct seeder • lack of mastery of conservation agriculture technologies (rotations, weed management) • Lack of technical references on conservation agriculture • Lack of exchanges between farmers who practice conservation agriculture and no adopters • Lack of training and demonstration and extension days on conservation agriculture.	• A clear and concrete politic for development of conservation agriculture • Give the research and development institutes resources to better take charge of the dissemination on CA technical package • Specific subsidy for the acquisition of the direct seeder • Availability of the direct seeder on the market • Intensify training, demonstration and extension technical days on CA • Intensify exchange between farmers • Introduce CA into academic training • Development of research topics on CA adapted to the conditions of the country.

At the national level

Constraints	Solutions	Strategy
Availability of direct seeder is essential in CA	▪ The manufacture of equipment adapted to CA. The Algerian agricultural equipment manufacturing complex (CMA) has recently developed a **direct seeder "BOUDOUR"**, which has given convincing and interesting results both on soil and crops. This equipment is adapted for small farms and fragile soils. ▪ Integrate the development of direct seeders produced locally in the FAO TCP (Technical Cooperation Program), related to the development of mechanization in Algeria ▪ State support for the purchase of direct seeders; ▪ Grouping of small farms to increase their means of investment and intervention, ▪ Creation of AC crop units.	- **A national plan for the resorption of fallow by the increase of fodder and legumes areas was initiated by the government, in 2015**, considering that the lentil rehabilitation program doubled the production between 2016 and 2017 ; it's not the case for forage production due to the unavailability of fodder seeds. - Introduce the national CA development program into the programs of the Ministry of Agriculture
A conventional production system	• Diversification of the production system with the increase of forage areas and food legumes; • Integration of livestock in CA system, • Adoption of a balanced rotation plan in farms under CA.	
Weed control problem	• Adoption of the right rotation. • Control of the sowing dates. • Combined management of weeds between chemical and mechanical control.	

Absence of national state Program	• Carry out a national extension program with the collaboration of all institutions that gr avitate in the sphere of production by highlighting all the experimental results obtained on station and farm level. • Introduce a national development program of CA in the programs of the Ministry of Agriculture • Introduce CA training in agricultural training institutes and universities.	Introduce CA training in agricultural training institutes and universities


Optimization of pastures on stubble under conservation agriculture in semi-arid zones.
Oum Bouaghi - Sétif - M'sila

Distribution of breeders considered in this study

Wilaya	Commune	Number	Breeders names
Sétif	**Saleh Bey**	3	Kebaili Laala Khamej Hocine Lazazga Rabah
Oum El Bouaghi	**Ain M'lila**	3	Station ITELV Ben M'hidi Laadjel Chibane
M'sila	**Ouled Manssour**	3	Daoud Lakhdar Ben yettou Lamri Ben yettou lazhar

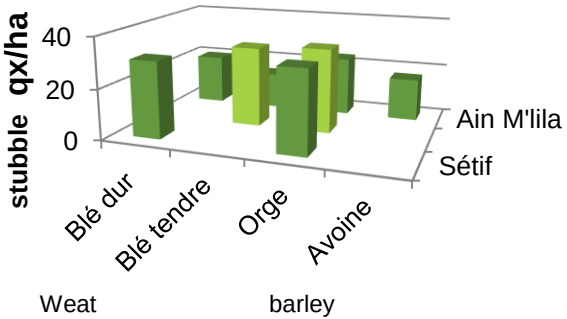
- The stubble quantities left on the ground were estimated before, during an d after ewes grazing

- The availability of UF stubble allowed us to estimate the conventional stoc king head /ha for a pasture period from June to September.

- The loads studied at the ITELV station and at the three breeders of Ain M'li la vary from 4 to 25 ewes /ha. Notations on stubble and ewes were taken 8 to 15 days apart.

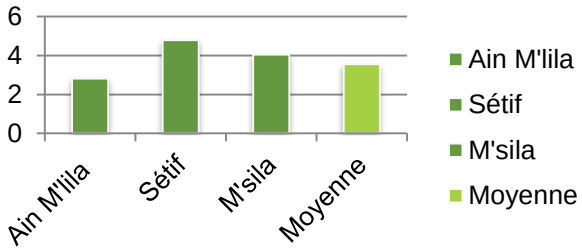
- At Setif and M'sila the logs were taken at intervals of 15 days on the stubbl e and the ewes.

