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

IFAD Investing in rural people
ICARDA Science for resilient livelihoods in dry areas
CIMMYT International Maize and Wheat Improvement Center

PROJECT PROGRESS REPORT:
YEAR I - APRIL 2018 TO MARCH 2019

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

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International Center for Agricultural Research in the Dry Areas

With contributions from:

CIMMYT
INRAT – IRESA (Tunisia)
ITGC (Algeria) – Fondacion Proinpa (Bolivia)

Cover page figure caption. Sheep grazing stubble in the site of Fernana – North West Tunisia (Credit: ICARDA)
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ACRONYMS AND ABBREVIATIONS

ADOPT	Adoption and Diffusion Outcome Prediction Tool
AFESD	Arab Fund for Economic and Social Development
AIS	Agricultural Innovation System
ANAPQUI	Asociación Nacional de Productores de Quinua (Bolivia)
ANSEJ	National Agency for Employment Support of Youth (Algeria)
APIA	Agence de Promotion des Investissements Agricoles (Tunisie)
AVFA	Agence de Vulgarisation et de la Formation Agricoles (Tunisie)
AWPB	Annual Work Plan and Budget
BA	Optimized Barley Production
BD	Bulk Density
BEM	Bitacora Electronica MasAgro/MasAgro e-Journal
CA	Conservation Agriculture
CBR	Cost-Benefit Ratio
CCI	Capital Composite Index
CGIAR	Consortium of International Agricultural Research Centers
CI	Confidence Intervals
CIMMYT	International Maize and Wheat Improvement Center
CLCA	Crop Livestock Conservation Agriculture
COTUGRAIN	Compagnie Grainière Tunisienne
CP	Crude Protein
CR	Crop Residues
CT	Conventional Tillage
DAGRI	Dipartimento di Scienze e Tecnologie Agrarie, Alimentari, Ambientali e Forestali
DGFIOP	Direction Générale du Financement des Investissements et des Organismes Professionnels
DSA-M'Sila	Direction Des Services Agricoles-M'Sila (Algérie)
DZD	Algerian Dinar
EC	Electrical Conductivity
FAO	Food and Agriculture Organisation
FGD	Focus Group Discussions
FU	Forage Unit
GDA	Groupements de Développement Agricole (GDA)
ODK	Open Data Kit
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
HH	Household
ICARDA	International Center for Agricultural Research in the Dry Areas
ICT	Information and Communications Technology
IFAD	International Fund for Agricultural Development
INGC	Institut National des Grandes Cultures (Tunisie)
INRAT	Institut National de Recherche Agronomique de Tunisie
IRESA	Institution de la Recherche et de l'Enseignement Supérieur Agricoles (Tunisie)
ITELV	Institut Technique des Elevages (Algérie)
ITGC	Institut Technique des Grandes Cultures (Algérie)
ITMAS	Institut De Technologie Moyen Agricole Spécialisé (Algérie)
KII	Key Informant Interviews
KM	Knowledge Management
LAC	Latin America and Caribbean Countries
LP	Linear programming
M&E	Monitoring and Evaluation
MARDF	Ministry of Agriculture, Rural Development and Fisheries (Algeria)
MAWRF	Ministry of Agriculture, Water Resources and Fisheries (Tunisia)
MCA	Mental Capacity Act
MU	Mulching
MUBA	Combination of Mulching and Optimized Barley Production

NA	North Africa
NARES	National Agricultural Research and Extension Services
NARS	National Agricultural Research Services
NEN	Near East and North Africa
NGO	Non-Governmental Organization
NT	No Tillage
OEP	Office de l'Elevage et des Pâturages (Tunisie)
OM	Organic Matter
PBA	Partial Budget Analysis
PCA	Principal Components Analysis
PMAT	Entreprise Nationale de Production de Matériels Agricoles Trading (Algérie)
PPPLab	PPPLab Food & Water for Public-Private Partnerships
PROINPA	Fundación para la Promoción e Investigación de Productos Andinos
PTO	Power Take-Off
R&D	Research and Development
SCT	Simplified Cultivation Techniques
SFEMI	Société de Fabrication d'Equipement Métallique Industriel (Tunisie)
SMART	Simple Multi-Attribute Rating Technique
SMSA	Mutual Association of Agricultural Services
SO	Strategic Objectives
SOLA	Maquinaria Agrícola Solà company
SOM	Soil Organic Matter
SPMSUD	Société de Production Métallique du Sud (Tunisia)
SWOT	Strengths, Weaknesses, Opportunities and Threats analysis
UMSA	Universidad Mayor de San Andres (Bolivia)
USD	United States Dollar
WOCAT	World Overview of Conservation Approaches and Technologies
WUE	Water Use Efficiency
ZT	Zero Tillage

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Background

The project goal is to sustainably increase production and enhance climate resilience of small farmers' communities and their crop-livestock production systems in drylands. To develop in participation with smallholder crop-livestock producers contextually relevant and gender sensitive processes for enhancing the broad uptake of Conservation Agriculture (CA) within integrated crop-livestock systems in drylands in LAC (Andean drylands, Central American dry corridor and the northern South American savannah) and NEN (Near East and North Africa) regions. The expected outcomes are: i) 3,000 smallholder farmers reached (at least 40% women and 20% youth below 35 years) and 2,100 have directly adopted CLCA farming systems [in four (4) target countries] with increased production and improved cost-benefits optimized by filling research and development gaps; ii) At least six (6) NARES, in addition to decision makers, NGOs and IFAD loan project partners in the four (4) target countries have adopted tools and methodologies for reliable decision making and guide investments on contextually appropriate CLCA system; and iii) At least four (4) effective agricultural innovation systems – one (1) in each implementation area of the four (4) target countries - are coalesced in order to foster broad uptake of CA practices within integrated dryland crop-livestock production systems.

Countries initially selected for the implementation of the project are Bolivia and Nicaragua in LAC and Algeria and Tunisia in North Africa. Through the IFAD investment projects and project partners it is estimated that the training and adoption of technologies and practices for CLCA systems will reach an additional 10,000 small crop-livestock farmers. Other beneficiaries will be NARES (National Agricultural Research and Extension Services) and R&D partners and policy makers who will have access to innovative technologies and practices and knowledge on proven benefits of CLCA systems for climate resilience and sustainable intensification of production for crop-livestock farmers in drylands.

The project consists of two (2) main components (Figure 1). The first component is further divided into two subcomponents:

Component 1. Participatory adaptive research with integrated capacity development of farmers and other key partners to fully implement and evaluate CLCA systems

a. *Subcomponent 1.1*: CLCA system optimization [filling research gaps and the full implementation and integration of technologies developed supported by both centres for the two (2) regions];
b. *Subcomponent 1.2*: Appropriate system development methodology to support wider adoption and decision-making.

Component 2. Accelerate adoption through the development of delivery systems/participatory farmer-led extension systems and inform the development of contextually relevant CLCA technologies and practices.

The overall cost of the project is estimated at US$ 3 million, over four (4) years (2018-2021), of which IFAD will finance US$ 2,5 million, governed by performance-based tranches. IFAD funding is supplemented by a contribution of US$ 0,5 million from NARES in the form of in-kind contributions. The official starting date is 13 April 2018, the project completion date is 30 June 2022 and the effective closing date is 31 December 2022. Up to 31 May 2019, the amount disbursed by IFAD to ICARDA is US$ 604,143.

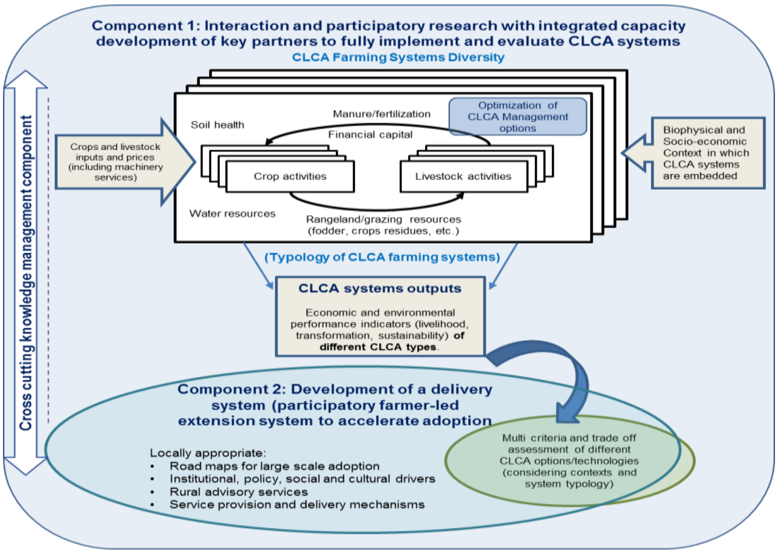

Figure 1. Conceptual framework for CLCA systems.

Review of progress and performance by project component

Although this project is seen as a second phase for ICARDA in Algeria and Tunisia, for CIMMYT it is not. This first year was basically a starting-up year in the LAC region as CIMMYT had no activities in the selected country sites. Although there were previous activities in southern states of Bolivia with CA in wheat systems in collaboration with local partners, the target region was delimited by the activities implemented by the Pro-Camelidos program (an IFAD-funded development loan in Bolivia) including only the Altiplano (Highlands) dryland areas where cropping systems are dominated by quinoa and livestock based on extensive llama management.

Originally, the project was to be implemented in Nicaragua, in line with the NicaVida program (an IFAD funded development loan in Nicaragua) with maize-based farming systems**.** Political unrest in Nicaragua made the execution of the project activities unacceptably dangerous. While exploring the possibilities to realign the CLCA activities with the ProLenca project in Honduras, it was decided to concentrate activities in Bolivia in the first year. The selection of the second target country in LAC by CIMMYT is further discussed in the next section "Implementation arrangements".

In what follows, we report the progress of the grant by project component. The grant performance can be assessed by comparing what was achieved against what was supposed to be achieved as described in the approved AWPB (Annex 2) and by attempting to show the level of progress by country using the logical framework matrix (Annex 3). To keep the integrated focus of the project, three (3) activities under component 1 are reported together. These are "fine-tuning of agronomic practices" together with "reduction of erosion" and "improvement of water use efficiency". For several examples, activities falling under components 1 or 2 are mapped to the cross-cutting components of the project namely "Knowledge Sharing and Management", "Scaling and Sustainability", "Gender Focus" and "Monitoring and Evaluation (M&E)". In such cases, and to avoid redundancies, the progress is reported under the relevant headings of this reporting template. For component 2 and referring to the logical framework matrix, several activities are expressed to a very high level of detail. For a first year which is mainly devoted to assessing baselines and diagnosis, it was very difficult to report against each activity. As a result, some activities were merged together.

Component 1. Participatory adaptive research with integrated capacity development of farmers and other key partners to fully implement and evaluate CLCA systems

Sub-component 1.1. CLCA system optimization (filling research gaps and the full implementation and integration of technologies developed supported by both centres for the two regions)

Stakeholder engagement and rapid appraisal

The inception workshop was held in Hammamet – Tunisia during the period 7-9 May 2018. During the workshop implementing CG centers and NARES in Algeria, Nicaragua and Tunisia were present. The workshop was mainly organized around working groups to develop workplans for the various components and activities of the project. Because of its multidisciplinary character and the strong integration between the activities, it was recommended to have, from the start, a strong governance structure around the project. Teams across centers and regions were formed for a smooth communication and for identifying cross-synergies between countries and between regions. All the material and information presented/generated during the inception workshop is accessible here.

Activities on the first year of the project in Bolivia were focused on assessing the stakeholders involved in Quinoa-Llama systems, their motivations, and their limitations. Key stakeholders where identified with the help of IFAD country representation; a meeting with 15 key stakeholders including government, NGO's, universities, and international development organizations was held in June 2018 where main challenges and opportunities for CLCA were discussed. More intensive meetings with stakeholders were held in October 2018. Main findings include the strong willingness and promising opportunities from a range of sectors to move to a more sustainable production system; however, this is pursued in isolation or in camps (public and private) and little or no integration of crop and livestock is practiced by stakeholders. Therefore, a system approach seems needed. Soil degradation in the Altiplano is recognized as a major threat to smallholder livelihoods (lack of alternatives for quinoa-llama farmers) and the global quinoa market position (quantity and quality of Quinoa Real). However, stakeholders in this region of Bolivia do not have a lot of experience with CA for quinoa-llama systems; hence, it is important first to get an overview of the current status and to introduce and test new ways of doing CA in Bolivia. Moreover, crop residues are not available in sufficient quantities; tillage is used as a way to "harvest" water and there is not enough scope for diversification due to hard environmental conditions of the Bolivian Altiplano. Further work in the project should be directed to identify the stakeholders with most interest and in best position to take the leadership on scaling Crop Livestock Conservation Agriculture (CLCA) systems.

In Algeria and Tunisia where the current project is building on the outcomes of the first phase, many meetings, workshops and field days were organized during this first year to secure stakeholder engagement whether at the national or regional levels in the districts where Phase I was implemented and in potential new areas which could represent the scaling domain. Stakeholder meetings, field days, workshops (Table 1) were held in an intensive pace to pave the road towards exposing all stakeholders to the concept of CLCA systems and to expose policy makers (Figure 2) to the concepts of sustainable, integrated crop-livestock systems.

Table 1. Events for stakeholder engagement in Algeria and Tunisia

Country	Type of event	Target population	Location	Objective/topic	#attending
Algeria	Information day	All stakeholders involved in CLCA project	ITGC headquarters	launch of the second phase of the CLCA project in the East of Algeria.	165
	Local workshop	All stakeholders in the district of M'Sila	ITGC – DSA de M'Sila – commune de Ouled Mansour	Assessment of extension actions and the adoption of CA in the district of M'Sila	35
	Local workshop	All stakeholders in the district of Setif	ITGC regional center	Assessment of extension actions and the adoption of CA in the district of Setif	25
	Regional workshop	Rural actors of 6 districts (M'Sila, Oum El Bouaghi, Setif, Batna, Bordj Bouareridj and M'Sila)	ITMAS de Setif	Scaling CLCA system in the eastern high plateaus of Algeria	50
	National workshop	Directorates MARDF, Ministry of Planification, Rural advisory services, National farmers' unions	ITGC headquarters in collaboration with ICARDA	Scaling opportunities of the CLCA system in the cereal-livestock belt of Algeria	75
	Field days	Potential CLCA farmers in the districts of Bordj Bouareridj, Ain Mlila, Setif	ITELV/ITGC	Stubble management under CLCA system	125
Tunisia*	Field days (10)	Farmers in the different districts of the project target area (Zaghouan, Siliana, Beja)	Various locations	CA principles, Soil fertility, Crop diversification, and soil management, Water Use Efficiency, Land-degradation, Direct seed Drill/ZT machinery, stubble management	200
	Local workshops (4)	All local stakeholders in the project target areas of Chouarnia/Siliana district, Saouaf – Fahs, Jougar/Zaghouan district, Testour/Beja district	Various locations	Introduction of the project activities to the main local stakeholders and establishment of innovation platforms	217
	Advanced training	Regional extension services and policy makers in the regional directorates of the Ministry of Agriculture in the districts of Beja, Siliana, Zaghouan and Kef	Hammamet (December 2018)	Buy in from regional technical staff and policy makers to support scaling of CLCA system	27

Table 1. Cont'd

Country	Type of event	Target population	Location	Objective/topic	#attending
Tunisia*	National workshop https://paepard.blogspot.com/2019/04/crop-livestock-conservation-agriculture.html	Deputies in the parliament from the agricultural commission, Director generals from MAWRF, from research institutes, extension institutes and representatives of farmers' unions	Bourouiss - Siliana	To increase awareness of decision makers to the importance of crop-livestock integration systems to mitigate climate change and to ensure sustainable intensification of agricultural production systems.	130
	National workshop	Rural extension and advisory services	National Institute of Field Crops (INGC)	Importance of the forage crops in the integrated crop-livestock production systems	70
	National workshop	Rural extension and advisory services, researchers, representative of farmers' organizations	INRAT-Tunis	Promising technologies to improve water use efficiency by field crops	60

*** A detailed list of the participants to the different events in Tunisia is provided in Annex 1.**

Figure 2. Deputies (president, left) and (vice president, right) of the agricultural commission in the Tunisian parliament chairing the national workshop on the sustainable crop-livestock systems and conservation agriculture to mitigate climate change and sustainably influence production systems.

Developing integrated improved crop management systems including reduction of erosion and improvement of water use efficiency

In this first year, in Bolivia, main technical alternatives for more sustainable CLCA systems were identified as well as the research gaps and protocols for further development and implementation. After the scoping mission and in close concertation with local partners, specific CLCA alternatives were identified to be tested and promoted, specifically, in collaboration with PROINPA (a local NGO devoted to agronomic research and development). The quinoa-llama system is an important element of Bolivian agriculture. Quinoa is a relevant cash crop and llama is a significant source of milk, meat and manure in highlands. The Quinoa boom during 2005-13 has changed extensive quinoa-llama system to intensive quinoa production with significant reduction in llama herds, thus reducing manure availability for quinoa and fodder for llamas. These new quinoa-llama dynamics have significantly reduced productivity of quinoa with several ecological threats for the Bolivian highland. Intensive cultivation of quinoa also led to unsustainable production systems, resulting in unstable crop yield, price volatility and poor profits to the growers. Interventions such as improved pastures, windbreaks and appropriate use of cover crop and llama manure can make quinoa-llama system sustainable and profitable. Several ecotypes of Lupinus (a leguminous plant adapted to the local agroecological conditions) that can drastically reduce soil erosion as well as control weeds and biologically fix atmospheric nitrogen in nitrogen-poor soils were identified. This is important, as quinoa needs sufficient nitrogen (N) in an ecology where external application of N is not common. Several species of grasses and bushes are being identified to produce fodder for llamas and to control soil erosion. Similarly, windbreaks have potential to reduce erosion and improve system productivity. Initial observations are encouraging. Package of practices need to be developed, tailored as per local needs and scaled for adoption and impact. Based on SWOT analyses and identified entry points a work plan was developed in considering conservation agriculture-based technologies, seed multiplication of cover crops and seedling production of bushes and grasses for wind breaks. The key partner "fundación PROINPA" took an important role in finalizing the action plan and its implementation at ground level. The activities were planned in the following locations of the Bolivian highlands (Table 2) and Figure 3 highlights some field activities.

Table 2. Intervention areas for the CLCA project in the highlands of Bolivia

Areas	Southern highland	Central highland	Northern highlands
Communities	Chacala Chita	Challapata Sevaruyo	Viacha (Quipaquiphani Center)

Manure management: Four (4) sets of trials were laid out in Chacala, Chita (Southern highland), Sevaruyo and Challapata (Central high lands) in February. Animal compost was treated with decomposer agent to accelerate composting process. The prepared compost will be used in quinoa field during next crop cycle. This compost will be evaluated against traditional compost.

Green manure trial: Three (3) on-farm trials on green manure (Tarawi, *Lupinus mutabilis*) were established in Chita (#2) and Challapata (#1). Apart from these, a trial for seed multiplication of purple lupin (*L. angustifolius*) was established. All trials were established in January 2018.

Demonstration of application of llama manure in quinoa fields: A farmer participatory trial on llama compost was set up in Sevaruyo community in central highlands. Llama compost application has resulted into impressive growth of quinoa crop. The crop looked twice as healthy when compared to the quinoa crop of neighboring farmers. It seems that regular use of compost in smaller quantities is better that using larger quantities once in three (3) or four (4) years.

Evaluation of windbreaks: Windbreaks (#14) were established in communities of Chacala, Chita, Sevaruyo and Challapata using perennial shrubs and bushes. These species included bushes e.g. Sup'u t'ula (*Parastrephea lepidophilla*), Ñak'a t'ula (Baccharis *incarum*), Uma'u t'ula (*Parastraphia luceda*), Lampaya (*Lampaya castellani*), and grasses e.g. pasto llorón (*Eragrostis curvula*), nasella (*Nasseella neesiana*) and pasto agropiro variedad Alkar (*Agropyron elongatum*). A total 2,950 saplings/plants of grasses and bushes were established (700 in Chita, 600 in Chacala, 1,000 in Challapata and 650 in Sevaruyo). Different species are being planted based on ecological consideration e.g. Lampaya as a windbreak for sandy soils but its multiplication is difficult. Uma'u t'ula (*P. luceda)* is good for loamy soils and sup'u t'ula (*P. lepidophilla)* for early growth*.* Plant height of different species has been measured, plant coverage plus the phenological characteristic of the plant were recorded to decide best-bet materials for wind break. Among bushes, Sea back thorn, is pretty impressive because of its fast growth and propagation by seed and cuttings. It is dioecious, where male produces brownish flowers, which produce wind-distributed pollen. The female plants produce orange berries 6-9 mm in diameter, soft, juicy, and rich in oils/vitamin c. The roots distribute rapidly and extensively, providing a non-leguminous nitrogen fixation role in surrounding soils. It has immense potential for windbreaks in combination with other species. It is clear that we need a mix of grasses, perennial lupines and bushes in windbreaks to achieve a multifunction of reducing erosion, biological N fixation and fodder availability for llamas during fallow period.

Improved fallow for reducing erosion and enhancing fodder availability: Two (2) sets of adaptive trials were set up in Chacala and Chita locality in southern highland. Wild lupins were introduced as cover crops considering their nitrogen fixing ability. Three (3) ecotypes of lupines, *Orinoca, Habas Cancha* and *Choclito* were planted in January 2019. About 80% germination was reported. By the end of the cropping season biomass production of wild lupins will be recorded, while their impact on quinoa yield will be recorded in following season.

Improving greenhouse and nursery in Chacala for producing saplings for windbreaks: The PROINPA greenhouse and nursery in Chacala is about seven years old and needs improvement to produce sufficient plants of fodder bushes and grasses for project domains. This 400 m^2 greenhouse has a capacity to produce 40,000 seedlings per year. In the framework of the current project, the facility has been refurbished with new net and irrigation system in 2019 to optimize production potential of seedlings.

Production of bushes and grasses for fodder and wind breaks: The foundation PROINPA nurseries in Quiphaquiphani (Viacha) and Chacala (Uyuni) were used to produce seedlings of bushes and grasses. Total 72,966 seedlings of bushes mainly *Baccharis incarum* and 7,168 seedlings of grasses mainly *Agropyron elongatum* were produced. These seedlings were used for establishing windbreaks and pastures in project sites.

Figure 3. Sowing Lupinus with minimum tillage for improved fallows (A), sowing Lupinus with minimum tillage as green manure/cover crop (B), composting of llama manure (C) and field day organized with farmers to show alternatives for CLCA (D).

Collection and production of lupin seeds: The q'ila-q'ila or wild lupin (Lupinus sp.) is represented by about 80 species with unclear taxonomy. These wild lupins are excellent cover crops because of their self-spreading mechanism, N fixation for subsequent crop cycles and perennial growth habits. PROINPA identified four (4) ecotypes, including Orinoca from northeast highlands, which prefers sandy soils, grows for three (3) years and sheds seeds in a circumference of 6 m. In January 2019, 5 kg seed of Orinoca were collected in Puerto Acosta community in highlands.

In the North African countries, cereal-dominated crop-livestock systems are the predominant farming systems. Cereal mono-cropping with intensive soil tillage and overgrazing does not only degrade soil quality and crop productivity but also increases the total production cost. Hence, these practices are threatening the sustainability of the crop production system in the region. No-Tillage (NT) practice has been identified as resource conservation technology, especially to reduce soil erosion, improve soil quality, improve water use efficiency, and reduce production cost. This technology was introduced in the region before 2000; however, the adoption rate is very low as only 12,000 ha in Tunisia, and 5,600 ha in Algeria were under conservation agriculture (CA) by 2016. The major reason for the low uptake of the technology is lack of awareness about the technology, insufficient availability of NT seeders, lack of site-specific production packages and the competition for crop residues between livestock and CA practices.

In this context, the project has emphasized on the identification of CA-based technologies mostly verified on-station and on-farm during CLCA first phase (2013-16) as well as on the technologies available at national and regional levels in the respective countries and validated under local contexts. In its first year, the current project identified suitable technologies, potential areas for their scaling and identification of the lead farmers through stakeholder consultation meetings. The main technologies identified for scaling were NT, the introduction of legume and legume-cereal mixtures in the cereal mono-cropping system for increasing the availability of quality forage and improvement of the soil quality as well as better weed management. The demonstration sites were established as a learning center, where farmers are able to evaluate the technology from seeding to harvesting.

In Tunisia, around 440 ha were implemented by almost 70 farmers in the different sites of the project (Figure 4). In addition to the district of Siliana (focus of phase I), the project activities were extended to the districts of Beja, Zaghouan and Jendouba. This is almost a 3-fold increase compared to what has been directly achieved in the last year of phase I (160 ha by 22 farmers).

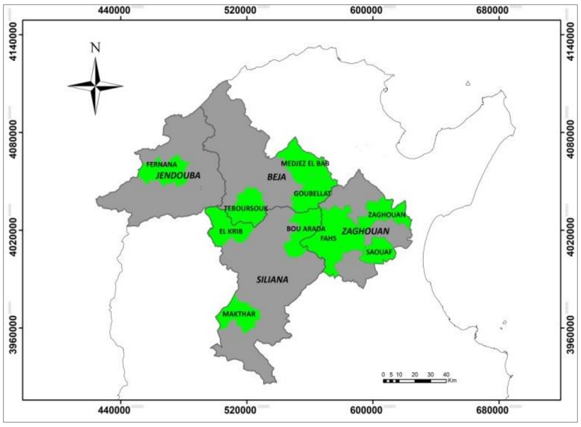

Figure 4. Map of the project sites in Tunisia.

- Beja: 105 ha implemented by 12 farmers;
- Zaghouan: 149 ha implemented by 24 farmers;
- Siliana: 186 ha implemented by 34 farmers.

In Algeria, similar to Tunisia, the project activities expanded from the target district of M'Sila in phase I to new districts mainly Setif and Oum El Bouaghi (Figure 5).

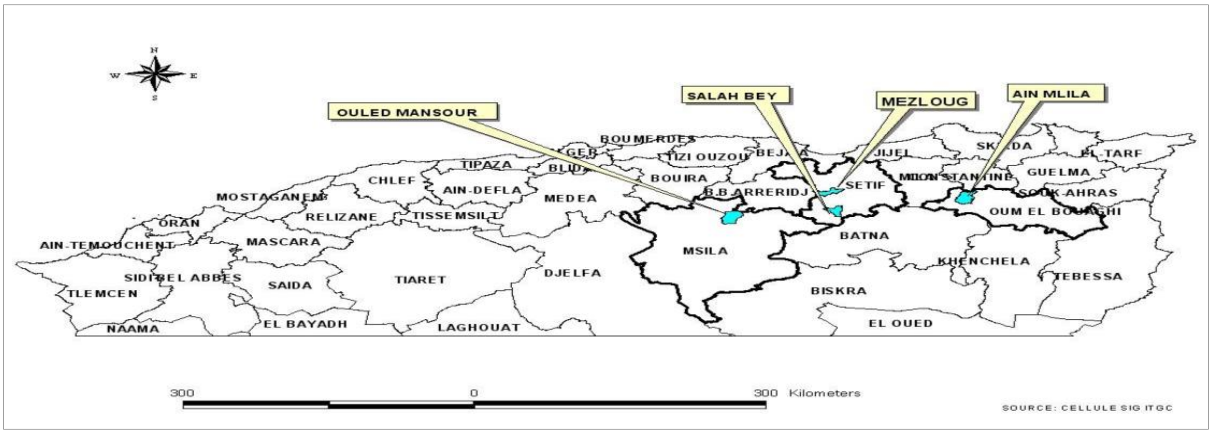

Figure 5. Extension of the project area in Algeria.

During the first cropping season in Algeria, 35 farmers were engaged in testing the different integrated agronomic packages. Farmers were located in the communities of Ouled Mansour (district of M'Sila) with a potential scalable area of 26,750 ha, Saleh Bey community located southwest of the Wilaya of Setif in the high plateaus with an area of 27,400 ha and Ain Mlila region which is located in the northeastern region of the district of Oum El Bouaghi at an altitude of 771 m with an area of 23,600 ha, in a plain of fertile land surrounded by the Aures mountains.

Based on the scaling road maps for each of the two (2) countries, the area under the improved agronomic practices (including NT) will be increased significantly in the coming seasons. The project is also working on the capacity strengthening and machinery value chain for timely availability of the NT seed drills in the region. The crop harvesting is underway, and the results of the agronomic trials will be presented in the forthcoming report. Below are the preliminary results from the soil characterization of the project sites and participatory on-farm evaluation with respect to soil, weed and biomass yield.

Assessment on the impact of CLCA practices on soil erosion, soil organic matter (SOM), and water use efficiency (WUE): decrease in soil erosion and increase in SOM and WUE are the major performance indicators targeted by the project for sustainable cereal-livestock based systems in the region. In this first year, assessment of those indicators with the adoption of CLCA technologies, i.e., conservation tillage, residue management, crop rotation, and better crop management were initiated in participation with farmers in all project sites. To assess the physical and chemical properties (variability) of the soil in each project sites and how they change over time with the implementation of the CLCA package, soil samples were collected and analyzed in all project sites in both countries. The physical and chemical properties of the soils are highly variable as illustrated by the large confidence intervals (CI) (Figure 6). The textural properties of the topsoil layer, i.e., percentage of sand, silt, and clay, are highly variable. Similarly, soil organic matter, available phosphorus are variable across the sites but mostly low. This justifies the importance of site-specific technology and management practices. This characterization will be used as a baseline to see how the CLCA technology helps to improve in short-, medium-, and long-term these different characteristics.

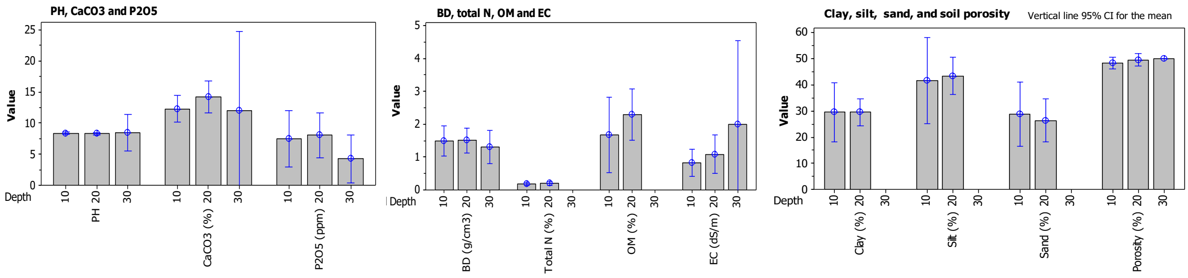

Figure 6. Physical [texture, porosity, bulk density (BD)] and chemical [total nitrogen (Total N %), organic matter (OM), electrical conductivity (EC), Calcium carbonate ($CaCO_3$), available phosphorus (P_2O_5), pH] properties of soil in different project sites in Algeria, 2019. The Vertical line indicate the confidence interval (CI) at 95% for the mean.

In Tunisia, the problem of soil erosion is more pronounced in the northern part of the country with the sloppy landscape. It is reported that out of approximately 3 million ha 1.5 million are severely affected by a strong to average soil erosion (Kefi et al., 2012)[1]. Intensive soil tillage for crop production induce both water and wind erosion. In this context, adoption of CA practices, for example, reduced tillage, residue cover, and proper rotation helps to minimize both water and wind erosion. To verify the effect of CA practices in reducing soil erosion, a participatory evaluation was conducted in two (2) sites in Siliana district, i.e., Chouarina and El Krib. Results from these two (2) sites are meaningful as they were established in the first phase and NARS, as well as the communities, were able to maintain CA practice during the gap period between phase I and phase II. We hence believe that at the end of the current project in 2022, results from these two (2) sites related to soil health and water use efficiency will provide invaluable information with regard to the impact of a CLCA system on natural resources.

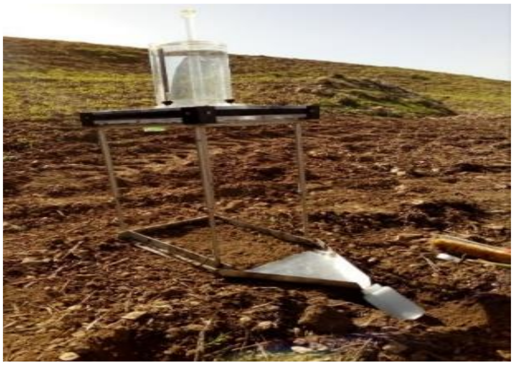

Figure 7. Rainfall simulator in Chouarnia, Tunisia.

In Chouarnia, a rainfall simulator (Figure 7) was used to measure the runoff and soil erosion in plots conducted for four (4) consecutive cropping seasons under CLCA package including partial grazing of stubble by sheep and Conventional Tillage (CT), respectively. The amount of water flow and sediment collected was measured. The result showed that soil loss from the CT plots was comparatively higher than from the CA plots (68 kg ha^{-1} in CA and 365 kg ha^{-1} in CT), while no difference was observed on runoff (Table 3).

Table 3. Amount of soil erosion loss from conservation agriculture and conventional tillage plot with rainfall simulator in Chouarnia, Tunisia

Treatment	Slope (%)	Soil erosion (kg ha^{-1})
CA	13	68
CT	14	365

In El Krib, to measure the soil loss from the conventional system and CLCA practices, six (6) Wischmeyer devices were installed; three (3) in plots under a conventional system and another three

[1] Mohamed Kefi, Kunihiko Yoshino, Yudi Setiawan, Khemaies Zayani, Mohamed Boufaroua. 2011. Assessment of the effects of vegetation on soil erosion risk by water: a case of study of the Batta watershed in Tunisia. Environ Earth Sci, 64:707–719. DOI 10.1007/s12665-010-0891-x

(3) in plots under CLCA system (Figure 8). The amount of soil loss was measured at three (3) different times during the cropping season, i.e., on 7 February, 15 February and 26 March (Figure 9). The results showed that soil loss due to erosion was reduced by 14% under CLCA technology (62 kg ha^{-1}) compared to the conventional farmer's practice (72 kg ha^{-1}).

Figure 8. Establishment of Wischmeyer plots in El Krib site.

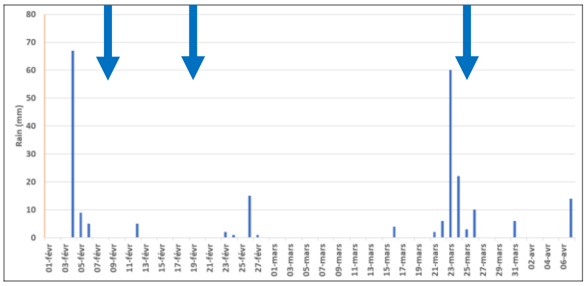

Figure 9. Daily rainfall amount on El Krib farm. Sampling dates are denoted by blue arrows.

Performance of legume and cereal-legume mixture in the cereal mono-cropping rotation under CA:_oat and triticale are the commonly grown cereal forages in the region. The nutritional quality of the cereal forage is low, and farmers have to rely on other resources such as wheat bran, cereal stubbles along with an overuse of cereal grains and commercial concentrates, hence making livestock enterprise very costly and unsustainable. Vetch (*Vicia sativa*) is considered an important forage crop. To increase the quality of forage production and enhance soil quality and diversify the crop rotation system, the project has evaluated the following mixture combinations under CA practice in both countries.

- Oat 15% +Triticale 15% + Vetch 70%;
- Oat 30% + Vetch 70%;
- Triticale 40% + Vetch 60%;
- Triticale 40% + fenugreek 60%.

Oat (30%) + vetch (70%) mixture at early crop growth stage under no-tillage.

Among the evaluated mixtures, the combination of oat (30%) + vetch (70%) produced the highest biomass yield (9.9 ± 1.8 t ha^{-1}) and total crude protein (CP) yield (985 kg CP ha^{-1}) (Table 4).

Table 4. Dry biomass yield (t ha^{-1}) and crude protein (CP) yield under triticale (40%) – vetch (60%) and oat (30%) - vetch (70%) mixture combination in Tunisia

Mixture	Dry biomass yield (t ha^{-1})	Crude protein yield (kg ha^{-1})
Triticale 40% - Vetch 60%	5.4±1.3	677.5
Oat 30% - Vetch 70%	9.9±1.8	565.0

This biomass yield is almost double of the amount produced by the cereal mono-crop, i.e., only oat. The triticale-vetch mixture produced more biomass in the initial growth stage than the oat-vetch mixture. In triticale-vetch mixture, the maximum biomass (5.4±1.3 t ha-1) was reached in the third week of April (at 1200°C growing degree day). The average dry biomass of the oat-vetch mixture increased from 5±1.4 t ha-1 on 28 March to 9.9±1.8 t ha-1 on 4 May (Figure 10). This indicates that adoption of vetch (70%) + oat (30%) mixture in the rotation systems helps to increase the quality and quantity of the forage production. This result will be communicated to different stakeholders for promoting the technology at scale. A private seed company in Tunisia (COTUGRAIN) has decided, starting from the cropping season 2019-20, to commercially put in the market the forage mixtures validated by INRAT.

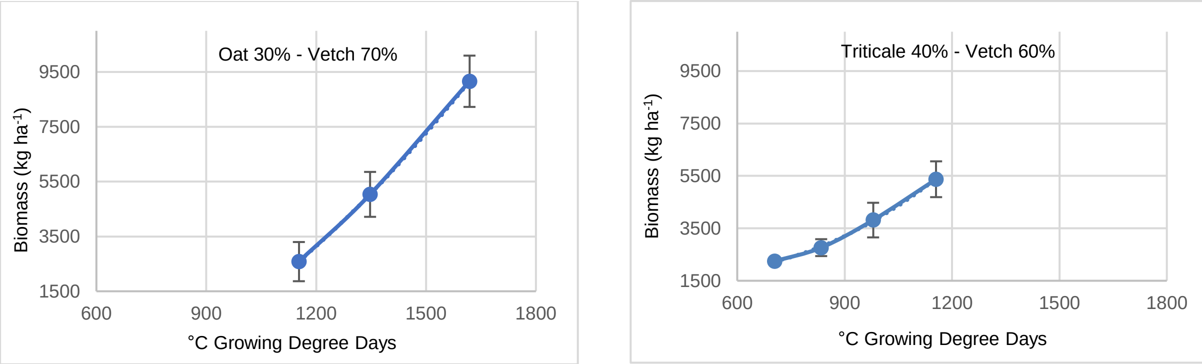

Figure 10. Total biomass yield (kg ha^{-1}) over time in two (2) mixture combination Oat (30%) + vetch (70%) and triticale (40%) + vetch (60%). Results from on-farm evaluation in Tunisia.