Fig. 4. Quantities of stubble qx / ha
by wilaya and species



The average yields are higher among Sétif and M' sila breeders compared to Oum El Bouaghi respe ctively 31.72, 32.44 and 18.33 qx / ha.
This is explained by the harsher weather conditio ns in Ain M'lila than in Sétif and M'sila and the use of supplementary irrigation. The average stubble yield obtained among the farmers is 25.30 qx / ha; less than the biomass required for semi-direct driv ing.

Fig. 8. Average animal stocking head/ha
and per wilaya



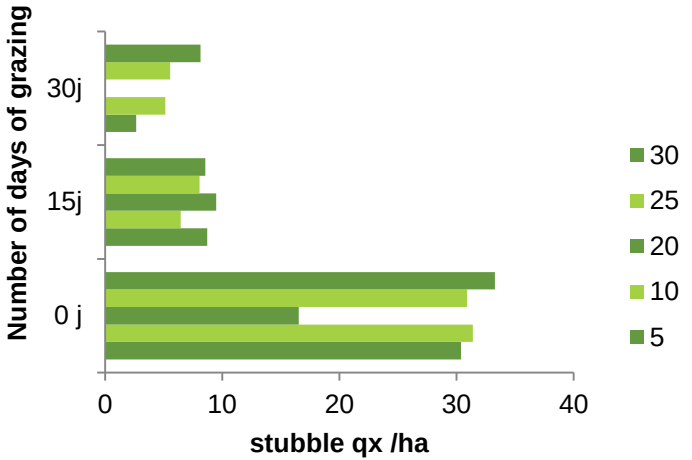
On average, yield is 546 UF / ha for the proj ect area. The load varies between 2 and 4 h eads per hectare depending on the producti on.

The average load is 3.5 heads / ha.

Town	Breeders	Species	DM %	OM%	MM%	TNM%
Ain M'lila	ITELV	Barley	98.23	85.69	14.31	4.27
		oat	97.47	86.86	13.14	3.69
	BenM'hidi Salim	Durum wheat	96.50	93.46	6.54	3.79
	Laadjel Ali	Soft wheat	97.67	86.40	13.60	4.07
	Chibane Rafik	oat	96.20	88.88	11.12	2.55
Sétif	Kebaili	Durum wheat	89.52	87.06	12.94	5.50
	Khamedj hocine	Barley	89.98	86.12	13.88	5.49
	Laazazga Rabah	Barley	89.46	86.22	13.78	5.22
M'sila	Daoued Lakhder	Durum wheat	90.38	81.16	18.84	3.18
	Benyatou laamri	Soft wheat	90.19	86.49	16.51	2.88
	Benyatou lazhar	-	-	-	-	-

Stubble evolution depending on stocking head and grazing duration

Fig.26. Evolution of stubble depending on the stocking head and the number of grazing days (qx / ha)

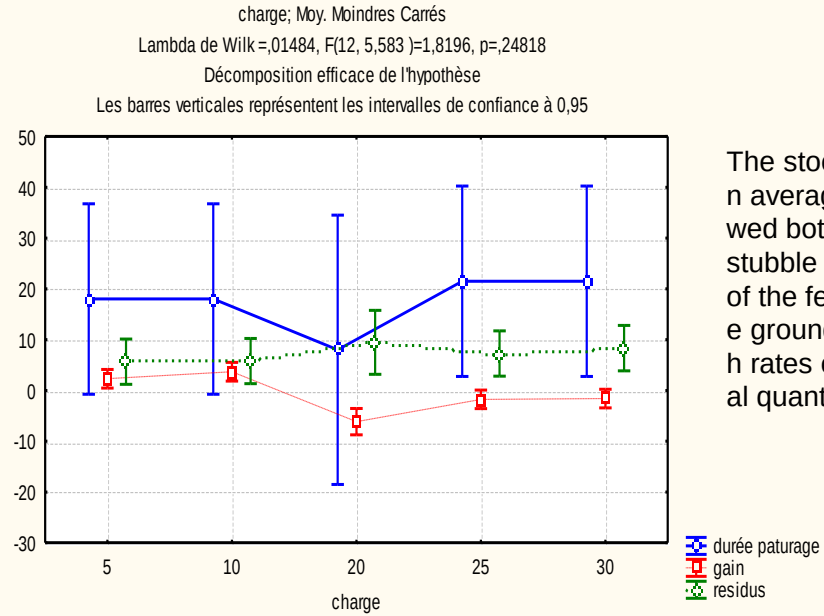


the largest amount of stubble is consumed in the first 15 days of grazing, on average 19.78 qx / ha against 2.88 qx / ha during the second 15 days of grazing. During the first days of grazing, the ewes consume the grains and the tender parts of the stubble like leaves. There after the consumption decreases because of hardness of stubble residues remaining on the ground.