Weed density and diversity under different agronomic management: weed management is one of the major challenges in crop production in dryland agriculture, especially during the early stages of NT adoption. Depending on the severity and management practices, yield loss due to weed ranges from low-to complete crop failure. A single management strategy is not sufficient for efficient weed management. It is important to adopt integrated weed management practices. With this initiative, the project has emphasized to understand the weed diversity and its intensity in the different production environments in both countries. It is found that weed species and intensity varied with the region and production system. In Ain Mlila region, eighteen different types of weeds were recorded; *Fumaria officinalis*, *Diplotaxis erucoides*, *Fumaria densiflora*, *Medicago laciniate*, and *Polygonum aviculare* were the five major dominating weeds. In M'Sila (irrigated system) twelve (12) different types of weeds were recorded; Melilotus *sps.*, *Calendula arvensis*, Sinapis *arvensis*, Lolium *multiflorum*, *Daucus carota* were the five (5) major dominating weeds. In Setif, eleven different types of weeds were recorded; *Fumaria parviflora, Gladiolus sps, Muscari comosum, Bunium incrassatum, Scandix pectin-venersi* are the five (5) major dominant weed species in the region. Weed intensity and types of weed also varied with the crop grown. Among the crops, weed density was higher in lentil than in triticale and wheat. Weed management in legumes is challenging and the project will focus on integrated weed management, for example managing the weed seed bank through better crop rotation and creating awareness for timely weed management.

Fine-tuning crop residue use in different geographies and socioeconomic environments

In the cereal-sheep belt in Algeria and Tunisia, stubble represent an important feeding resource for livestock during summer when other crops are impossible to grow under rain-fed conditions. However, a conflict exists between mulch for covering soil when promoting CA practices and the use for grazing. Therefore, trade-offs between the use of stubbles for livestock feeding and to cover the soil have to be resolved, particularly in drylands where fodder potential is low (FAO, 2006). In Tunisia, on-farm trials in phase I were conducted to optimize crop residue management and livestock grazing under CA systems testing the 30/30 stubble grazing model (stocking rate of 30 ewes ha^{-1} for a grazing period of 30 days). The trials were carried out in June 2019 during one (1) month in the region of El Krib, district of Siliana after cereal harvest (immediately after the project inception). During the experimental period, animals grazed on stubble of durum wheat for an area of one (1) ha using a stocking rate of 30 ewes ha^{-1}. The model 30/30 was once again verified, both with linear and exponential fitting. At the same time, ewes progressed through their gestation stage normally, with a moderate increase in live weight.

In Algeria for this new phase of the CLCA project, an important new partner has been engaged to be in charge of the livestock component. This is the "Institut Technique de l'Elevage" (ITELV). On-farm trials were undertaken in the different sites of the project and the preliminary results seem to indicate that a carrying capacity of five (5) to ten (10) ewes ha^{-1} with an average grazing time of less than twenty (20) days allowed both the preservation of a certain amount of stubble and an acceptable average weight gain of the females varying between 1.5 and 2 kg. For carrying capacities of five (5) and ten (10) ewes/ha, the amounts of stubble left on the ground are respectively 0.87 and 0.64 t/ha representing 29 and 21% compared to the initial quantities, respectively. If we refer to the results from phase I, such levels of residues > 0.6 t/ha were shown to be compatible with the practice of CA in semi-arid conditions.

In Tunisia, another on-farm trial was put in place in Fernana with ten dairy cows. The site of Fernana was part of the ACIAR-funded project (Conservation Agriculture in North Africa) and it is under a higher rainfall than all other sites (annual rainfall averaging 650 mm). Small-scale mixed farmers in Fernana were already exposed to the technology of CA, have organized themselves within a CA-based association and we anticipate the CLCA project not to encounter major constraints in scaling its activities in this site. During the experimental period, cows grazed on stubble of bread wheat cultivated under CA. The whole grazing duration lasted 75 days starting from July 1st and was divided in two (2) periods: 30 days under farmer practices and the remaining 45 days under improved CLCA package (Table 5). For both practices, the same feed quantities were used but the distribution pattern and the grazing practices were modified, and we report here the effect on milk production.

Table 5. Description of farmer and improved practices

Farmer Practice	Proposed practice
Wheat stubble gazing: morning and evening during more than 5 hour (h)	Wheat stubble grazing: only one h in the morning
Concentrate: 4 kg distributed in the morning	Concentrate: 2 kg distributed in the morning + 2 kg distributed at 14 h
Oaten hay ad libitum: distributed just in the morning after concentrate	Oaten Hay ad libitum: distributed twice a day before the concentrate

The stubble biomass dropped from 7 t DM ha^{-1} in the beginning to 3.5 t DM ha^{-1} after the first grazing period under farmer practice. However, with the suggested grazing package (second period), biomass decreased in a linear trend from 3.5 t DM ha^{-1} to 2.4 t DM ha^{-1}, leaving a suitable soil cover (Figure 11). Milk production showed an increase of 16 % with the improved management practices; it increased to 24.6 l/day/head with the improved management practices compared to 21.2 l/day/head during the initial period when the cattle were managed under conventional farmer practice.

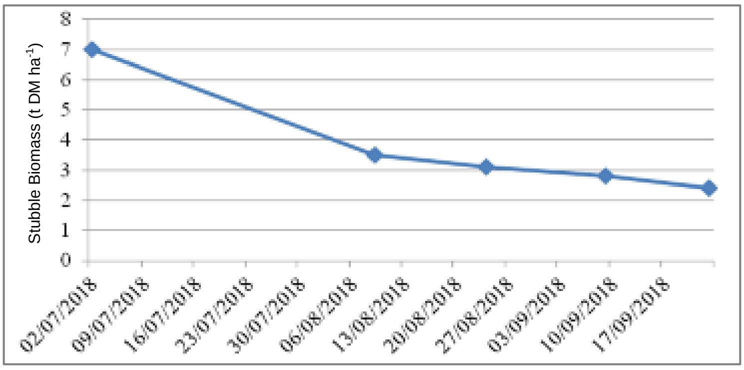

Figure 11. Decrease of wheat stubble biomass under cattle grazing over time.

Advocating alternative feeding systems and livestock enterprises

In the project target area in Bolivia, practically all farmers manage mixed crop-livestock systems. The major livestock species are llamas, cattle and sheep. In southern highlands, llamas are common, while, in central and northern highlands cows and sheep are dominant. Animals are an important source of milk, meat and manure products. Open grazing in cultivated and rangeland is common. Overgrazing by domestic and wild animals (Vicuña, alpaca) causes degradation of rangelands. Most of rangelands in the project domain are degraded. Activities initiated during the first year were aimed at setting-up trials to improve feed availability for llamas.

Establishment of pastures: model pastures were setup in Chita, Chacala and Sevaruyo communities during the month January 2019. In Chita grasses such as pasto lloran (*Eragrostis curvula)*, *Nasseella neesiana* and *Agropirun elongatum* were established under minimum tillage conditions. Similarly, in Sevaruyo, grasses *Nasseella neesiana* and *Nasseella neesiana* were planted with few rows of Brazilian grass (*Phalaris* sp.) and tall fescue (*Festuca arundinacea*). In the same manner in Chacala a hectare of pasture was established with pasto lloran.

Evaluation of new forage species for Bolivian highland: Thirteen (30) forage species were received from University of Copenhagen, and were planted in PROINPA research center in Quipaquipani, in Northern highland. These species include *Agastache rugosa, Astragalus mongholicus, Chenopodium bonus-henricus, Galega officinalis, Lathyrus maritimus, Lotus pedunculatus, Lupinus arboreus, Melilotus officinalis, Vicia sativa* ssp *nigra, V. sylvatica, Onobrychis viciifolia, Bunia orientalis* and perennial rye (*Secale cereanum*). The germinated seeds were transplanted in for evaluation. Results are not yet available.

CIMMYT and PROINPA are also trying to import several lines of grasspea, lentils and chickpeas for the diversification of the monocrop quinoa system. However, the process is taking time and phytosanitary certificate is yet to be issued by SENASAG.

Nutritional evaluation of native and adapted fodder species: the native grasses better adapted to the area and more preferred by the llamas are tall fescue or *Iru Ichu* (*Festuca orthophylla*) and purple grass (*Nassella* sp.). Both of these grasses are liked by llamas and have quick regrowth ability. Similarly, the native lupine (q'ila-q'ila) is also preferred as dry fodder in field during winter cycle. Considering these facts, all three species including three ecotypes of native lupine (Orinoca, Habas Cancha and Local) have been collected for quality analyses at early stage in February 2019. These materials will be collected again during flowering phase for fodder quality analyses. These fodder species will be analyzed in foundation PROINPA facilities in Sucre.

In Algeria, ITELV has evaluated a number of forage associations which could represent an interesting alternative to stubble grazing. These forage associations can be grazed or can be harvested as hay and used later during the summer grazing season. Some of the preliminary results regarding these associations are displayed in table 6.

Table 6. Percentage and Dry Matter yield of forage associations tested in the Ain Mlila station

Association	Dry Matter t ha^{-1}	Legume %
Vetch x Oat	0.4	13
Vetch x Barley	0.5	8
Vetch x Triticale	0.4-0.5	24.5
Pea x Oat	0.6	30
Pea x Barley	0.8	18
Pea x Triticale	0.9	32

The project team also made an inventory of the number of industrial units producing agro-industrial by-products. By-products represent an important source of alternative feed resources for livestock. The collected information is presented in table 7. Further to this, the project team is currently investigating the total volume produced by each of these industrial unit.

Table 7. Number of units producing agro-industrial by-products and their nature in the project area

District	Number	Type
Setif – Bordj Bouareridj	7 10 1	Pasta and couscous Wheat flour Olive oil
M'Sila	1 2 1	Pasta and couscous Wheat flour Apricot processing
Ain Mlila	2	Oil mill, Olive oil

Financially viable business models for No-Till and other agricultural machinery service provision enterprises

Lack of adapted agricultural machinery is a major constraint for agricultural development in semi-arid countries like Tunisia and Algeria. This is partly causing low crop production per ha, high production costs due to high labor costs, poor seed quality, etc. In the CLCA project a particular attention is given to forage seed and feed production to reduce competition for stubbles, and ZT to reduce moisture loss of soil and reduce erosion. All of these areas request adapted machinery. Successful introduction and adoption of machinery as well as development of privately-led machinery service delivery are crucial for scaling and sustainability. In this first year, we assessed the current situation in the two (2) North African countries looking at the constraints and opportunities for the development of viable business models not only for no-till seeders but also for other machinery.

Forage seed production: forage seeds like barley used by small scale farmers are mostly farm seeds; few farmers are actually purchasing seeds on the market. They prefer to use part of their own harvest and use it as seed in the upcoming season. They are of poor quality (mixed small and large sized seeds, impurity, etc.) and have therefore low yield potential.

Seed Cleaning and Treatment Unit, Beja/Tunisia.

The introduction of a locally produced and movable seed cleaning and treatment unit is an opportunity to be considered. Such units are produced in Beja/Tunisia by a local manufacturer. Those units are already on the market and have a capacity of 800 kg/h. They operate with electricity (220 V) and a unit costs about 4,000 US$. The unit can be pulled by a car or a tractor. It is also an ideal opportunity for a service provider, cleaning seeds for farmers; or a farmer cooperative can use it as service for its members. The export of such a unit to Algeria could promote forage seed production. An Algerian manufacturer could replicate the unit. A further opportunity for South-South collaboration.

Feed production: other than stubble, pastures and straw, livestock farmers purchase occasionally subsidized wheat bran, barley, pellets and concentrates as supplementary feed. Pelleted feed and concentrates are costly as several ingredients are imported. The local production of high-quality feed is therefore an opportunity to explore and would increase the efficiency of the feedlot system.

Small-scale feed grinder to improve the quality of roughage feed.

Two (2) opportunities have been identified so far. The first is a grinder, which can grind barley and chop olive branches, straw, hay, cactus cladodes and fruits… to prepare a balanced ratio. These grinders can work with electricity (380 V) or by PTO. Just like the seed treatment unit, it can be moved easily by a tractor. Its capacity is around 2 tons/day and the price per unit is 1,000 US$. It is produced locally in Kasserine, Tunisia by SFEMI. It can also be used as an income generating activity by a farmers' cooperative. In Tunisia it is part of the subsidy program (APIA). They are already used on the market and as part of the project, we are already in contact with one of the project partners ["Office de l'Elevage et des Pâturages (OEP)"] to make a number of units available through its regional offices.

Pellet machine.

The second opportunity is a locally-manufactured pellet machine. The machine can grind, mix and finally produce pellets. It can use agro-industrial by-products (olive cakes, cactus pulps…), straw, hay, cereals, etc. The pellet machine is still only a prototype produced by SFEMI in Kasserine. It has no drying compound and no private actor is using it yet. We are currently testing the machine and verifying its productivity before we can recommend it. The manufacturer states its production capacity at 2 t/day; but it is likely to be less. Collaboration with Florence University might help in testing and improving the machine for pellet production. Farmers appreciate pellets (more than feed blocks).

No-Tillage/Direct seeder: to make CA more attractive to farmers the production and scaling of a low cost local direct seeder is another opportunity to explore. Two (2) prototypes have already been produced and tested successfully in Tunisia and Algeria.

Tunisian NT Seeder.

The local Tunisian seeder has better results compared to other imported seeders (SEMEATO, John Deere, Gil …) in terms of adjustable and homogenous sowing depth, high germination rate and homogenous on the sowing lines and similar yield; but still needs some improvements. Some John Scherer tines have been used in the Tunisian local seeder and INGC is still working to upgrade the integration level by trying to design and manufacture a local tine. The seeder will then be more adapted to the Tunisian soil context. The design of the new prototype will also be improved.

Algerian NT Seeder.

In Algeria, the prototype “Boudour” is produced by a public society (PMAT) in collaboration with SOLA company, based in Algeria. Twenty (20) Boudour seeders are in stock. For large scale seeder production, farmers’ demand needs to be created. The integration level (in terms of locally-available spare parts) is about 70%. Algerian government provides a 30% subsidy for any machinery equipment (including this direct seeder).

The Algerian and Tunisian local direct seeders use expensive imported tines. The local production of adapted tines and the transformation of conventional seeders would make the seeders less expensive and more attractive. There are strong prospects for collaboration with Florence University (“Dipartimento di Scienze e Tecnologie Agrarie, Alimentari, Ambientali e Forestali (DAGRI) Università degli Studi di Firenze”) in this respect which could be very helpful. The “tine-study” could be done by INGC and ITGC. In the long run, both countries could benefit from the local tine prototype.

Sub-component 1.2. Appropriate system development methodology to support wider adoption and decision-making

Developing comprehensive trade-off models

In relation to subcomponent 1.2, farming systems approaches were developed and applied to have a better understanding of the diversity of farming systems in the region, the main indicators to be used for multi-criteria assessment of current and alternative CLCA systems, as well as the data sources and modelling methods. The first step for farm level assessment of CLCA systems is to understand the diversity of farming systems as each different type will have different priorities, objectives and aspirations that will need to be taken into account and transformed into indicators for system optimization.

For Bolivia, a farm household typology is presented for the five selected municipalities. The typology was made from the Pro-Camelidos baseline survey dataset. Originally, we developed the typology for two municipalities in the southern highlands (Uyuni and Challapata) as those are the municipalities where we have set up field activities related to alternative CLCA. Later, and by request of the Pro-Camelidos team, other three municipalities with more livestock activities were included in the report.

Through a comparative analysis, it was found that in Challapata farms are larger than in Uyuni. Both municipalities carry out agriculture with different objectives. In both municipalities, income generation is based on what they produce in the farm, but in Challapata there is a greater generation of income from activities outside the farm, even though, the income generated is higher in Uyuni. In Challapata, income coming from agriculture is almost zero and self-consumption crops are more common. In Uyuni, crop production is usual and is intended mainly for marketing. In Uyuni llama herds are slightly larger but in Challapata exists a greater diversity of animal keeping including a few alpacas or sheep. Although different types were found in each municipality, some convergences could be found in production strategies. In Uyuni the following types are found: a_{Uy}) Livestock farms with crops self-consumption, low income with off-farm activities; b_{Uy}) Livestock and agricultural farms with large land holdings and high incomes with off-farm activities; and c_{Uy}) Crop farms with livestock and income based on on-farm activities. In Challapata the following types were found: a_{Ch}) Low income farms of diversified livestock, large land holdings and off-farm activities; b_{Ch}) Commercial farms based on llama trading with intermediate incomes and smaller land holdings, with significant income generated off-farm; and c_{Ch}) High off-farm income farms, with livestock and crops for self-consumption.

Modelling options to assess the contribution of different CLCA alternatives to the sustainability of farming systems in the two municipalities include farm level modeling such as Farm Design or multiple goal linear programming. These models can take into account multiple criteria and indicators and find optimal solutions for the satisfaction of multiple objectives. Criteria and indicators to be included in the analysis include: income (for some commercial farms) and income variation, food self-sufficiency, diversification of production, soil fertility, returns to labor and risk management. Further refinement of indicators and modeling tools will be developed.

In North Africa and building on existing previous datasets and complementary collected data, two (2) sets of activities were undertaken: 1) financial evaluation and adoption assessment of CLCA related technologies; and 2) farm modeling activities to characterize and quantify production and environmental tradeoffs and explore the impact of enhanced CLCA scenarios.

Specific objectives of the first set of activities are: i) Economic evaluation and assessment of the different CLCA technologies; ii) Characterization of the profile of the new adopters of CLCA technologies; iii) Prediction of the level and time to peak adoption level of the CLCA technologies in the different target regions of the project using Adoption and diffusion outcome prediction tool (ADOPT); and iv) Categorize the major challenges to the adoption of CLCA systems, identify practical and affordable solutions to overcome these challenges, and provide guidance and recommendations on which policy and institutional support are needed to help determining priorities for future scaling investments.

Integrated crop-livestock systems face tradeoffs among the dual uses of crop residues. Such tradeoffs often depend on the biophysical and socio-economic characteristics and context of the farmer, including factors related to the availability and demand for residues. Thus, our specific objectives for the second set of tradeoffs related activities consist of i) characterizing the tradeoffs related to the use of crop residues in smallholder farms in Chouarnia and Bez belonging to Siliana governorate; ii) calculating the weights of the crop residues used for feed and for mulch; iii) identifying the principal factors that influence farmers in their decisions regarding crop residue allocations; and iv) design of a mathematical farm model that can be used to assess the impact of some CLCA scenarios and solutions.

The data used in this research stem from different sources. First, a survey was carried out both in Algeria and Tunisia using a questionnaire completed by the farmers selected for the study. Thus, farmers adopters and non-adopters are the observation units. Second, focus group discussions (FGD's) were carried out in the new project sites during which the same structural questions were asked as dictated by the ADOPT software. The objective was to analyze farmers' perception about the technology and predict their respective adoption levels of CA. Third, a key informant interview (KII) tool was implemented with regional and local stakeholders who have expertise, knowledge and broad vision perspective on CA and sustainable cropping systems methods in both countries. This is to categorize and prioritize the major constraints and challenges to the adoption of CLCA systems and provide the most relevant solutions in both countries. Fourth, the modeling activity mainly used 2013/14 data collected within the framework of the CLCA project, phase I. A random sample of farmers was selected in Chouarnia and Bez. The sample included 152 households (HH), with 142 HH from Chouarnia and only 9 HH from Bez.

Different methodological approaches were employed to deliver against the multiple objectives outlined in the previous section. These methods could be summarized as follows: i) Partial budget analysis (PBA); ii) ADOPT software; iii) FGD's; and iv) KII's.

Assessing patterns for biomass use in the studied crop-livestock systems: to estimate the quantity of the above ground biomass we used the formula of the harvest index. The Harvest Index is defined as the ratio of grain yield to above ground biomass. This formula is then combined with other estimates of the quantity grazed of cereal crops residues to end up with a value respective to the quantity of residues left on the soil. This calculation is made for each farmer in the sample based on a primary data collected through farmers' survey. Once we generate these variables, we can then provide some general results about patterns for crop residues use in the study area, with specific focus on allocations of these residues across mulching and feeding.

Identifying determinants of biomass use, a binary modeling approach: this activity attempts to identify the set of factors which are strongly associated with farmer's behavior on crop residues allocation using binary logistic regression models. The variables used in this model is as follow:

Y: representing the dependent variables, which is the quantity of the crop residue left on the soil per hectare. The depended variable is tested for different values:

- Model 1: the quantity of the crop residue left on the soil is lower or equal to 200 kilograms per hectare (Y=< 200 kg/ha);
- Model 2: the quantity of the crop residue left on the soil is between 200 and 500 kilograms per hectare (200 kg<Y<500 kg/ha);
- Model 3: the quantity of the crop residue left on the soil is higher or equal to 500 kilograms per hectare (Y>=500 kg/ha).

X are the explanatory variables tested in each model. These can be summarized as follows: Barley area (ha); Livestock herds; Number of days of grazing; Share of Livestock income in total income; Quantity of concentrate per head of cattle (kg); Quantity of concentrate per head of sheep (kg); and Quantity of concentrate per head of goat (kg).

Use of farm typology and mathematical farm models: A first step of building farm models is to conduct a farm typology that can reflect the wide structural and activities diversity in the studied sites. Then the farm models can be tailored to the representative data of each farm type identified. In this activity, we conducted a Principal Component Analysis (PCA) and Cluster Analysis (using K-Mean method); in addition to Linear Programming (LP) which is a mathematical technique for building farm models; running scenarios simulation and generating/selecting optimal solutions for a given objective function. This activity was initially planned for the second year of the project lifetime. However, we were able to start with preliminary design of an early version of a farm model for the case of the Tunisian site. For the case of Algeria, only farm typology has been conducted.
The main results and key findings are summarized in the following sections.

Economic evaluation of conservation agriculture under crop-livestock farming system in comparison to other mixed conventional crop-livestock systems: The purpose of this activity is to provide an economic analysis that can help guiding farmers in their future decisions to invest in the CLCA practices. A Cost-Benefit analysis was conducted according to a comparative approach of CA [ZT, Simplified Cultivation Technique (SCT)] with the conventional farming system, to highlight the economic effects of CA under crop-livestock farming system. To this end, partial budget analysis (PBA) have been used and applied for farmers practicing CA (direct seeding and SCT) in addition to other farmers under conventional agriculture. In Algeria, this comparison has been done for two (2) different farming systems: rainfed (Setif) and irrigated systems (M'Sila). Given that we are comparing mixed crop-livestock systems, we integrated livestock in our comparative PBA assessment by calculating the expenses generated by the management of the herd (vaccination and expenses of the shepherded of animals) and the supplementary feeding (concentrate). The sheep diet was formulated under two (2) different forms: conventional feeding plan and a feeding plan practiced by CA farmers (Table 8).

Table 8. Sheep feeding plans under conventional and conservation agriculture farming systems

Under Conventional Farming System				
September to February	**Mars Flushing**	**April – May**	**June – July –August**	
Natural grazing + straw + barley grain	Natural grazing + straw + barley grain	Natural grazing (fallow)	Stubble grazing	
Under Conservation Agriculture Farming System				
September to February	**Mars Flushing**	**April – May**	**June – July**	**August**
Natural grazing + straw + barley grain	Natural grazing + straw + barley grain	Natural grazing + straw + barley grain	Stubble grazing	Straw + barley grain

Source: Own elaboration by Algerian CLCAII team (2019).

The PBA analysis shows that for the irrigated farming system (in M'Sila), the total costs are higher for conventional farmers compared to CA farmers who have practiced direct seeding and Simplified Cultivation Techniques (SCT). The difference is about 2,301 DZD/ha (around 19,34 USD/ha) between applying zero-till technique and conventional farming and is about 2,492 DZD/ha (around 20,95 USD/ha) between applying SCT and conventional farming. With respect to the net return, empirical findings suggest that the highest income was obtained from using direct seeding technique compared to applying conventional farming or applying SCT. This has led to a slightly higher Cost-Benefit Ratio (CBR) of about 2.01 for farmers practicing direct seeding compared to a CBR equal to 1.77 for farmers applying SCT, and a CBR of 1.96 for conventional farmers. Whereas, under rainfed farming system (Setif), results show that the total costs are higher for conventional farmers compared to farmers practicing no-till, with a difference of about 4,432 DZD/ha (around 37,18 USD/ha). Average production costs for farmers practicing direct seeding are higher compared to farmers having practiced the SCT, with a difference for about 3,037 DZD/ha (around 25,48 USD/ha). This has led to a CBR of 3.29 under direct seeding; 3.3 under conventional farming; and of about 2.42 under the use of SCT.

We also made an economic evaluation of the recommended rotations by the project in comparison with current conventional rotations practiced by the farmers under direct seeding innovation for both rainfed (Setif) and the irrigated farming system (M'Sila). The different types of rotations practiced in the two (2) regions are presented in table 9.

Table 9. Types of rotations practiced in the two (2) Algerian regions (farmer *vs* CLCA project)

Region	Rotation practiced by the farmer	Rotations recommended by the project
Under rainfed farming system (Setif)	Wheat/wheat & barley/barley	Barley/peas forage Barley/vetch Wheat/oat vetch Wheat/lentil
Under irrigated farming system (M'Sila)	Barley/barley	Barley/Triticale peas Barley/oat vetch

Source: Own elaboration by Algerian CLCAII team (2019).

Results show that under rainfed farming system (Setif), the main rotations used in this area by farmers are cereals/cereals (barley/barley or wheat/wheat). The project recommends the introduction of forage peas, vetch, vetch-oat and lentil in rotations. The assessment of the economic profitability of the wheat/wheat rotation in comparison with the wheat/lentil, wheat/peas forages and wheat/vetch-oat rotations shows that the net income of the rotation wheat/lentil, wheat/peas forages and wheat/vetch-oats are higher than the net income when the rotation is wheat/wheat rotation, a gain of 6,547.4 DZD/ha (around 54,928 UDS/ha); 6,557.4 DZD/ha (around 55,012 USD/ha); and 2,315.4 DZD/ha (around 19,425 USD/ha), respectively. However, the per hectare charges are higher for the wheat/wheat rotation, a difference of 5,587 DZD/ha (around 46,87 USD/ha) for the wheat/peas forage rotation; 5,427 DZD/ha (around 45, 53 USD/ha) for the wheat/vetch-oat rotation; and 5,287 DZD/ha (around 44,35 USD/ha) for the wheat/lentil. Thus, the highest BCR was calculated for the wheat/lentil, wheat/peas forage rotations, with the value of 3.1 (for both) compared to the farmer's rotation (wheat/wheat) choices (1.6). The same trend was found for the comparison of barley/barley rotation with barley/peas forage and barley/vetch rotations. The BCR ratio is higher at the barley/vetch turnover (3.0) followed by the barley/peas forage (2.9) rotation against 0.9 for the barley/barley rotation option applied by farmers.

The main rotation practiced under irrigated farming system (M'Sila) is barley/barley. The project recommends the following crop combinations/rotation: Peas forage-triticale and vetch-oats. The assessment of the economic profitability of the barley/barley rotation compared to the barley/peas forage-triticale and the barley/vetch-oat rotations show that the net income from the rotation, barley/vetch-oat is greater than the net income of the barley/barley rotation with a gain of almost 9,000 DZD/ha (around 75,5 USD/ha). On the other hand, the net income of the rotation barley/peas forage-triticale is less with a difference of 1,000 DZD/ha (around 8,39 USD/ha). Concerning the use of inputs, barley/vetch-oat and barley/peas forage-triticale rotations were 2% higher in costs compared to barley/barley rotation. Thus, the best BCR was obtained by applying the rotation barley/vetch-oats rotations (1.9) compared to the application of the conventional rotation practiced by the farmer (barely/barely), where a BCR equal to 1.8 is being recorded.

In conclusion, the best rotation under CA for the rainfed area (Setif) is the wheat/lentil or wheat/pea. Under the irrigated farming system (M'Sila), the best economically rotation under CA is barley/vetch-oat.

Adoption assessment of conservation agriculture under crop-livestock farming systems: In practice, there is enough knowledge about factors that influence adoption of new agricultural technology and/or practices, but few attempts have been made to construct predictive quantitative models of adoption for use by agricultural decision makers, agricultural research planners, development, and extension. In this section, we are providing predictions of CLCA technologies practice's likely rate and peak level of adoption as well as shedding light on the importance of various factors and determinants influencing adoption of these improved technologies in both target countries.

In Algeria, the framework process started by the organization of four (04) focus groups each composed of 15 people. two (2) focus groups have been conducted with researchers and extension staff and two (2) focus groups with farmers in the two (2) project regions (M'Sila, Setif). The aim to conduct FGD's in each region was to understand key specific and contextual drivers and factors that may affect the CLCA technologies adoptability in the two (2) different areas. It should be emphasized that the focus was not held in Oum El Bouaghi because CA was newly introduced in this area.

Case 1: Adoption of conservation agriculture under irrigation system at M'Sila region

In the first case, ADOPT was implemented with two (2) different focus groups: farmers practicing CA under irrigated farming system and with technicians and extension staff. Combining the results issued from these two (2) FGD's gives us a clear picture on the likely rate and peak level of adoption for CLCA technologies from two (2) different perspectives. Empirical findings reveal that the predicting level of adoption is about 66% and the time to peak such level is after 20.5 years. This adoption level is expected to be 17% and 51.6% after five (5) and ten (10) years, respectively. According to the outcome from the FGD's with farmers, it seems there is a reluctance on the adoption of the CLCA technologies. This is due to the nature of the soil texture in the area which is silty and when it is irrigated there is a formation of a layer of fine elements and the land becomes in some way heavily compacted, hence requiring tillage. In addition, the target area is mainly for agro-pastoral vocation where sheep farming is key activity and sheep diet is based on stubble grazing which is considered as a source of free feed. Indeed, leaving vegetative cover on the ground would force the farmer to buy food from market to compensate the deficit caused by the absence of pasture.

Concerning the focus group with researchers and extension agents, the results are somehow different; the predicted years for adoption of CLCA technologies is estimated to be for about 13.7 years and the maximum level of adoption expected would be around 95%, from the beginning. The expected level of adoption in five (5) years will be around 51.4% and after ten (10) years it expected to be 92.8%. The expected time and level to peak adoption of the CLCA technologies is shorter. This is mainly due to the level of understanding of this group on the benefit of applying CLCA technologies. Although, there is a convergence with the farmers that upfront cost of investment (i.e. no-till seeder) and the high competition between crops and sheep are the main key factors that influences both time and level of adoption.

Case 2: Adoption of conservation agriculture under rainfed system at Setif

The results of the FGD's with farmers obtained by the ADOPT software on the expected peak level of adoption of CLCA technologies under of this system by suggests that this peak would reach 94% after 16 years. Therefore, it would be around 37.8% and 86.5% after five (5) and ten (10) years, respectively. The assessment from researchers and extension agents reveals a similar result to farmers. The predicted years for adoption of CA is about 20.6 years and the expected maximum adoption level will be around 95%, from the beginning. The expected adoption level in 5 years will be around 24.2% and after 10 years it will be approximately around 73.9%. The sensitivity analysis for the FGD's results from the researchers' and extension agents suggest the same factors influencing the expected time and adoption levels for CLCA techniques at Setif region.

In Tunisia, three (3) FGD's were carried out with farmers under rainfed crop-livestock farming system in Siliana, Beja and Zaghouan, the three (3) target governorates. During the FGD's the same structural questions were asked as dictated by the ADOPT software. The empirical findings reveal that in Siliana study area, after five (5) years of its introduction, the diffusion of technology, CA, would be of the order of 41.9% and it would be of the order of 89.4% after ten (10) years. The adoption peak is estimated to be 95% that would be reached in 15.5 years. In the region of Beja, ADOPT results shown that after 5 years of its introduction, the diffusion of technology, CA, would be 21.7% and it would be 70.1% after

10 years. The adoption peak is estimated to be 95% and it would be reached in 21.7 years. Finally, in Zaghouan study area, it appears that after five (5) years of its introduction, the expected peak of its adoption level will reach 13,9% of population and it would be 53,5% after ten (10) years. The adoption peak is estimated to be 95% and it would be reached in 26.7years.

Consequently, an additional analysis has been elaborated with the aim to assess the potential adoption level of CLCA technologies by the calculation of the Composite Capital Index (CCI) that uses SMART method: The Simple Multi-Attribute Rating Technique (Edward, 1977)[2]. All indicators used were gathered from a survey questionnaire that has been conducted during March-April 2019 among CA farmer's adopters in Beja, Siliana and Zaghouan. Each indicator represented an element of social, human and physical capital sets. The weights given to each indicator or dimension signified the importance of that indicator or dimension in our CCI. For purposes of simplification, we attributed equal weights to all indicators.

Figure 12 presents the results of a brainstorming session in which relationships were sought between capitals and indicators. The indicators were the lowest level of criteria in the proposed Mental Capacity Act (MCA) tree. Inclusion of all values (preferences, indicator values) in the MCA would yield separate matrices for each hierarchical level. The ***Criterium Decision Plus*** software was used to calculate the CCI via SMART.

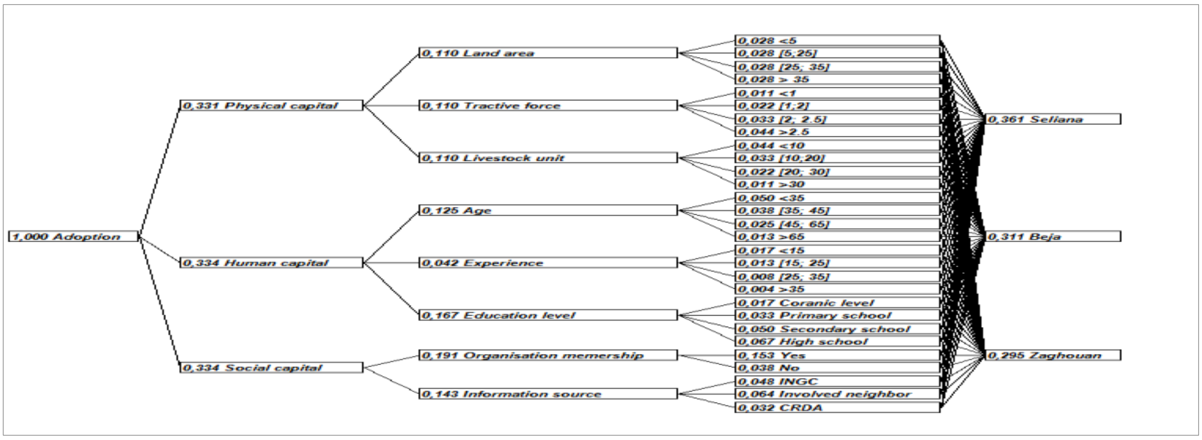

Figure 12. Weighting of the selected 2Indicators; *Source: Own elaboration by Tunisian CLCA II team (2019).*

Figure 13 depicts the overall CCI for each region (Beja, Siliana and Zaghouan). Based on the chosen weighting system and the indicators values, Siliana was found to have the highest CCI score (0.361), thus suggesting that farmers in this region are more willing to adopt CA.

In fact, human, social and physical capital endowment would positively affect the adoption process and subsequently reaching adoption pick will be more fasters. Beja takes the second position in terms of CCI (0.311) and Zaghouan the third position (0.0295). CCI scores of the three (3) regions are compatible with results of adoptions outcomes.

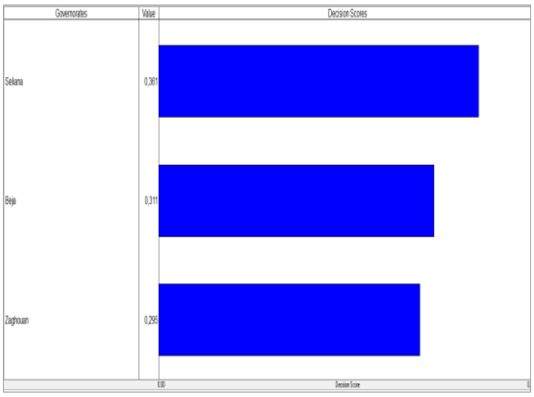

Figure 13. Overall capital composite index (CCI). Source: Own elaboration by Tunisian CLCAII team (2019).

Assessment of tradeoffs and farmers behavior determinants: *Quantification of crop residues left on the soil:*

The socioeconomic component of the project also aims to provide relevant methodologies for assessing tradeoffs related to the crop residues use between mulch and animal feed. For doing that, it is necessary

[2] Edwards, W. 1977. How to use multi-attribute utility measurement for social decision making. IEEE Transactions on Systems, Man, and Cybernetics SMC-7:5, 326–340.

to first quantify the quantities of residues devoted to different potential uses in the farms (straw, grazed, kept on the soil, etc.). We did this exercise for Tunisia, and we here present some of the preliminary results.

Figure 14 shows the distribution of the quantity of crop residues retained on the soil in a considered farmers sample from the region of Siliana (Chouarnia). It shows that most farmers (70.4%) retain an overall quantity of residue lower than 200 kg/ha, while 15% of farmers are keeping a quantity varying between 200 and 500 kg/ha, and only 14.5% of farmers are retaining more than 500 kg/ha.

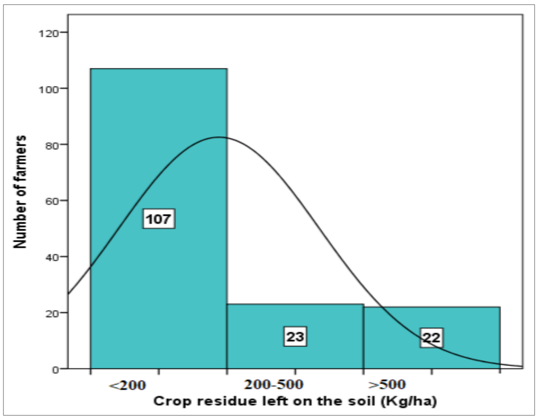

Figure 14. Distribution of the quantity of crop residues left on the soil.

Figure 15 presents the distribution of the quantity of (crop residues) mulch in different farm size categories. It shows that about 83% of the small farmers (lower than 5 ha) retain an overall quantity of crop residues lower than 200 kg/ha. For the medium farms, about 67% of farmers retain less than 200 kg/ha. Whilst, for larger farms, the highest percentage (about 48% of farmers) are keeping more than 500 kg/ha.