Evolution of some chemical parameters during stubble grazing

Wilaya - species		0 days of grazing			15 days of grazing			30 days of grazing		
		MM	OM	TNM	MM	OM	TNM	MM	OM	TNM
Ain M'lila	Orge	14.31	85.69	4.27	11.05	88.95	4.93	10.70	89.30	3.70
	Blé dur	12.27	87.75	3.79	12.97	87.03	3.70	-	-	3.35
Sétif	Blé dur	12.94	87.06	5.50	13.45	86.55	3.85	14.19	85.81	3.13
	Orge	13.88	86.12	5.49	15.48	84.52	3.81	14.05	85.95	3.51
M'sila	Blé dur	18.84	81.16	3.18	12.95	95.07	2.54	16.62	83.38	2.56
	Blé tendre	3.51	86.49	2.88	8.39	91.61	2.77	12.01	87.99	2.35

Graphical analysis of the best combination between studied variables



The stocking head of 5 and 10 ewes / ha with a n average grazing time of less than 20 days, allo wed both the preservation of a certain amount of stubble and an acceptable average gain weight of the females. The amounts of stubble left on th e ground are respectively 8.7 and 6.4 qx / ha wit h rates of 29% and 20.49% compared to the initi al quantities.

Stocking head/ha

grazing time

stubble residus

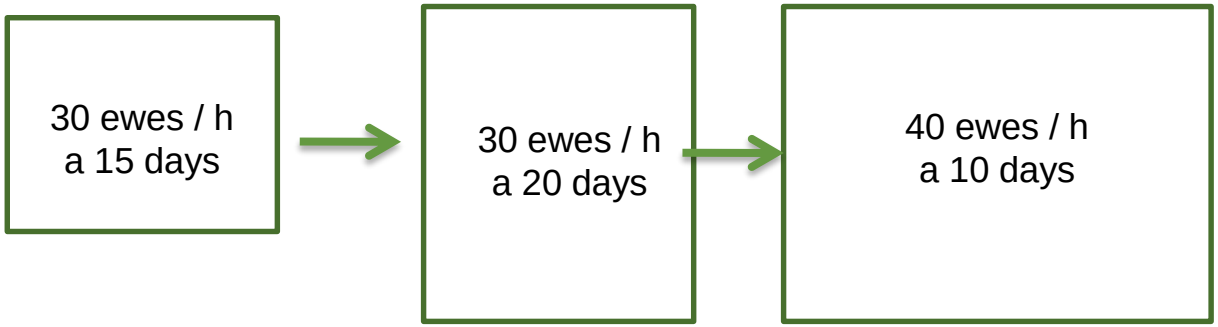
weight gain

CONCLUSION

The stubble evolution during grazing and through different stocking head 70% of stubble was consumed on average after 15 days of grazing for th is year.

Stocking head of 5 and 10 ewes per ha with a grazing time less than 20 days, allow a better ewes weight gain and a stubble residues of 0.64 to 0.87 t / ha.

Design Management for stubble grazing



Conventional grazing

CA grazing

Food systems

Food systems study is based on surveys according to a questionnaire addr essed to farmers and their women gathered in focus groups during technic al days and with the contribution of Agriculture services direction (DSA) an d agriculture chamber services of each wilaya in project area.

These surveys are being carried out the breeders. For the surveys with bre eders women, they will begin with gender aspect investigations.

We present you, some preliminary results for Oum El Bouaghi.