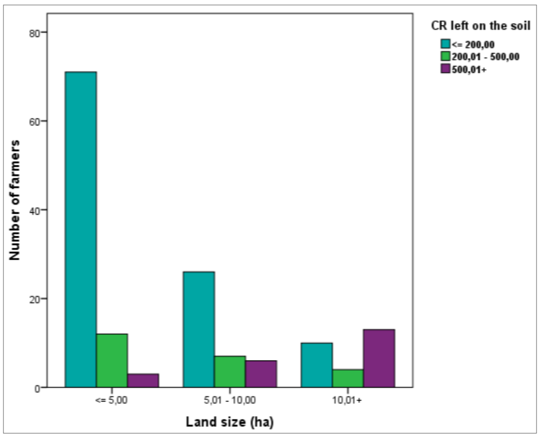

Figure 15. Quantity of crop residue left on soil for different farm-size categories.

Determinants of crop residues use: results of the binary logistic model: here we try to explain why some farmers are keeping large quantities of mulch as soil cover, while others are keeping rather small quantities.
The choice of the explanatory variables to be tested has been made based on the assumption that they have potential influence on farmer's behavior in terms of allocation of the quantity of crop residue left after harvest. Descriptive statistics of these variables (reported in table 10) show that, the most important features of farmers, leaving less than 200 kg/ha of residues on the soil, is that they have the highest number of livestock herds, the highest share of livestock income and the highest quantity of concentrates consumed per head of goat.

Table 10. Descriptive statistics of variables used in the binary logistic models

Variable	CR<200 kg/ha		200<CR<500 kg		CR>500 kg	
	Average	Sd	Average	Sd	Average	Sd
Barley area (ha)	0.52	0.54	0.94	1.22	2.47	2.48
Livestock herds (head/ha)	1.21	1.64	0.53	0.36	0.46	0.43
Number of days of grazing	0.87	0.50	1.12	0.12	1.09	0.13
Livestock income/Total income	1.01	0.58	1.08	0.30	0.85	0.60
Quantity of concentrate/Head of cattle	0.94	1.19	0.55	1.01	1.82	2.18
Quantity of concentrate/Head of sheep	0.77	1.00	1.71	1.67	1.37	1.25
Quantity of concentrate/Head of goat	1.25	7.20	0.00	0.00	0.88	3.93

Farmers who are keeping on the soil a quantity of crop residues between 200 and 500 kg/ha are characterized by a medium barley area and a relatively low quantity of concentrate consumed by cattle compared to the other two (2) groups whilst they have the highest quantity of concentrate consumed by head of sheep. The third group, keeping more than 500 kg/ha of residues on the soil are characterized by the largest barley area (average of 2.47 ha) and the highest quantity of concentrate consumed by each head of sheep. They also have the lowest number of livestock herds per ha with an average of 0.46. The results of each of the three logistic regressions are as follows:

Model 1: farmers mulching with less than 200 kg/ha
In our first model, four (4) out of seven (7) variables were shown to be significant. Barley area: coefficient regression is equal to -1.079, and the odds ratio is equal to 0.340. Livestock herds: coefficient regression is equal to 1.486 and the odds ratio is equal to 4.418. Number of days of grazing: the regression coefficient was equal to -2.606 and the odds ratio was equal to 0.074. Quantity of concentrate consumed per head of sheep: regression coefficient is equal to -0.466 and the odds ratio is equal to 0.627.

Model 2: farmers mulching with 200 kg/ha to 500 kg/ha
In the second model, we have four (4) significant variables out seven (7). Livestock herd: coefficient regression is equal to -1.181 and the odds ratio is equal to 0.307. Number of days of grazing: coefficient regression is equal to 2.053 and the odds ratio is equal to 7.793. Quantity of concentrate consumed by the cattle: coefficient regression for is equal to -0.403 and the odds ratio is equal to 0.669. Quantity of concentrate consumed by sheep: coefficient regression is equal to 0.404 and the odds ratio is equal 1.498.

Model 3: farmers mulching with more than 500 kg/ha
In the third model, we have also four (4) significant variables out of seven (7). Barley area: coefficient regression is equal to 0.671 and the odds ratio is equal to 1.957. Livestock herd: coefficient regression is equal to -1.474 and the odds ratio is equal to 0.229. Number of days of grazing: coefficient regression equal to 1.841 and odds ratio equal to 6.304. Quantity of concentrate consumed by cattle result show that, the coefficient regression is equal to 0.448, and the odds ratio is equal to 1.565.

Tradeoffs modelling of biomass use using mathematical programming: as suggested earlier, the work under this activity is still at its early stages. For the case of Tunisia, we identified three (3) groups of farmers as follows:

- Farm type 1: FT1: well-integrated crop-livestock farms;
- Farm type 2: FT2: moderately integrated crop-livestock farms;
- Farm type 3: FT3: least-integrated farms.

For each of these farms, the following three (3) scenarios have been tested:

- Scenario 1. Higher % of crop residues is used as Mulching to cover the soil (MU);
- Scenario 2. Improved barley production (BA) with enhanced yields of barley that can reduce pressure on crop residues;
- Scenario 3. Combination of Mulching and Optimized barley production (MUBA) (both previous scenarios).

For scenario 1, preliminary results suggest that Mulching under CA, that is, leaving approximately 30% of CR in the soil, will obviously result in less feed available for animal consumption. An increase from only 10% (baseline value) of crop residue used as mulch to 30% (MU scenario) leads to an average of 15% decrease in animal feed available (in terms of FU) in the farm level. The reduction is slightly higher in a well-integrated farm (FT1) compared to farms with lower crop-livestock integration and higher use of market feed (FT2 and FT3). Preliminary simulations also show that the shift of crop residue from feeding purposes to mulching at this level does not affect other farm components such as land allocation and herd size of any of the farm types, which means that farmers will only adapt by purchasing the needed feed quantity from market. Therefore, CA-based mulching reduces the available animal feed at the farm-level, but this reduction does not pose a threat in terms of herd size reduction. This may suggest that there are enough biomass resources in the farm to cater the needs of the sheep and at the same time adopt CA-based mulching.

For scenario 2, Optimizing barley production under CA translates in a change of income but does not affect any other farm activities such as land allocation, herd size, and feed availability at the farm-level. A 5% increase in barley yield results to an average of 1.7% increase in the total farm income across different farm types due to higher revenue of the cropping component. Thus, is also suggesting that existing barley yields are very low in the studied farms.

For scenario 3, the two (2) packages together can lead to improved total income across farm types by 13%. However, it will also reduce the available biomass for animal feed (in terms of FU) by 15% on the average but will not lead to changes in activity levels such as land allocation and herd size.

Establishing appropriate monitoring and evaluation frameworks

Progress for this activity is reported under the section "Monitoring and evaluation".

Component 2. Accelerate adoption through the development of delivery systems/participatory farmer-led extension systems and inform the development of contextually relevant CLCA technologies and practices

Develop a road map – based on previous CLCA initiatives by ICARDA and CIMMYT - for large-scale adoption of CA within dryland crop livestock environments + Integrate scaling partners with the network of on-field, multiscale innovation and validation sites + Develop of network of on-field, multiscale innovation and validation sites

Achievements related to these three activities are pooled together under the section "Scaling up and Sustainability".

Identify women's (both women-headed households and women in male headed households) decision-making constraints and develop opportunities to effective

Please refer to the section "Gender focus".

Developing a framework for effective rural advisory and service provision for machinery, agronomic and livestock services + Testing of effective service delivery mechanisms for machinery, agronomic and livestock services

Please refer to the activity "Financially viable business models for no-till and other agricultural machinery service provision enterprises".

Develop multi-level capacities to manage integrated interventions from field to food

Please refer to the activity "Stakeholder engagement and rapid appraisal" under component 1 and to section "Knowledge management".

Implementation arrangements

The two (2) original sites for LAC in the project where i) the Highlands of Bolivia; and ii) the Dry Corridor of Nicaragua. In the first year of the project, activities in Bolivia went very well as per the current report. In close collaboration with Bolivian partners and IFAD representation, CIMMYT colleagues developed and started testing alternatives for more sustainable CLCA and drawing/promoting scaling pathways. The activities are progressing slowly but steadily aligning with the objectives and activities of the Pro-Camelidos program.

However, in the case of the Nicaragua, the political situation of the country did not allow for any start of the project. Honduras and Mexico were originally suggested as potential substitutes and, although Honduras was a better candidate, the situation in Honduras is not an enabling one (high insecurity and political unrest), CIMMYT lacks the collaborative links for implementation of the project and the IFAD funded program ProLenca is not yet advanced enough for CIMMYT to have a really fruitful collaboration.

Consequently, CIMMYT officially requested the approval from IFAD to move their activities for the second LAC case study to Mexico, more specifically in the Mixteca Alta of the state of Oaxaca. The Mixteca Alta is a dry area in the central mountains of Mexico where a wide range of maize-based farming systems, many of them integrated crop-livestock systems, co-exist. The Mixteca Alta is one of the most marginal and poorest regions in Mexico, with high levels of migration and important degradation of natural resources. Alternatives for more sustainable crop-livestock systems based on CA have great potential to improve farmers' livelihoods and their resilience to extreme climatic events, the Mixteca Alta is also known for the devastating effects of drought on agriculture. It is anticipated that CIMMYT links up with existing IFAD investment projects. IFAD has two investment projects both covering the Oaxaca province, "*Sustainable Development Project for Communities in Semiarid Areas (*PRODEZSA)"; and "*Social Economy: Territory and Inclusion Project (*PROECO)". In the case of the first project, the CLCA grant can contribute with experiences to the Exit strategy while in the second case it can support small livestock keepers and the integration with their cropping system using CA and including fodder production

CIMMYT has important presence in the region through a MasAgro hub where activities related to CA are being implemented. Moreover, several collaborations are already in place with local universities and NGOs aligned with the activities of the project. CYMMIT can build on these relations, experience and results to accelerate learning and impact of the CLCA project.

Innovation

At the end of this first year of the project, it is early to generate innovations. There are a number of initiatives to bring together the stakeholders in the different countries where the first year activities have been put in place and these are geared towards generating new institutional arrangements from which the project would benefit, and which would represent a relay to uptake the improved technological practices developed by the project. The second phase also aims at confirming and scaling innovations of the first phase and in this respect, we anticipate that more efforts will be deployed to test and adjust at a large-scale, tools for stubble grazing and management, introduction of forage cropping in the rotations and novel weeding interventions under CA cropping system.

Knowledge sharing and management

The objective of the KM component of this project is to develop a process of generating relevant information and closing adoption gaps through developing, testing and disseminating CLCA information packages to smallholders (men and women) via participatory instruments and processes. The participatory approach sustains the effort to ensure proper contextualization and adaptation of products aiming to support innovation and scaling processes as evidenced by the respective sections of this report.

The innovation systems model implemented in the project is based on the lesson learned of the first phase and focused on participatory research, capacity development, knowledge exchange, and dissemination events with focus on women's decision-making constraints and obstacles preventing effective CLCA adoption.

Participatory research brought to better understanding of needs and aspirations of smallholder farmers and agro-pastoralists. This process has been supported by a review and improvement of existing KM models, products, and tools for data gathering, analysis and dissemination. Among different options implemented during the first year the project focused on a) printed materials; b) calibration of ICT-based data collection tools; c) use of media such as radio, video, TV, SMS; and d) face-to-face interactions.

One technical brochure was produced, titled "Méthode de réglage du pulvérisateur à rampe céréalière pour l'optimisation du désherbage chimique" in addition to a book on enhanced forage and pastoral varieties released by INRAT (https://hdl.handle.net/20.500.11766/10073) and a leaflet on the description of CLCA-II project (in arabic).

Leaflet on the description of CLCA-II project (in arabic).

Book on enhanced forage and pastoral varieties.

Baseline data from previous initiatives were curated and used for the initial activities of the project. In addition, a descriptive analysis was conducted to screen the Pro-Camélidos 2017 baseline and an analysis at municipality level was completed for Uyuni and Challapata. The results were arranged by system components and results are presented in the document Descriptive Analysis Línea Base Pro-Camélidos 2017, Boleta Hogar.

The data collection systems were designed. The required data will be used to monitor and systematize the progress on the fields, and to feed decision support products to inform farmer's activities in the next agronomic cycles. Trials' and farmers' data describing the management of crops, yields, costs, dates and crop status will be captured through field books using two (2) data collection tools: an in-house developed system (BEM http://bem.cimmyt.org), and GeoODK Collect (http://geoodk.com). Both allow form logic, entry constraints (i.e. ranges in the answers-input), sub-structures repetitions and geo-referenced information. Data collectors will be local stakeholders and their extension agents who can work online and offline in the field, save submissions at any point and – once they are finished – send them to the project servers. GeoODK Collect uses the Android platform and supports a wide variety of question types: text, number, location, polygons, multimedia, and barcodes.

Three (3) main forms were designed to collect data: Agronomic logbooks to collect dates, detailed practices, costs and income; field visits to identify, for instance, pest and disease problems on time; and training forms to collect attendants' lists, training topics and duration in number of hours. These forms will be operated in GeoODK and BEM systems.

Three (3) videos on the awareness, demand and perceptions by different stakeholders were produced and will be subject to a dissemination plan to be developed and implemented in 2019. The video produced in Bolivia focuses on the awareness and demand by different stakeholders on the lost equilibrium between the livestock and crop component of the quinoa-llama system identified as one of the major challenges or preconditions for scaling CLCA systems (https://we.tl/t-7oc8kjzK6i).
The other two (2) videos in North Africa (https://hdl.handle.net/20.500.11766/10012; https://hdl.handle.net/20.500.11766/10013) present the farmers' perception on CA. Overall the three (3) videos present a demand from producers for innovations/knowledge to move to a more stable sustainable system to ensure long-term rural livelihoods and the environment.

Additionally, two (2) videos related to CLCA field days in Algeria were produced and distributed on Facebook Setif station channel and ITGC reaching more than 2,000 views.

Radio was also used as common method for reaching out to the target audiences. Algeria promoted project activities in five (5) broadcast events [one (1) national level and four (4) local ones]. In Tunisia, two (2) team members of the CLCA-II project (Hatem Cheikh M'hamed and Houcine Angar) and one leader farmer involved in the CLCA project (Adnen Abd Rabbah) participated in the broadcast in the national radio concerning CA to talk about Tunisian experience in CA, the benefits of CA, the challenges of CA for wider adoption and to talk about the CLCA-project and its objectives. The broadcast was held on Friday, February 22, 2019 from 3 pm to 5 pm.

Broadcast in the national radio concerning CA.

Three hundred (300) SMS messages were transmitted to farmers to participate in three (3) workshops held in Setif, M'Sila and Bordj Bouareridj in Algeria. The use of SMS will be further expanded thanks to the experience of the GIZ funded project Mind the GAP and the new initiative "ICT2Scale – Access to E-Learning and Cell Phone-based Services to Strengthen Extension Services for Smallholder Farmers in Tunisia".

Blogs have also played an active role in disseminating activities via institutional sites and generating interaction with the project teams. Examples are:https://www.icarda.org/media/drywire/pushing-toward-integration-crop-livestock-and-conservation-agriculture;https://www.icarda.org/media/news/model-farmer-adopts-conservation-agriculture-north-africa

The project has engaged with several stakeholders' groups using the most appropriate methods such as training, workshops, information events (for policy makers, students, and farmers) and more technical field days (Table 11). Long-term degrees are also supported in order to create long-term sustainability in the national systems starting with the young generation. Youth was also supported with more than 25 new young farmers funded by the Young Investors Coaching Program (ANSEJ) and via innovation platforms (e.g. Setif, M'Sila and Oum El Bouaghi in Algeria).

Table 11. Summary of the stakeholders' engagement in Algeria, Bolivia and Tunisia

Type	Algeria	Tunisia	Bolivia
Training	0	27 (9 F; 10 Y)	0
Information days (Participants)	165 farmers (165 M; 42 Y) + 280 students (206 F; 280 Y)	265 (250 M; 62 Y)	19 (19 M)
Field days (Participants)	353 (243 M; 117 Y)	332 (300 M; 78 Y)	32 (13 F; 15 Y)
Post-graduate students (MSc, PhD)	13 (7 F; 13 Y)	10 (8 F; 10 Y)	0
Workshop/Conferences	265 (193 M; 80 Y)	320 (250 M; 83 Y)	0

M: Male participants; F: Female participants; Y: Participants below 35 years of age.

Key long-term results related to the engagement with stakeholders have been achieved in Algeria in terms of agreements with several stakeholders to sustain the project achievements beyond the project duration:

i. Signature of a collaboration agreement between the ITGC and the ITMAS in Setif for the inclusion in the annual courses of CLCA practices;
ii. Signature of an agreement between PMAT, a direct seeder Producer, and ITGC in July 2018 to expand collaboration;
iii. Agreement under signature between ITGC and "REQUAblé Network" to promote CLCA packages;
iv. Preparation of the signature of a collaboration agreement between ITGC and University of Setif for the inclusion of CLCA practices in the Master on agronomy.

The implemented tools have been incorporated into the scaling mechanisms developed in each country as documented in the respective section of this report. South-South exchange and learning was already in place among NA countries (i.e. Tunisia and Algeria) and has been strengthened involving farmer-led actions in addition to NARES scientists and extension officers exchange in joint training, field workshops and joint planning and implementation. Continuing this learning cycle will ensure that the project will be able to know how the different existing extension approaches could be further improved or how alternative ones would have performed in the same situation. Most importantly the learning cycle feeds back to key stakeholders (small farmers, farmers' groups, rural women institutions, local researchers, and public and private partners) and is used to support decision making towards both CLCA practices and project management/agrifood system corrections. A Tunisian team composed by the ICARDA innovation specialist and an INGC mechanical engineer visited Algeria to exchange about the locally manufactured direct seeders in both countries and identified common challenges (e.g. tines) and opportunities. The team supported the Algerian team in the development of a sound scaling strategy which was presented and approved by major Algerian stakeholders.

A first South-South KM task force was identified within the team members of the different regions. A virtual meeting was conducted to share methodologies and tools for KM in Latin America and a matrix was generated (Figure 16) to categorize, systematize and compare experiences. The matrix was then harmonized and adopted by the project in both regions. Specifically, for this project, it was agreed that the KM approach should be based on principles of the innovation system model, pay special attention to identify women's decision-making constraints and obstacles preventing effective CLCA adoption. Additionally, KM products (information packages generated within the

project) will contribute to closing adoption gaps, support the upscaling of field successes, best practices and lessons learned and be culturally/regionally adapted, specific to the needs of the target populations and able to fill information gaps. The following diagram with outcomes and KM products was validated by the group and agreed to be used as a guideline for the execution of the plan.

COUNTRIES	KM OUTCOMES AND OUTPUTS																
	Data collection tools (off/online functionality)	Knowledge of production and agrifood systems and beneficiaries of the project			Knowledge sharing				Capacity building			Peer knowledge exchange			Evidence-based recommendations for farmers		Public policy influence
		Conducting baselines (productivity, social inclusion, income, etc)	Targeting beneficiaries	Developing performance and impact indicators	Printed material (infographics, magazines, brochures, etc)	Online content (Blogs, websites, APPs, articles, videos, etc)	GIS tools	SMS tools	Trainings to farmers and key stakeholders	Demonstration events	Trainings to service providers	South – south collaboration	Peer to peer videos	Whastapp groups	Data cleaning and analysis	Decision Support Systems	Policy briefs for decision makers
Hint	Which tool (ODK, web forms, ect), describe data storage (servers management), collected forms and member staff responsible	If available describe year, groups of questions and sample. Include links to data or more info	If available describe metodology, results and links to documentation	Type of indicators, if measured before include year/month and links to results	Decribe type of material, links to PDFs and # of printed copies	Decribe type of material, include links and feed responsible	Briefly describe and include links. Mexico example: http://46.20.115.195/MasAgroTTF/v2/Estado/GTO/	Briefly describe and include links	Number of trainings, topics, and links to attendance lists. Describe data collection tool	Number of trainings, topics, and links to attendance lists. Describe data collection tool	Number of trainings, topics, and links to attendance lists. Describe data collection tool	If available describe strategies and include links to results	Describe strategy, year and include links	Describe strategy, year and reuslts	Describe strategy, and include links to results	Describe protocols and user intefaces. Include links to additional info.	Describe if it has been done in the past. Include links to PFD if available.