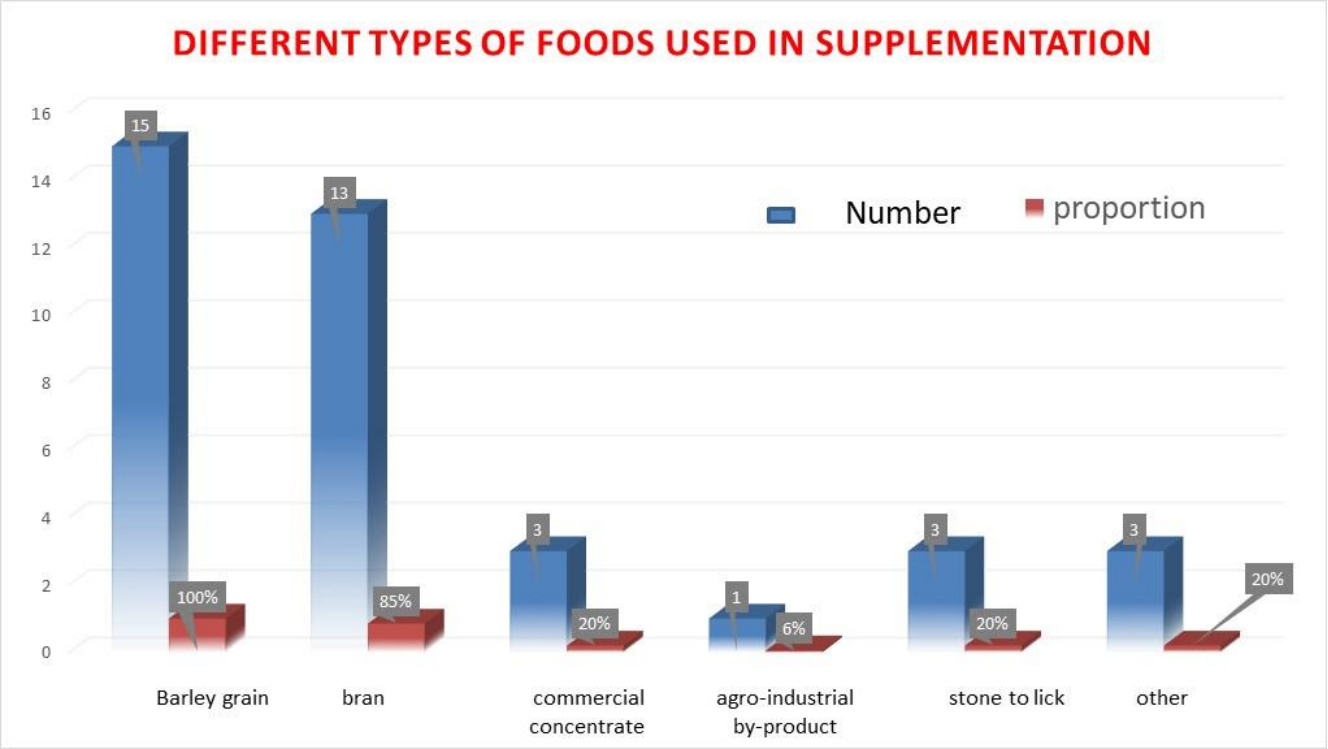
Récapitulatif de plan fourrager –wilaya Oum El Bouaghi

	sept	oct	nov	dec	jan	feb	mar	apr	may	jun	jull	aug
barley in mown gree n	6%	6%	6%									
barley in green pastu red	25%	25%	63%	63%	63%	56%	44%	6%				
pasture fallow	19%	31%	31%	13%	6%	31%	56%	69%	50%	13%		
hay	38%	31%	38%	38%	44%	38%	38%	25%	31%	31%	31%	25%
Straw	50%	44%	44%	50%	50%	50%	50%	31%	31%	38%	38%	25%
Stubble	31%	31%								63%	69%	44%
rangland	25%	38%	38%	25%	13%	19%	38%	38%	38%	19%	13%	13%
forest				6%	6%	6%	6%	6%	6%	6%		

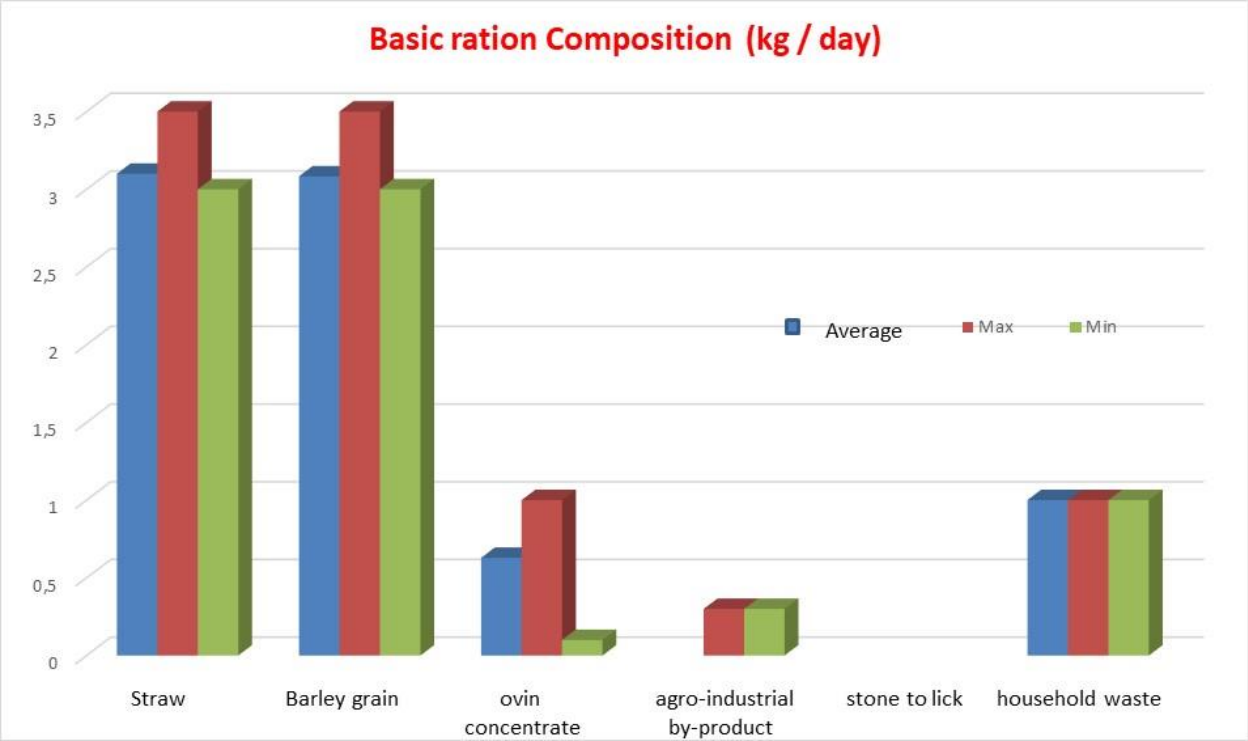
-The fodder calendar is based primarily on green barley grazing in autumn until early sp ring, fallow and rangeland grazing much longer in the spring and stubble in summer.

-Hay and straw are distributed mainly in autumn and winter simultaneously or alternativ ely.

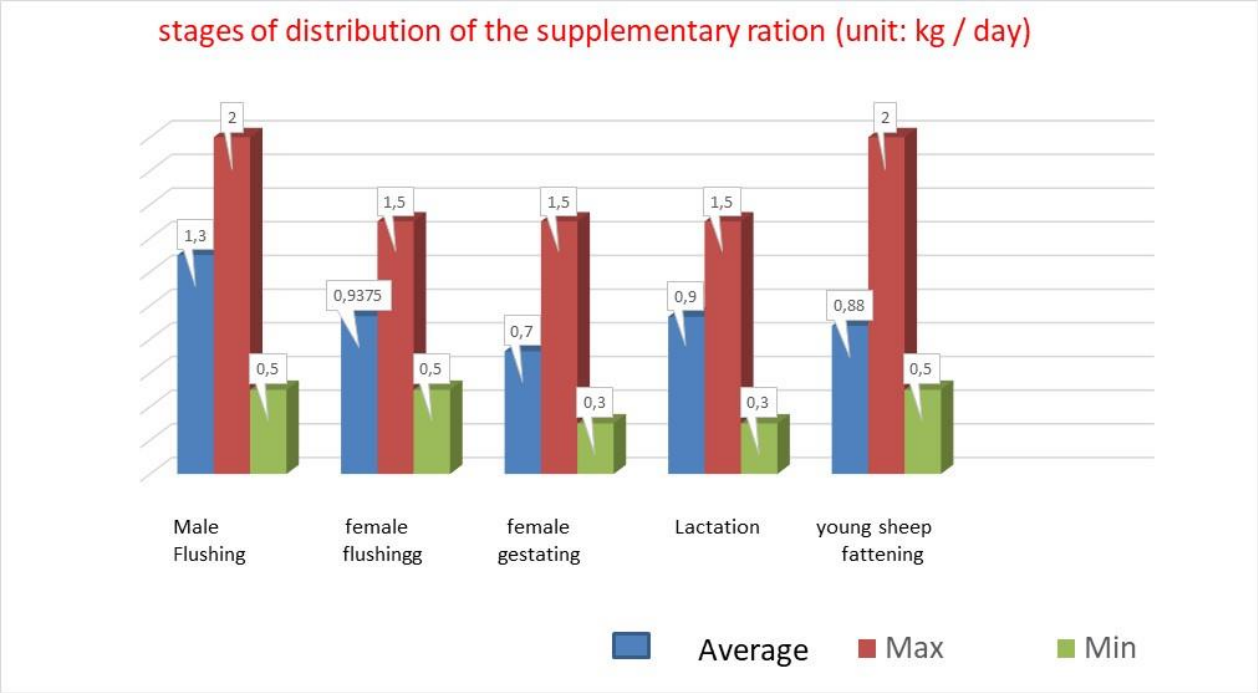
-Forest are grazed by breeders who are not far from it, in winter and spring. Neverthel ess during the dry years the grazing of the forest is more accentuated.