Figure 16. KM product matrix.

E-Learning (http://elearning.icarda.org/) will be tacked in the forthcoming years since the development of related adapted content will take time. Specific gender responsive guidelines for extension and advisory services have been discussed and will be defined during the second year in order to be promoted through global portals (e.g. WOCAT, IFAD).

Generated knowledge is made available through open access repositories (http://repo.mel.cgiar.org/; http://data.mel.cgiar.org/) and re-used during several technical and policy events.

The project design in relation to KM has been confirmed as aligned with target indicators as referenced in the M&E section of this report. However, an additional field KM staff have been hired to support the documentation of KM efforts implemented by national partners. While national partners are fully committed to the process it is important to systematize and document their action in order to create a solid baseline to evidence the effectiveness of the process at mid-term and final stage of the project. The systematized knowledge sustained the efficient finalization of the scaling strategies in each country. The strategies include the different tools and methods are to be strengthen in order to channel existing knowledge. It is also important the collective awareness of segment knowledge by target group in order to maximize its impact. Only through a more focus targeting knowledge value can be estimated, and processes made scalable.

Continuous efforts to feed lessons into IFAD and National initiatives have been made across target countries and shared for better coordination. The identified IFAD investment project with significant potential to collaborate is Pro-Camélidos. This project offers an opportunity to establish a joint KM strategy that could cross the four (4) target countries considering its focus on improving families' living conditions and their productive economic organizations when increasing their productivity sustainably managing natural resources. Pairing this objective with the one of this project could articulate a KM strategy in terms of sharing acquired knowledge and lessons learned regarding recommended technologies to sustainably increase productivity. Since Pro-Camélidos supports systematization, exchanges of experiences, life stories and the use of audiovisual techniques in evaluation, this project will foster knowledge exchange opportunities and will share research-based evidence, printed and audiovisual material and any other relevant knowledge product. Specifically, a key component of Pro-Camélidos states the sustainable use of natural resources where the main activities include integrated water management among communities, soil management and conservation (in order to recover and maintain soil productive properties, water retention, reduction of the evapotranspiration rate, among others), and strengthening of local institutions for natural resources management and systematization of experiences in territorial planning and risk management. These concrete objectives open an interesting collaboration opportunity where the knowledge generated in the project could feed the scaling activities on these matters. In North Africa linkages are foreseen with two IFAD investment projects in Tunisia (1. Siliana Territorial Development Value Chain Promotion; 2. Agro-pastoral value chains in the governorate of Medenine) but also at national level with key initiatives where members of the agricultural commission in the parliament were involved to ensure broader support to the importance of crop-livestock integration under CA system to mitigate climate change and to ensure sustainable intensification of agricultural production systems. Such initiatives aim to have CA adopted in the national strategy of agriculture.

In accordance with the recent re-orientation of the project to Mexico, the second year will focus on analysis of the existing IFAD portfolio and linkages with Oaxaca province, Sustainable Development Project for Communities in Semiarid Areas (PRODEZA); and Social Economy: Territory and Inclusion Project (PROECO). The project has the potential to contribute to PRODEZA with experiences to the exit strategy and it can support small livestock keepers and the integration with their cropping system using CA and including fodder production for PROECO.

Scaling up and sustainability

This second phase of CLCA project is a scaling phase at least for countries in North Africa building on the results of the first phase. Although research on the innovation to be scaled is only starting in countries of Latin America, scaling should be integrated as early on as possible. In relation to this, a road map for large-scale adoption of more sustainable CLCA systems in Algeria, Bolivia and Tunisia was developed. The scaling workshops used the Scaling Scan tool developed by CIMMYT and the PPPlab https://www.cimmyt.org/scaling-scan-a-simple-tool-for-big-impact/ to identify necessary intervention areas for successful dissemination of the CLCA technology. Scaling innovations to improve the sustainability of farming systems in a region requires understanding of the main scaling ingredients, particularly the ones acting as the bottlenecks and opportunities for scaling (Figure 17). For that, “The Scaling Scan” is a useful tool that can identify the strengths and weaknesses of a scaling ambition. Important in the “scaling scan” is to define the scaling ambition as it will determine the kind and size of investments.

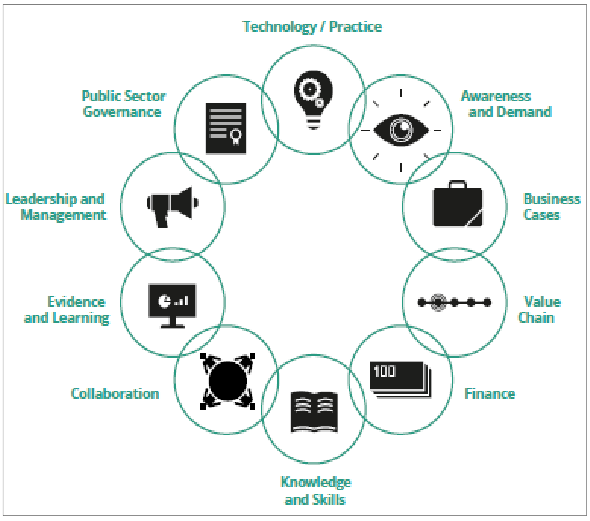

Figure 17. Each of the ten scaling ingredients require due attention for successful scaling.

In consultation with stakeholders we could state that the scaling ambition for the CLCA project in Bolivia is: “By 2022 CIMMYT facilitates scaling partners in Bolivia to have 500 [at least 50% women and 30% youth (below 35 years)] small crop-livestock farmers in drylands directly adopt one or more CLCA technologies to sustainably increase production and enhance climate resilience”.

However, in terms of leadership it can be said that, today, coordinated efforts to reverse land degradation are scattered and not properly recognized. The levels of awareness related to the importance of integrated CLCA systems and the conservation of natural resources, vary by place and by type of producer. In general, there is recognition of their relevance although there are not many active alternatives. There is interest in sustainable practices such as recovery of native plants; fertilizing the soil with llama manure; use of organic pesticides; proper techniques for water recovery; proper techniques for frost protection; fallow areas; crop rotation; placing wind barriers according to wind directions; and appropriate mechanization practices and others.

For the producers and community authorities, there are specific demands for information, training, dialogue and coordination of activities. For consumers, it is required to tell the story of *Quinoa Real* and its coexistence with camelids and the ecosystems of the Altiplano to add value at national and international level. Further, the steps to be taken are: i) to validate the scaling implementation plan with stakeholders (scaling workshop July 2019); ii) to nurture iterative feedback and update of the scaling road map; and iii) to develop and follow-up of critical scaling ingredients.

An Agricultural Innovation System (AIS) has to be built putting together the different stakeholders with a common purpose in close collaboration. Research and development institutions, such as PROINPA and the “Universidad Mayor de San Andres (UMSA)”, together with CIMMYT and other international agencies such as IFAD and FAO need to collaborate with scaling entities such as Pro-Camelidos and NGO’s (e.g. ReverdeSer) in order to develop, adapt and implement alternatives for more sustainable

CLCA systems. Champion farmers to test different alternatives need to be accompanied in the local adaptation of main CLCA principles and their experiences will be used as learning elements for other farmers in the communities. Scaling agents such as Pro-Camelidos but also local authorities and cooperatives or farmers organizations, such as "*Asociación* Nacional de *Productores de Quinua* (ANAPQUI)" need to be involved from the beginning in the development and adaptation of alternatives.

Emphasis on gender issues in the scaling strategy is very important. The main aim of this is to ensure that technologies and policies/programs consider the role and position of women and empower them. In order to identify gender-inclusive institutional/policy options for promoting up-scaling CLCA farming system, the first step is to understand the role of different farm household members have in relation to agriculture and natural resources management.

As the "scaling approach" was still new to most of the NARES partners in North Africa and to put all major project partners on the same track, the project initiated a three-day training workshop on "scaling up for sustainable crop livestock production". Twenty-two (22) participants (7 women and 15 men) from Tunisia, Algeria and Bolivia working in national agricultural research and extension institutes (NARES) and international CG centers came together to learn more about the scaling approach and how to develop a scaling strategy. The training took place from 20 to 22 November 2018 in Hammamet, Tunisia and was co-organized by CIMMYT, ICARDA, IRESA and IFAD (http://www.icarda.org/dryWire/scaling-out-sustainable-farming-practices).

Training workshop on "scaling up for sustainable crop livestock production".

A common understanding of the" scaling" terminology was achieved through the following definition: "Scaling is a process towards sustainable change at scale. Although reaching the numbers is important, the scaling approach goes beyond what can be done within a project context and aims for sustainability and system change that has an impact beyond the project boundaries..."

The so-called, "scaling ingredients" are at the heart of the tool and are as follows: i)Technology practices; ii) Awareness and demand; iii) Business cases; iv) value chain; v) Finance; vi) knowledge and skills; vii) Collaboration; viii) Evidence and Learning; ix) leadership and management; and x) public sector governance (Figure 18).

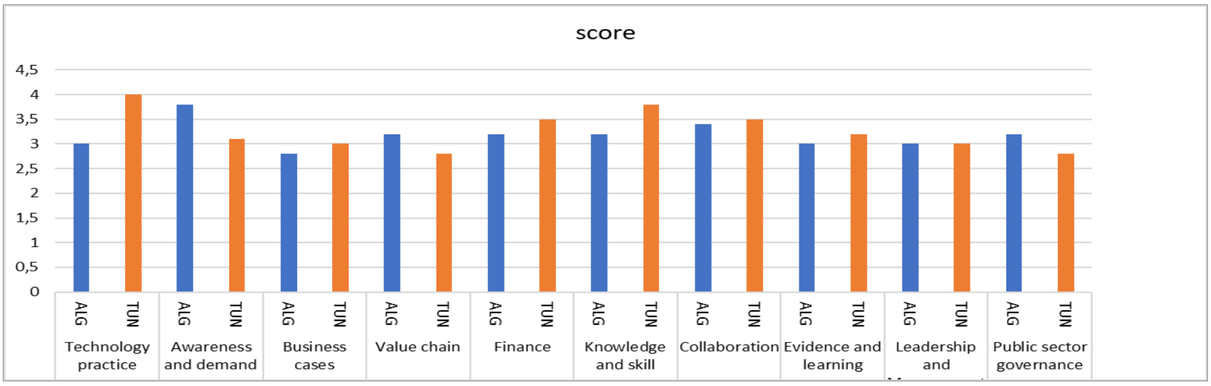

Figure 18. Scoring of the 10 scaling ingredients through country team self-assessment.

A country team self-assessment of the ten (10) ingredients revealed the points where intervention is necessary to ensure a successful scaling of the CLCA technology package. Following this exercise, the countries developed their scaling ambition and later fine-tuned their scaling strategy. Each country developed a scaling document serving as a guide to implement activities.

Technology practice: There is a significant difference to be observed between the self-assessed score of Algeria (3.0) and Tunisia (4.0). This is partly due to the fact that in Tunisia, the CA technology package has been introduced about 20 years ago and several projects were implemented since, whereas in Algeria it started only in 2006. In Tunisia CA is included in the training program of technicians and engineers of agronomy in the higher school/institution of agriculture. Also, CA is included in the training program of National Institute of Field Crop (INGC), organized each year for farmers and extension services. Nevertheless, in both countries the new aspect of livestock integration needs to be further developed.

Awareness and demand: In order to create more demand and awareness different sensitizing activities for WUE, livestock production in CLCA and forage seed production were realized in Algeria. CLCA videos were produced in both countries. Algeria produced three (3) videos on “supplementary irrigation”, “CLCA field days” and “CLCA packages practiced by farmers” with a total number of views of over 2,100. They are broadcasted on Facebook Setif station, ITGC web site (www.itgc.dz) and even in the national TV. To sensitize farmers and create demand Tunisia has also developed a CLCA film of a farmer’s perspective, has written two (2) blogs and organized a radio show with technicians and a lead farmer.
Both countries developed also printing materiel. Tunisia published one technical book on enhanced forage and pastoral varieties released at INRAT (32 pages) and a leaflet on the description of the CLCA-II project. Algeria published a brochure on the regulation and use of a knapsack sprayer for weeding in cereal production.

SMS as an ICT tool has been newly introduced in both countries. Algeria has used it to invite 300 farmers to workshops whereas Tunisia developed more than ten (10) technical SMS messages which will be sent to 1,000 farmers.

Knowledge and skills, evidence and learning: To deepen the knowledge on CLCA packages, field days and trainings are organized. In Tunisia ten (10) field days on CA practices including crop residue management, direct seeder use and soil health with over 330 participants were organized, whereas in Algeria twelve (12) field days on “stubble management”, “forage seed production”, “weed control” and “use of Boudour - direct seeder”, took place with a total of 353 participants.

In Tunisia a CLCA training course for 27 extension agents was organized in December 2018 and three (3) workshops were held on “Promising Technologies to improve Water Use Efficiency by Field Crops”, “Importance of the forage crops in the agriculture production systems”, and “Conservation agriculture for limiting soil degradation and ensuring sustainable intensification of agricultural production systems in the context of climate change”. A total of 320 people from public and private sector participated.

In Algeria six (6) workshops with a total of 265 participants covered the following topics: “the assessment of extension actions”, “scaling of impacts of the CLCA project”, and “stubble management under CLCA”. Topics were repeated in the different intervention areas of the project.

Business case and value chain: This area has been ranked lowest in both countries (2.8-3.2). This is due to the lack of private actors involved in CLCA activities. The lack of low-cost direct seeders was identified as one of the most crucial bottlenecks in both countries to make CLCA package sustainable. During the first phase of CA, mainly expensive imported direct seeders were used to install the demonstration plots. But it is obvious that to make the technology sustainable, a low-cost local solution must be developed and promoted. In Algeria, the locally produced direct seeder “Boudour” was tested successfully by technicians and farmers at the end of the first phase. Six (6) farmers and four (4) cooperatives have expressed their interest in purchasing a Boudour seeder. The mechanization subsidy policy of MARDF provides a 30 - 70% subsidy to farmers for farm implements. To make “Boudour” part of the list, PMAT, the seeder producing enterprise is negotiating with the Ministry with the support of the project. PMAT has still ten (10) Boudour seeders in stock, ready to be sold to farmers. Once the subsidy is guaranteed and more farmers express their interest, the enterprise will launch chain production of this innovative farm implement.

In Tunisia a prototype of a local direct seeder was developed by INGC in collaboration with the private enterprise SPMSUD. Before the large-scale production of the seeder can start, a sound technical assessment needs to be carried out. This is planned in collaboration with the University of Florence, Italy and ITGC Algeria. Furthermore, testing the improved Tunisian prototype of no-till seeder by more farmers in the next cropping season is mandatory to confirm the performance of the seeder and to give more support for its marketing.

Another bottleneck is the production of clean forage seeds in Tunisia and Algeria. Farmers are often using their own farm seeds which are of poor quality. A local enterprise was identified which produces in Beja-Tunisia, movable seed cleaning and treatment unit. The introduction of this technology is an opportunity to be considered to develop seed business and improve forage production.

Finance: Financial constraints regarding the scaling of CLCA packages are mainly linked to the purchase of direct seeders by farmers and their associations or service providing enterprises. As mentioned above, the import of expensive machinery is not sustainable; not only because of high prices but also because of lack of spare parts and specialized technicians. The promotion of the locally manufactured direct seeders in Algeria and Tunisia, once the technical performance is satisfactory, will go hand in hand with lobbying on the institutional level (APIA/MAWRF in Tunisia, MARDF in Algeria) to ensure that these machines receive the same subsidy as conventional agricultural implements.

Leadership and management: In Tunisia grouping farmers in associations and/or organizations (SMSA, GDA) is significant for the dissemination of the CLCA technology, in that it eases technology transfer, access to information, and to subsidies and investment. Collaboration with public institutions like AVFA and DGFIOP to encourage smallholders for the creation of farmer's organizations and to sensitize existing professional organizations in order to push them towards a collective action (acquire no-till seeder and use it collectively, acquisition of all inputs) is essential. So far, two (2) SMSA farmer organizations have been convinced to test the CLCA package and collaborate with the project.

In Algeria the "lead farmer approach" has been chosen to scale the technology. Identification, training and coaching of ten (10) lead farmers in the whole CLCA package happened in this first year. Each lead farmer coaches 50 farmers. Each year another ten (10) lead farmers will be added to reach in total 1,500 farmers with 30 lead farmers by 2022.

Collaboration and public sector governance: Both countries rate on collaboration is equally high (3.4, 3.5). In Algeria there are twenty-two (22) public institutions involved in project activities. The installation of three (3) regional innovation platforms in Setif, M'sila and Oum El Bouaghi enhanced the exchanges between these actors. Strong collaboration with the University in Alger led to thirteen (13) students preparing their thesis on CLCA themes in the project sites and more than 280 students visiting and learning about the different components of this production system. The same applies to Tunisia were a multitude of public and private stakeholders including farmer syndicates and cooperatives participate at project events like workshops and trainings. This strong multi-stakeholder collaboration in both countries is mandatory for institutionalization and long-term sustainability of the approach.

Because of the importance of the scaling road maps in affecting the project logframe matrix and the annual workplans for the remaining three (3) years of the project, it was considered important to have them fully embedded in this report and they can be accessed here:

Scaling%20Strategy%20Algeria.docx , Scaling%20strategy%20Bolivia.docx , Scaling%20Strategy%20Tunisia.docx

The documents still need some fine tuning before uploading them on the project MEL repository, but this is not to affect the relevance of the existing information and data.

Gender focus

In the CLCA project the gender elements outlined in the proposal are provided below and will be achieved during the project cycle:

- Targeting stereotypes among officials and extension agents' circles related to women being housekeepers and helpers when they contribute to 80% of livestock work;
- Improve access to extension services for women;
- Use sex-disaggregated data;
- Address both women's and men's needs in CLCA;
- Implementation processes favouring gender equity;
- Understand better gender-specific roles in farming, gender-specific decision-making power in technology adoption, and gender-specific power in controlling assets (e.g., land and livestock) and income expenditures for use as the basis for the content and dissemination of the specific CLCA KM products.

Forty percent (40%) of the beneficiaries in the project will be women and as such, roughly speaking 300 women/country/year are to be targeted.

CIMMYT has just invited a gender specialist to help them achieve the project objectives in Latin America. She is expected to join the team shortly. Preliminary data from Bolivia show the roles that household members play in the CLCA system and that the farm household unit is key in the development of alternatives as all different members of the family play differentiated roles in either the production of quinoa or llama. In order to have an institutional framework and/or policy that benefit women and young people in CLCA systems, it is mandatory to understand that llama production seems to be more of youth/women activity while quinoa production more of a men's activity. As the project aims at impacting women, more work on the livestock component will be needed. Therefore, we would have to see the social implications of the activities of our project in this regard, as well as those of Pro-Camelidos such as work burden in family members and gender division of labor. To impact children, teenagers and young people, alternatives that allow them to have mobility and alternate between the rural/urban life (pendular migration or school holidays) seem feasible. Moreover, research on how these groups perceive CLCA in their life aspirations in order to co-imagine a future and co-build it will be relevant.