The complementation is based essentially on barley grain and bran. Other fo ods are less used, such as commercial concentrate, household waste (dry b read) and lick stone. One breeder use



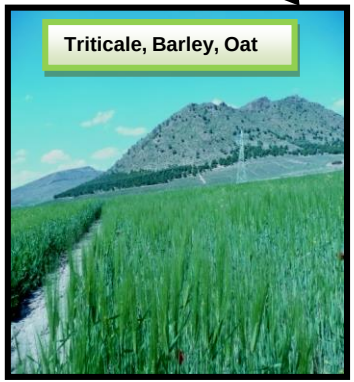
The food ration is based primarily on dry fodder such as straw and barley grai n compared to other components of the ration.



The complementation is used for different physiological stages the proportions used are different from one breeder to another according to the availability of pasture.

Food alternatives

GRASS



LEGUMES

Site de Ain M'lila

Site de Ksar Chellala

Site de Ain El Hadjar

Yield of different forage species

Species an varities	%DM	YIELD OF DM Qx / ha
Seigle RC9	32,67	126,76
Barley Rihane	30,00	73,80
Barley Saida	31,12	100,12
Barley Fouarra	31,00	96,70
Barley Safra	28,90	86,70
Barley Tichdertt	28,85	124,60
Pea Sefrou	17,00	105,40
Vetch Languedoc	18,20	83,70
Triticale I	36,36	126,53
Triticale II	38,30	163,92
Oat 912	34,80	108,58
Oat Avon	30,80	99,79
Oat Prévision	30,30	117,56
Oat Amel	30,16	112,20

Production of some forage associations

Associations	Dry Matter Qx / Ha	Légume %
Triti x Légum	88,67	24,93
Oat x Légum	81,67	22,05
Barley x Légum	93,89	13,92
Rye x Légumi	66,57	19,90

Food value of triticale

	AVOINE	ORGE	SEIGLE	TRITICALE	BLE	SORGHO	MAIS
MAT- AZ	12,1	13,0	10,4	15,2	14,2	19,8	10,8
CENDRES	3,2	2,7	2,0	2,3	2,0	1,9	1,5
UF L		1,12	1,18	1,21	1,19		
UFV		1,11	1,19	1,22	1,19		

Agro-industrial products

- Maïseries; semolina and flour mills
- Oil mill (olive oil)
- Canneries (tomatoes, orange pulp, apricot)
- Waste of dates
- Brewery
- Grape marc

Agro-industrial enterprises in the project area

Wilaya	Number	Type
Sétif – Bordj Bouarreridj	7	Pasta and couscous
	10	Wheat flour
	1	Olive oil
M’sila	1	Pasta and couscous
	2	Wheat flour
Ain M’lila	2	Oil mill, Olive oil

Scaling activities from the first year 2018 - 2019

1134 farmers and managers affected by project activities since the project's launch,