Finally, the roles and activities of men, women, elderly, youth and children in the quinoa-llama systems are complex and interrelated. With a focus on farming systems or farm households, almost every visited household had an intricate network of tasks from different members (i.e. adult men who get into quinoa and its market, women who are more dedicated to livestock, young people who live in the cities and come back to their villages in specific seasons to work and support, children and teenagers who contribute to the family income/means by working in temporal jobs).

In North Africa, focus groups have been conducted in four (4) of the Tunisia target regions and in one (1) of Algeria's target regions (1 with men and 1 with women of lower class and 1 with men and 1 with women of middle class in each of the target areas). The focus groups attempted to understand gender roles and needs in integrated livestock-crop production as well as understanding the impacts and costs of adopting CA and means to mitigate them. By the end of this year, it is expected that Algeria also completes its focus group exercise to inform the intervention phase.

Agricultural engineers from the national system in Algeria as well as the Rural Women Unit were trained on conducting these focus groups in February 2019. During the same period, a presentation identifying the importance of integrating gender in CLCA activities to achieve project outcomes was also provided to key stakeholders involved in the CLCA project in Algeria.

Based on focus group findings on women's roles and needs in integrated CA and livestock production in Tunisia and Algeria, the following activities were designed in the planning meeting conducted in April 2019 in Hammamet, Tunisia.

In each country work plan of Tunisia and Algeria, teams have designed the following activities to target women with the aim of reaching 100 women beneficiary/country:

i. Capacity building of women farmers in a) herd health care and b) feeding;
ii. Involvement of women farmers in on farm trials on CA and community-based forage seed production;
iii. Leadership support to women (along with involvement of young women and men) by working with women champions in the scaling roadmap (e.g., through encouraging women to join farmers' organizations in Tunisia along with working with these groups for scaling purposes);
iv. Youth as students are to be involved in the project and as participants in above activities.

The workplan also identified existing projects which have targeted women beneficiaries in the CLCA targeted areas (such as the BMZ-funded Mind the Gap project and BMGF/AFESD funded Food Security project). The women beneficiaries in these projects will be recruited as participants in the CLCA project and as leaders and champions for the scaling roadmap.

A new KM officer has been hired on the project for NA and his role is also to help NARS partners recruit women farmers for the trainings and activities identified above. NARS partners in both Algeria and Tunisia have emphasized the difficulty in the recruitment of women as a bottleneck which significantly limits women's participation. To help overcome that, in the focus groups conduced in Tunisia we have collected a roaster of over twenty (20) women farmers interested in the project per area with their phone numbers. These women will be targeted and mobilized by the KM officer for participating in the activities identified above. In Algeria the rural women unit which has presence in all Algerian provinces has been brought on board to help us with accessing women farmers for involvement in the above activities.

In Tunisia the focus group findings brought evidence to the forefront on women's role in livestock production. A training activity which initially involved women in backyard poultry production is now expanded to training on small ruminant diseases as well as feeding. Based on the focus group findings, which identified this training as a need for women as well, stereotypes were challenged with regards to the exclusive involvement of women in poultry production (which is significant but not exclusive to their roles) and now expanded to livestock diseases and feed.

Environment and climate focus

Amongst the expected outcomes of the project is the effect on natural resources (soil health including reduction of erosion and increase in soil organic matter, and water use efficiency) as a result of the integrated CLCA package. These environmental parameters evolve very slowly particularly in a semi-arid context. It is yet premature to suggest firm conclusions in this respect but for sure the preliminary results on the reduction of erosion in the site of Chouarnia and El Krib in Tunisia (heritage sites from phase I) are very encouraging. The CLCA system in the sites have started since 2013 (inception of phase I) and has now been in place for six (6) consecutive cropping seasons. The project team is also aware that the number of measurements to fully characterise this environmental benefit should increase and starting from the summer of 2019, the whole site of Chouarnia will be covered by an expanded measuring network of soil erosion and water runoff. The General Directorate of Soils within the Ministry of Agriculture in Tunisia is being involved in this monitoring and they accepted to support the project through their advanced measuring equipment facilities, network of laboratories and regional offices.

Monitoring and evaluation

In accordance with the submitted proposal the project uses the M&E system adopted in phase I and currently in use by other four (4) IFAD projects in Africa, Asia and Europe. The initial steps were to configure the system in accordance with the approved logical framework along with the six (6) outputs and the three (3) outcomes. Each level was populated with the related indicators. The system was described using multiple media in order to facilitate its use. A series of short overview/frequently asked questions documents have been produced (http://repo.mel.cgiar.org/handle/20.500.11766/4962 and http://repo.mel.cgiar.org/handle/20.500.11766/4961) in addition to a dedicated YouTube Channel for tutorials https://www.youtube.com/channel/UCIe4a86Rp-hcTt5C_x4YkHg and online wiki guide: https://cgiarmel.atlassian.net/wiki/spaces/MEL/pages/8552647/Projects+Planning.

The system was also equipped with an online chat to provide support and integration with GitHub in order to establish a direct linkage with the software development team able to address any technical constraint. A discussion forum was also included to facilitate discussions.

While the first year was more dedicated on the structural design of the system, it is expected that the second year will be characterized with more capacity development around M&E. The launch events and the synergies with the KM component facilitated several discussions about the logical framework indicators and related targets in order to perform a reality check. It is also true that the first year report has stimulated the team to look back and see joint achievements and reflections against the logical framework. This is also important in view of the mid-term evaluation and its related TOR under preparation during the second half of the second year. The reflections around other indicators used in the CGIAR, in other IFAD projects and most importantly at country level were initiated – a process that will generate case studies by country and a robust M&E plan to be shared with stakeholders in the second year.

Since the project goal is to sustainably increase production and enhance climate resilience of small farmers' communities and their crop-livestock production systems in drylands, we would adopt from the CGIAR the indicators related to innovations, partnerships, trainees, peer review papers, smallholder farmers reached and smallholder farmers who have directly adopted CLCA farming systems. In addition, we will test the feasibility to estimate the adopting institutions and projects, number of agricultural innovation systems coalesced, yield variation, net income variation, contribution of the innovations to the climate resilience capacities of smallholder families and strengthening of the innovation network. The monitoring and evaluation framework include details on methods, data collection and cleaning systems, storage and visualization tools proposed for this process. The process

to review indicators follows the IFAD framework to assess: a) relevance; b) effectiveness; c) efficiency; d) impact; e) sustainability; f) governance and management; g) Gender equality and women's empowerment; h) Innovation and scaling up; i) Environment and natural resources management; l) Adaptation to climate change; and m) Partnership. In addition, Science quality has been added being the project implemented by CGIAR organizations.
The table in annex 2 shows the proposal logical framework with the following color coding and related qualitative progress achievements after the first year. This exercise focuses on the perception by the project team and its utilization in other IFAD projects helped the team to reflect on the main project indicators. It is important to note that Nicaragua has been recently replaced with Mexico thus several indicators in LAC should be re-calibrated.

(blue)	In progress: On Track	(orange)	Not achieved/To be replaced
(yellow)	In progress: Off Track	(green)	Achieved

Financial and fiduciary management

The financial statement table for the period between April 13, 2018 (official inception of the project) and March 31, 2019 is presented in annex 4. First year budget from IFAD grant is US$ 684,469 of which US$ correspond to the 2% CSP contribution. The funds available for ICARDA and CIMMYT amount to US$ 670,780 of which US$ 362,116 were allocated to ICARDA and US$ 308,664 were allocated to CIMMYT. Up to 31 May 2019, the amount disbursed by IFAD to ICARDA is US$ 604,143. By March 31st, 2019 (end of first year) the balance is US$ 170,485. The underspending mainly corresponds to CIMMYT working in one country of the LAC region and to procurement delays in purchasing equipment for Algeria. Furthermore, the supply of some of the equipment purchased for Tunisia was delayed and the corresponding budget is recorded as commitment and not as actual expenditure.

Relevance to IFAD target group

The proposed grant is aligned with IFAD corporate priorities. The project focuses on the continuing and growing challenges of food security, climate change, and land and natural resource degradation faced by mixed smallholder farmers in drylands. The grant reflects different rural development priorities in NA and LAC countries where food security, climate change and natural resource degradation are of outmost importance for the low end of the wealth gradient and marginal households, notably for rural women and youth. The project will contribution to the three (3) strategic objectives (SO) of IFAD's current Strategic Framework (2016-25). It will in particular contribute to SO_1, "Increase poor rural people's productive capacities" and SO_3, "Strengthen the environmental and climate resilience of poor rural people's economic activities". The main target groups are 3,600 HH of small crop-livestock producers in NA and LAC, whose livelihoods are dependent on crop production (barley and wheat-based systems in NA, and maize, wheat and Andean cereal-based production systems in LAC) that has a livestock component. Through the support to innovation systems supporting adoption, the involvement of NARES and linking to IFAD investment projects, the spill-overs are expected to reach 20,000 HH, who will indirectly benefit from the project. Processes and practices developed will be made available for national innovation systems to expand adoption to other areas outside of the project implementation area through processes and approaches developed within the project lifetime. Specific strategies will be used to integrate women from both women headed households and men headed households in participatory trial activities and their needs and priorities will be included in the development of the adapted CLCA practices to insure benefits for women. Likewise, specific strategies for reaching women will be included in the development of processes for promoting the wider uptake. An effort will be made to involve young farmers and capture their innovative ideas and potential role as change agents. In Bolivia, the communities and farmers to implement the activities of the project in its first year were selected based on a typology analysis using the IFAD-funded investment project Pro-Camelidos targeting small-scale mixed farmers within the existing indigenous communities. For Algeria and Tunisia, we privileged the communities and farmers where the first phase of the project was implemented in order to ensure continuation and engagement. For new sites, the project teams based their choice on the outcomes of the typology carried out in the first phase and clearly targeted small to medium-sized farms practicing crop and livestock production in which the sustainable use of natural resources is threatened by a high risk of soil erosion and a depressed water use efficiency.

Linkages (to IFAD investment portfolio and other development initiatives)

Continuous efforts to feed lessons into IFAD and National initiatives have been made across target countries and shared for better coordination. The identified IFAD investment project with significant potential to collaborate is Pro-Camélidos in Bolivia. This project offers an opportunity to establish a joint KM strategy that could cross the four (4) target countries considering its focus on improving families' living conditions and their productive economic organizations when increasing their productivity sustainably managing natural resources. Since Pro-Camélidos supports systematization, exchanges of experiences, life stories and the use of audiovisual techniques in evaluation, this project will foster knowledge exchange opportunities and will share research-based evidence, printed and audiovisual material and any other relevant knowledge product. In accordance with the recent re-orientation of the project to Mexico, the second year will focus on analysis of the existing IFAD portfolio and linkages with Oaxaca province, Sustainable Development Project for Communities in Semiarid Areas (PRODEZSA); and Social Economy: Territory and Inclusion Project (PROECO). The project has the potential to contribute to PRODEZA with experiences to the Exit strategy and it can support small livestock keepers and the integration with their cropping system using CA and including fodder production for PROECO. In NA linkages are foreseen with IFAD investment project in Tunisia (1. Siliana Territorial Development Value Chain Promotion; 2. Agro-pastoral value chains in the governorate of Medenine) but also at national level with key initiatives where members of the agricultural commission in the parliament were involved to ensure broader support to the importance of crop-livestock integration under CA system to mitigate climate change and to ensure sustainable intensification of agricultural production systems. Such initiatives aim to have CA adopted in the national strategy of agriculture.

Conclusions and recommendations for follow up

Annotations

This section should describe the major accomplishments achieved and constraints encountered, as well as recommendations for the following phases of grant implementation.

The project encountered delays in engaging with the second country in LAC. This has already been discussed above. With the approval of IFAD for CIMMYT to engage in Mexico, such a constraint is now lifted, and the project is expected to progress with a normal pace and capitalize on CIMMYT results achieved in the last 50 years.

The multidisciplinary articulation of the project is innovative; yet it is a constraint in getting all stakeholders adopt a system thinking. There was a focus during the first year to multiply contacts and dialogues with all stakeholders to leverage up the system thinking amongst all participants and this was successful to a large extent.

One major achievement during the first year was to agree and to validate with the national partners the scaling road maps for Algeria, Bolivia and Tunisia. These scaling road maps will represent the conceptual framework for the project to operate. We therefore built participatory scaling road maps into how we reframed our logical framework indicators in order to have a better and more accurate M&E templates.

The validation of the technical packages, particularly in NA was facilitated by the outputs and lessons from the first phase. This has greatly catalyzed the field implementation of the activities in Algeria and Tunisia where the partners are now more engaged in finding the scaling mechanisms for already tested and proven technical packages.

The project design in relation to KM was confirmed within ICARDA and CIMMYT and aligned with target indicators as referenced in the M&E section of this report. Additional synergies were discussed with IFAD activities in North Africa. Specific attention has been placed on Knowledge Management with the IFAD initiative “Strengthening Knowledge Management for Greater Development Effectiveness in the Near East, North Africa, Central Asia and Europe”.

Annexes/Appendices

Annex 1. CLCA Project Beneficiaries (2018-2019) in Tunisia

Project activities	Farmers	Farm Associations & NGO's	Scientists and Students	Extension specialists	Policy makers	Service and Input providers	Total	Female participation	Female participation (%)
Workshops: **3 workshops were organized**	115	15	82	60	40	8	**320**	70	21.8
Training: **1 training on CA**	0	0	3	17	7	0	**27**	9	33.2
International visits	1	0	2	1	0	0	**4**	1	25
Field days: **10 field days were organized**	200	20	60	30	12	10	**332**	32	9.6
Information days at the beginning of the season: **4 Information days were organized**	217	8	15	20	5	0	**265**	15	5.6
Survey and focus group	180	4	20	30	8	0	**242**	60	24.7
Radio broadcasts	500*	50*	100*	200*	100*	50*	**1000***	200*	20
Grand total	**1213**	**97**	**282**	**358**	**172**	**68**	**2190**	**387**	**17.6**

* **Estimated.**

Annex 2. Detailed work plan April 2018 – March 2019

Component	Sub-component	Activity	Description of activity and in which country it will be implemented.	Time frame	Implementing entity and responsible person	Outputs for the first year against the logframe
Component 1: Adaptive research with integrated capacity development of key partners to fully implement and evaluate CLCA systems	**Sub-component 1.1: CLCA system optimization (filling research gaps and full implementation and integration of technologies developed by both centers for the two (2) regions**	Ac. 1.1.1 Stakeholder engagement and rapid appraisal	Conducting inception workshop in Tunisia and country specific meetings in Algeria, Bolivia, Nicaragua and Tunisia	April – June 2018	CIMMYT & ICARDA (Santiago Lopez and Mourad Rekik)	- Report on inception WS; List of private stakeholders invited and involved in the project in three countries; reports on meetings with stakeholders.
					Subtotal ICARDA	
					Subtotal CIMMYT	
		Ac. 1.1.2 Developing integrated improved crop management systems	Develop integrated improved crop management systems through the generation of empirical evidence (especially on-farm) and its discussion with the different actors in Algeria, Bolivia, Nicaragua and Tunisia	June 2018 – March 2019	CIMMYT & ICARDA (Ravi Gopal and Claudio Zucca)	- Reports and protocols describing establishment of on-farm and on-station trials.
					Subtotal ICARDA	
					Subtotal CIMMYT	
		Ac. 1.1.3 Fine-tuning crop residue use in different geographies and socioeconomic environments	Development of locally adapted improved crop residue management in relation to soil fertility and livestock feeding in Bolivia and Nicaragua	May 2018 – December 2018	CIMMYT Only (Santiago Lopez)	- Database. Data collected from on-farm trials and on-station long-term trials.
					Subtotal ICARDA	
					Subtotal CIMMYT	

Annex 2. Cont'd

Component	Sub-component	Activity	Description of activity and in which country it will be implemented.	Time frame	Implementing entity and responsible person	Outputs for the first year against the logframe
Component 1: Adaptive research with integrated capacity development of key partners to fully implement and evaluate CLCA systems **(Cont'd)**	**Sub-component 1.1: CLCA system optimization (filling research gaps and full implementation and integration of technologies developed by both centers for the two (2) regions** **(Cont'd)**	Ac. 1.1.4 Advocating alternative feeding systems and livestock enterprises	Development and promotion of small-scale farm feedlots in support of residue retention to support CA in Algeria and Tunisia	May – October 2018	ICARDA only (Mourad Rekik)	- Flocks feeding management protocols owned by farmers adopting CLCA systems developed and monitored.
					Subtotal ICARDA	
					Subtotal CIMMYT	
		Ac. 1.1.5 Financially viable business models for no-till service provision enterprises	To support the development of innovative business models and business plans suitable for small entrepreneurs willing to invest in machinery service delivery in Algeria and Tunisia	October 2018 – March 2019	ICARDA only (Aymen Frija)	- Database, Key informant interviews, project surveys.
					Subtotal ICARDA	
					Subtotal CIMMYT	
		Ac. 1.2.1 Reducing irrigated water use in CLCA systems; optimizing in-situ water use in rain fed systems	A suite of pertinent soil and water conservation practices (SWC) (including no-till and residue management), identified and promoted for different agro-ecologies in LAC and NA countries, and appropriate for different types of farming systems in Algeria, Bolivia, Nicaragua and Tunisia	April 2018 – March 2019	CIMMYT & ICARDA (Ravi Gopal and Claudio Zucca)	- Report and protocols describing established project on-farm and on-station long-term trials.
					Subtotal ICARDA	
					Subtotal CIMMYT	
		Ac. 1.2.2 Reducing erosion in soils with steep slopes			CIMMYT & ICARDA (Claudio Zucca)	
					Subtotal ICARDA	
					Subtotal CIMMYT	

Annex 2. Cont'd

Component	Sub-component	Activity	Description of activity and in which country it will be implemented.	Time frame	Implementing entity and responsible person	Outputs for the first year against the logframe
Component 1: Adaptive research with integrated capacity development of key partners to fully implement and evaluate CLCA systems **(Cont'd)**	**Sub-component 1.2: Appropriate system development methodology to support adoption and decision-making**	Ac. 1.3.1 Developing comprehensive trade-off models	Develop and apply comprehensive trade-off models and tools to assess the technical feasibility, economic viability, and environmental performance of integrated CLCA farming systems in Algeria, Bolivia, Nicaragua and Tunisia	June 2018 – March 2019	CIMMYT & ICARDA (Santiago Lopez and Aymen Frija)	- Report on data collection and field surveys.
					Subtotal ICARDA	
					Subtotal CIMMYT	
		Ac. 1.4.1 Establishing appropriate monitoring and evaluation frameworks	Establish appropriate monitoring and evaluation frameworks which will be used across the different project activities in particular components 1 and 2 in Algeria, Bolivia, Nicaragua and Tunisia	October 2018 – December 2018	CIMMYT & ICARDA (Enrico Bonaiuti)	- M&E framework and Tool developed to monitor progress. - Appropriate monitoring and evaluation frameworks for Peru, Bolivia, Nicaragua, Guyana, Iraq, Algeria, Tunisia (Internal document).
					Subtotal ICARDA	
					Subtotal CIMMYT	