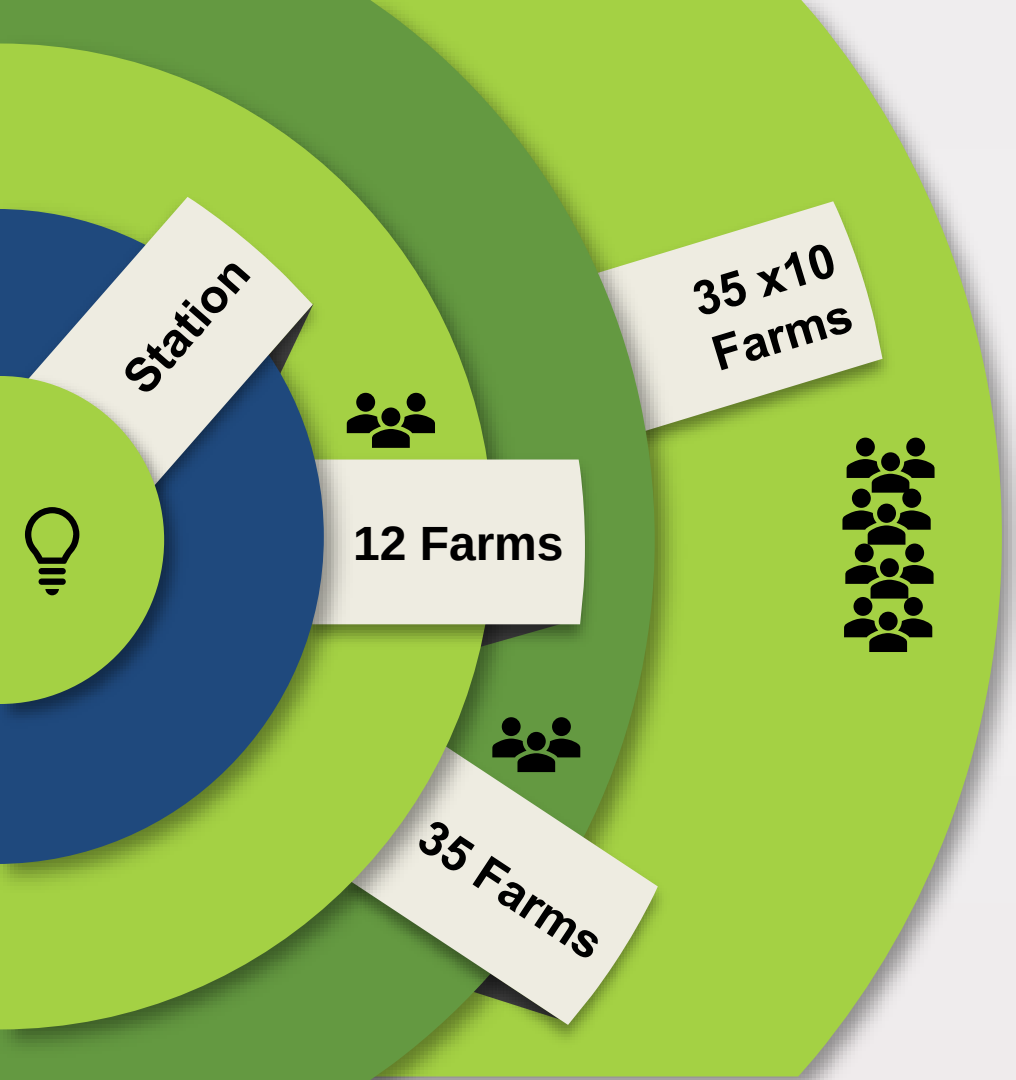
- Including 12 women,
- More than 45 new young farmers Program (ANSEJ),

- More than 22 partners and structures involved in the extension program (in the 3 innovation platforms: Sétif, M'sila and Oum El Bouaghi),
- 05 radio programs, including one in the national channel,
- More than 13 students prepare a thesis in the project sites, and more than 280 students have visited and learned about the different components of the project.

- Signature of a collaboration agreement between ITGC of Setif and the ITMAS of Setif to introduce the CLCA practices in the training course of technicians of ITMAS de Setif.
- signature , in July of an agreement between PMAT (Boudour trader) and ITGC
- signature of a collaboration agreement between ITGC and University of Setif to introduce the CLCA practices in the curriculum of training of students Master in agronomy.
- Visit of the Minister of Agriculture, Rural Development and Fisheries to the company CMA Sidi Belabbes
- Preparation of a leaflet on the food ration and good practices (CLCA practices) in CA
- Preparation of demonstration video for farmers,

SCALING STRATEGY

(ALGERIA)



Chain	species	Number of training	Breeders/ young investers	Broadcasts TV and radio	Theme
Red meat	Ovine - goats	63	2038	14	Conduite d ’élevage ovin/Caprin/ CA
Cheese production	-	25	268		Craft manufacturing of cheese
Stubble managment		3	95	1	**Stubble managment under CA**

Actions	Number of participants	Organisation/ Encadrement	location	Date	Target	Observation
Information day for the launch of the second phase of the CLCA project in the East of Algeria.	165	ITGC – ATU	ITMAS de Sétif	04-12-2018	All the actors involved in CLCA project	Broadcast on national channel radio of Sétif and M'sila
seeds Production Techniques of legumes and forage	30	ITGC Sétif – CCLS de Sétif -CAW de Sétif.	Sétif Station ITGC de	20-12-2018	Seeds producers.	One woman
Installation of chickpea crop in conservation Agriculture	40	ITGC de Béni Slimane	Wilaya de Médéa	25-12-2018	Farmers and seed producers	Broadcast on a local Radio of Médéa
Workshop on the assesement of extension actions and the adoption of CA in M'sila	35	ITGC – DSA de M'sila - commune de Ouled Mansour.	Ouled Mansour.	25-12-2018	Local actors of M'sila.	/
Workshop on the assesement of extension actions and the adoption of CA in Setif	25	ITGC	Sétif Station ITGC	26-12-2018	Local actors of Sétif.	/
Cereal weed control under CA.	40	ITGC Sétif – CCLS de Sétif -ATU – DSA de Sétif.	Sétif Station ITGC	02-01-2019	Seeds producers.	2 women
Accelerated training on forage crops in semi-arid areas under CA and AC	25	ITGC Sétif – ITMAS de Sétif – CAW Sétif	ITMAS de Sétif	08-01-2019	Young farmers	In the framework of ANSEJ program Agreement with setif itmas/
Weed control and fertilization of cereals under CA and AC	48	ITGC Sétif – ATU – DSA de Sétif.	Commune de Saleh Bey - Sétif	13-01-2019	Farmers and seed producers.	Sensitization on preventive vaccination of small ruminants
Regional workshop on scaling of impacts of the CLCA project in eastern high plateaus of Algeria	50	ICARDA/IFAD – ITGC - ATU	ITMAS de Sétif	23-01-2019	actors s des 6 wilayas	Presentation and amendement of CLCA program
Weed control of cereals under CA	40	ITGC Sétif – ATU - CASSAP Sétif -	Commune de Béni Fouda - Sétif	31-01-2019	Farmers and seed producers	/
Accelerated training on cereals maintenance in semi aride zone under CA and AC	25	ITGC Sétif – ITMAS de Sétif – CAW Sétif	ITMAS de Sétif	05-02-2019	Young farmers.	04 women
Presentation of direct seeder BOUDOUR to the Minister of Agriculture, Rural Development and Fisheries during the visit CMA manufacture of Sidi Belabbes	/	Ministry agriculture Rural Devevelopment and Fisheries	CMA de Sidi Belabbes	07-02-2019	Stakeholders and producers	public and private TV channel
Weed control of cereals under CA	30	ITGC Sétif – CCLS M'sila – DSA M'sila	CCLS de M'sila	12-02-2019	Farmers and seed producers.	05 women M'sila Radio
Direct seeder Presentation BOUDOUR	50	ITGC Sétif – association PRODEC Sétif	Commune de Khroub - Constantine	12-02-2019	Farmers of wilaya Constantine	/
Video on supplemental irrigation		INSID NATIONAL extension services				National wide TV
visits for students						
master agronomy students – option vegetal biotechnology	160	Sétif university		06-12-2018	/	110 women
master agronomy students – option vegetal biotechnology	120	Université de Sétif		19-12-2018	/	96 jeunes women
Students educational supervision	08	ENSA – Université de Sétif – Université de M'sila		PhD	/	3 women
	05	ENSA – Université de Sétif – Université de M'sila		Master	/	4women