Annex 2. Cont'd

Component	Sub-component	Activity	Description of activity and in which country it will be implemented.	Time frame	Implementing entity and responsible person	Outputs for the first year against the logframe
Component 2. Development of a delivery system/participatory farmer-led extension system for accelerating of adoption		Ac. 2.1.1 Develop a road map – based on previous CLCA initiatives by ICARDA and CIMMYT - for large-scale adoption of CA within dryland crop livestock environments	Contextually relevant processes for enhancing broad uptake of conservation agriculture – different from traditional (linear) processes of technology transfer - are refined in Tunisia (from a previous engagement), adapted and fine-tuned in both Algeria and Latin America (Bolivia and Nicaragua), through participatory processes for agricultural innovation	April 2018 – March 2019	CIMMYT & ICARDA (Lennart Woltering)	- Inventory reports per country. - Report on rural advisory services diagnostic document.
					Subtotal ICARDA	
					Subtotal CIMMYT	
		Ac. 2.1.3 Develop of network of on-field, multiscale innovation and validation sites			CIMMYT & ICARDA (Lennart Woltering)	
					Subtotal ICARDA	
					Subtotal CIMMYT	
		Ac. 2.1.4 Identify women's (both women-headed households and women in male headed households) decision-making constraints and develop opportunities to effective			CIMMYT & ICARDA (Dina Najjar)	
					Subtotal ICARDA	
					Subtotal CIMMYT	

Annex 2. Cont'd

Component	Sub-component	Activity	Description of activity and in which country it will be implemented.	Time frame	Implementing entity and responsible person	Outputs for the first year against the logframe
Component 2. Development of a delivery system/participatory farmer-led extension system for accelerating of adoption (Cont'd)		Ac. 2.2.1 Developing a framework for effective rural advisory and service provision for machinery, agronomic and livestock services	(Cont'd)	April 2018 – March 2019	CIMMYT & ICARDA (Lennart Woltering and Boubaker Dhehibi)	(Cont'd)
					Subtotal ICARDA	
					Subtotal CIMMYT	
		Ac. 2.2.2 Testing of effective service delivery mechanisms for machinery, agronomic and livestock services			CIMMYT & ICARDA	
					Subtotal ICARDA	
					Subtotal CIMMYT	
		Ac. 2.2.3 Develop multi-level capacities to manage integrated interventions from field to food			CIMMYT & ICARDA	
					Subtotal ICARDA	
					Subtotal CIMMYT	
		Ac. 2.2.4 Integrate scaling partners with the network of on-field, multiscale innovation and validation sites			CIMMYT & ICARDA	
					Subtotal ICARDA	
					Subtotal CIMMYT	

Annex 2. Cont'd

Component	Sub-component	Activity	Description of activity and in which country it will be implemented.	Time frame	Implementing entity and responsible person	Outputs for the first year against the logframe
Component 2. Development of a delivery system/participatory farmer-led extension system for accelerating of adoption (Cont'd)		Ac. 2.2.5 Examine implications for women's involvement and empowerment in above approaches	Review and identify existing institutional / policy factors and how they impede or facilitate (promoting) scaling up of CLCA practices in LAC and NA in Algeria, Bolivia, Nicaragua and Tunisia	June 2018 – March 2019	CIMMYT & ICARDA (Dina Najjar) Subtotal ICARDA Subtotal CIMMYT	Technical report drafted on lessons learned and outcomes attained from the revision and identification of gender-inclusive institutional/policy options for promoting up-scaling CLCA farming system.
Cross cutting knowledge management component		To develop a process of generating relevant information and closing adoption gaps through developing, testing and disseminating CLCA information packages to smallholders (men and women) via participatory instruments and processes in Algeria, Bolivia, Nicaragua and Tunisia		June 2018 – March 2019	CIMMYT & ICARDA (Andrea Gardeazabal and Katrin Park) Subtotal ICARDA Subtotal CIMMYT	- Database and related narrative reports. Project documents, survey tools and data generated including field books per site and lists of participants in courses. - Database and related narrative reports. Evidence of each knowledge product generated including SMS, video, printed material and online dissemination tools. - MSc thesis. MSc degree/thesis engaged within the activities of the project.

Annex 3. The project logical framework matrix

	Objectives-hierarchy	Objectively verifiable indicators	Overall	Tunisia	Algeria	Bolivia	Means of verification
Goal	To sustainably increase production and enhance the resilience of smallholder crop-livestock production systems to climate variability in drylands in NEN and LAC countries.	- Yield gaps of cereals, legumes and livestock are reduced by increased resources use efficiency (e.g. water and nutrients). Crop yield gaps reduced by as much as 40% and livestock offtake rate by 30% in both rain-ed and irrigated systems.	0%	0%	0%	0%	- Database. Project generated data and reports; results of the IFAD loans and government programs; national statistics. - Agreement. Collaborative agreements signed between consortium and NARES for strengthening local technical capacities and scaling activities.
Objectives	To develop in participation with smallholder crop livestock producers contextually relevant and gender sensitive processes for enhancing the broad uptake of CA within integrated CL systems in drylands in LAC and NEN regions.	- Beneficiaries of existing and new IFAD as well as other government initiatives have been exposed and have applied technologies and practices promoted by the project through 4 country-based formative research and interactive KM models, tools and products.	40%	40%	40%	40%	- Report. Reports identifying the presence and participation of IFAD project representatives and key officials from local, regional and national government organs at key meetings, consultations, workshops and policy dialogue events.
		- Regulatory systems and policies in four countries have been informed on newly gained knowledge via evidence-based policy briefs and bottom-up information flow.	10%	10%	10%	0%	- Report. Capacity development and training reports on partners' and beneficiaries' participation in formative research activities.
		- Four (4) national innovation systems (one in each target countries) have been engaged in developing avenues for enhancing an enabling institutional and economic environment to facilitate broad uptake of CLCA technologies.	25%	30%	30%	20%	- Database and related narrative report. Project data from on-farm trials and long-term on-station trials; NARES project reports; technology adoption assessment and participatory video.
		- Farmers, men and women, have adopted agronomic and biomass management practices resulting in a better management of natural resources for more productive and sustainable use (relative increase of 3-5% of soil organic matter depending on soil type and aridity conditions and 10-20% increase in water use efficiency).	15%	30%	10%	0%	- Report. Records of effective innovation systems, with installed infrastructure and members who meet regularly and who jointly uncover opportunities for enhancing equitable access to machinery services and to technical knowledge (project reports and testimonials) through private investment potential and/or public-private partnerships in the provision of machinery services and technical support.
		- Farmers, men and women, have adopted fodder, cover crops, and alternative feed resources leading to increased feed availability with ultimate increases in livestock productivity.	20%	30%	20%	10%	

Annex 3. Cont'd

	Objectives-hierarchy	Objectively verifiable indicators	Overall	Tunisia	Algeria	Bolivia	Means of verification
Objectives (Cont'd)	(Cont'd)	- Farmers, men and women, in the intervention areas of NA and LAC are exposed to an efficient, integrated and economically viable CLCA system achieving increased productivity, and most importantly, stabilization in cereal yields, as well as reduction in production costs (20-40% reduction in energy cost, 15-20% reduction in other production costs).	15%	30%	10%	0%	
Outputs/Outcomes	**Outcome** 1: 3,000 smallholder farmers reached (at least 40% women and 20% youth below 35 years) and 2,100 have directly adopted CLCA farming systems [in four (4) target countries] with increased production and improved cost-benefits that are optimized by filling research and development gaps.		15%	20%	20%	10%	
	Output 1.1*:* An extended technical CLCA framework (including crop production, stubble management, forage production, livestock and manure management resilient to shocks) is developed and applied, taking into consideration farming systems and agro-ecological specificities as well as farmers' needs for sustainable livelihood development.	- In NA, 20% increase in barley and wheat yields across a total area of 60,000 ha (11,000 irrigated) through effective integrated CA packages; 30 % increase of forage biomass which will support small-scale farm feedlots.	0%	0%	0%	NA	- Databases and related narrative reports. Project data from on-farm trials and on-station trials; NARES project reports; results of the IFAD loans and government programs.
		- In NA at least 25% increase in live weight growth and 20% increase in fertility of sheep directly and indirectly impacting 220,000 heads.	0%	0%	0%	NA	
		- In LAC grain and straw yield of cropping systems increased by 15% through CA management, including agroforestry and soil and water conservation practices. Fodder and cover crops adopted by farmers leading to 25% increased fodder availability with ultimate increase of livestock productivity by 15%.	0%	NA	NA	0%	
		- In both regions, 25% of total beneficiaries (900 farmers), 50 extension staff, and 30 scientists participate in knowledge sharing on CLCA practice management.	20%	40%	40%	10%	
	Output 1.2: Increased water use efficiency in rainfed and irrigated systems and reduction of erosion in soils with steep slopes.	- A suite of pertinent soil and water conservation practices (SWC) (including no-till and residue management) identified and promoted for different agro-ecologies in LAC countries and appropriate for different types of farming systems.	0%	NA	NA	0%	
	Outcome 2: At least six (6) NARES, in addition to decision makers, NGO's and IFAD loan project partners in the four (4) target countries have adopted tools and methodologies for reliable decision making and guide investments on contextually appropriate CLCA systems.		15%	30%	20%	0%	
	Output 1.3: Comprehensive trade-off models between competing uses for crop residue biomass developed and simplified for wider use.	- Detailed analysis of costs, benefits, and market viability of CLCA options.	10%	10%	10%	10%	- Database and models. Project generated data, national statistics, CLCA farms typology and manuals for model calibration and use.
		- Farm level models for multi-criteria assessment and trade off analysis for different farm types and agro-ecologies, one in each target countries of NA and LAC developed, calibrated and available for use by NARES.	10%	10%	10%	10%	
		- Simplified simulation tools of optimized CLCA systems for wider use by IFAD loan projects and local development partners.	0%	0%	0%	0%	

Annex 3. Cont'd

	Objectives-hierarchy	Objectively verifiable indicators	Overall	Tunisia	Algeria	Bolivia	Means of verification
Outputs/Outcomes (Cont'd)	***Output 1.4:*** Appropriate monitoring and evaluation frameworks are established.	- ITC-based M&E tools developed and used by NARES and collaborators. Algorithms for data storage, classification and analysis developed.	25%	30%	10%	40%	- Training report. Collaborators and NARES appropriation of M&E and qualitative research tools.
		- Four (4) qualitative studies on farmers' (men and women) existing knowledge, attitudes and practices are carried out with 150 participants in each country.	0%	0%	0%	0%	- Database. Project generated data.
		- Four (4) participatory evaluations are conducted with 150 farmers (men and women) in each country.	0%	0%	0%	0%	- Protocol. FGD protocols and transcripts.
		- Feedback indicators from decision makers and private market actors are collected via survey monkey on a national level and shared between the countries.	0%	0%	0%	0%	- Report. FGD content analysis report. - Report. Use/stakeholder survey report.
	Outcome 3: At least four (4) effective agricultural innovation systems – One (1) in each implementation area of the four (4) target countries - are coalesced in order to foster broad uptake of conservation agriculture practices within integrated dryland crop-livestock production systems.		30%	50%	20%	10%	
	Output 2.1: Contextually relevant processes for enhancing broad uptake of CA – different from traditional (linear) processes of technology transfer - are refined in Tunisia (from a previous engagement), adapted and fine-tuned in both Algeria and Latin America (Bolivia and Nicaragua), through participatory processes.	- Context relevant knowledge and learning centered structures are facilitated (innovation systems, learning centers, multi-stakeholder workshops) – at least two (2) in each country of engagement – within which IFAD's toolkits on household methodologies (HHMs) are tested for proof of concept and adaptation in context.	0%	0%	0%	0%	- Manual involving CPM's and IFAD country technical staff. CLCA technologies guidance/manual (for management and implementation of CLCA practices in different agro-ecologies). - ISI paper (with IFAD collaboration) One cross country/cross region synthesis paper on approaches and process uncovered in coalescing innovation systems for CLCA within marginal production environments.
	Output 2.2: Effective delivery systems for machinery, agronomic and livestock services through facilitation of access to finance, private investment and public-private partnerships.	- Extension/advisory services providing efficient and effective support to the beneficiaries allowing for a successful implementation of the framework.	30%	30%	30%	30%	- Database and related narrative reports. Project documents, survey tools and data generated including field books per site and lists of participants.
		- CLCA guidelines for extension and advisory services are developed with partner organizations.	20%	20%	20%	20%	- Training report. Number of farmers and stakeholders receiving training and services
		- Private machinery service providers are supported through facilitation in access conventional finance sources, and where required through public-private partnerships in order to foster investment in machinery required to facilitate broad uptake of CA.	15%	20%	20%	10%	- Policy brief. CLCA adoption rates indicator.

Annex 3. Cont'd

	Objectives-hierarchy	Objectively verifiable indicators	Overall	Tunisia	Algeria	Bolivia	Means of verification
Outputs/Outcomes (Cont'd)	(Cont'd)	- 500 farmers, 50 extension staff, 20 scientists, 2 NGOs, and 2 traders per country participating in courses, workshops and field days in relation to CLCA.	30%	50%	50%	15%	
		- At least one (1) training platform and 10 validation sites and 10 scaling partners using methodologies and knowledge generated in the project per country.	0%	0%	0%	0%	
		- At least two (2) research questions per country formulated that feed back to Component 1.	50%	50%	50%	50%	
Key Activities	**Ac.** 1.1.1. Engage stakeholders and conduct rapid appraisal.	- Setup and facilitation of learning/knowledge centers [two (2) in each country].	0%	0%	0%	0%	
		- Identification of the initial entry point for the learning/knowledge centers to engage, agreement on the facilitator for the centers, roles and responsibilities clearly identified and pledges made on contributions (resources, time, etc.).	0%	0%	0%	0%	
		- Key actors within the innovation system (private, public, research, civil society) identified and engaged.	45%	50%	50%	30%	
		- Rapid assessments (surveys if applicable) in countries which were not part of the previous CLCA engagement.	50%	NA	NA	50%	
	Ac.1.1.2. Develop integrated improved crop management system.	- Integrated weed management packages combining seeder type, rotations and grazing fine-tuned and out-scaled.	15%	20%	20%	10%	- Reports and protocols. Established project on-farm and on-station trials.
		- Screening of best adapted cereal varieties for different agro-ecologies and CLCA systems in sites of NA and LAC.	20%	30%	30%	10%	
		- Deployment of scale appropriate mechanization options and planting platform trials with collaborators and NARES.	0%	0%	0%	0%	
	Ac.1.1.3. Fine-tune crop residue use in different geographies and socioeconomic environments.	- At least three (3) stubble grazing tools to optimize stubble grazing in the cereal-sheep belts in NA are developed and utilized by mixed crops-livestock small farmers.	20%	30%	30%	0%	- Database. Project data from on-farm trials and on-station long-term trials.
		- Two (2) field experiments per country in LAC established standardize amount of residue retention to achieve 30% residue cover or cover crop growing depending of soil fertility and moisture conditions	0%	NA	NA	0%	
		- Within the centers for knowledge and learning, options sought for introducing non-traditional forms of ground cover (tree pruning waste, compost, etc.) in areas where there is intense competition for crop residue as ground cover with livestock feeding needs (linked to activities 3.1.2, 3.2.2, 3.2.3).	25%	30%	30%	15%	

Annex 3. Cont'd

	Objectives-hierarchy	Objectively verifiable indicators	Overall	Tunisia	Algeria	Bolivia	Means of verification
Key Activities (Cont'd)	**Ac**.1.1.4. Advocate alternative feeding systems and livestock enterprises.	- Feeding systems to support livestock enterprises during the feed-scarce seasons integrating stubbles, forages, alternatives feed sources and concentrates are developed using a participatory research and development approach (linked to activities 3.1.2 and 3.2.1).	20%	30%	30%	0%	- Review paper. Flocks management protocols owned by farmers adopting CLCA systems. - Review paper. Feeding systems alternatives documented in research articles, manuals and other communication materials.
	Ac.1.1.5. Develop financially viable business models for no-till service provision enterprises.	- CIMMYT's scale appropriate mechanization prototypes tested/validated in Target countries in LAC.	0%	NA	NA	0%	- Database. Key informant interviews, project surveys. - Report. Business plans for no till service provision. - Report and protocols. Established project on-farm and on-station long term trials.
		-Financially viable business plans for machinery service delivery tailored to small farmers in NA developed and shared with project partners.	0%	0%	0%	0%	
	Ac.1.2.1. Reduce irrigated water use in CLCA systems; optimizing in-situ water use in rain fed systems.	- WUE (kg/m3) in rain fed systems is increased by 20% in the project intervention areas in NA and LAC. In the irrigated areas of the project intervention sites in Algeria water is reduced by 30%.	0%	0%	0%	0%	
	Ac.1.2.2. Reduce erosion in soils with steep slopes.	- Soil erosion and run-off are reduced by 50% through no-till, residue management and other soil and water conservation practices.	10%	30%	0%	0%	- Database and related narrative report. Established project on-farm and on-station trials.
	Ac.1.3.1. Develop and apply comprehensive trade-off models and tools to assess the technical feasibility, economic viability and environmental performance of integrated CLCA farming systems.	- At least one (1) decision making model/tool based on multi-criteria and trade off analysis for CLCA systems (one in each country in NA and LAC) parametrized and available for use by NARES and collaborators.	0%	0%	0%	0%	- ISI research paper (with collaboration of IFAD). Project documents, manuals and models/tools deployed.
	Ac.1.3.2. Analyze costs and benefits as well as the market viability of the proposed CLCA practices.	- Cost and benefit sheets developed for the identified CLCA options with clear emphasis on their respective financial and market viability for smallholder farmers.	20%	30%	30%	0%	- Database and narrative report. Project documents including cost and benefit sheets of different CLCA options.
		- Value chain analysis of different CLCA products and by-products and market opportunities and constraints for integrated and sustainable CLCA farming systems	0%	0%	0%	0%	
	Ac.1.3.3. Discuss results from farm level trade off models with local partners and simplification of models for wider use.	- The developed model for trade-off analysis shared and tested with local partners (including farmers, NARES, local extension services, etc.), and potential feedbacks considered for further improvements.	0%	0%	0%	0%	- Short technical note. Project documents, manuals and models/tools tested, improved, and re-deployed.
	Ac. 1.4.1. Establish appropriate monitoring and evaluation frameworks.	- Annual M&E reports developed in each country.	10%	20%	20%	0%	- Report. Project documents, manuals and models/tools, technical reports, publications, etc. are deployed.

Annex 3. Cont'd

	Objectives-hierarchy	Objectively verifiable indicators	Overall	Tunisia	Algeria	Bolivia	Means of verification
Key Activities (Cont'd)	**Ac**.2.1.1. Develop and implement a road map –based on previous CLCA initiatives by ICARDA and CIMMYT– for large-scale adoption of CA within dryland crop livestock environments.	- Drivers identified to inform the road map definition for scaling out technologies and processes developed within the life of the project initiative.	100%	100%	100%	100%	- Report. Inventory reports per country.
		- Four (4) CLCA practices and technology inventory reports [one (1) in each country].	50%	50%	50%	50%	- Briefs. Policy and briefing notes.
		- Guidelines for appropriate CLCA best practices and technology use for different agro-ecologies.	0%	0%	0%	0%	- Report. CLCA road map progress and final reports including technical report on best bet CLCA technologies (one in each country).
		- Policy notes [one (1) per country] on recommendations for fostering a more enabling policy and economic environment for broad uptake of CLCA.	0%	0%	0%	0%	- Report. Leaning events reports.
		- Briefing notes on production CLCA practices and technologies developed within the life of the initiative (English and in each of the local languages within the countries of engagement).	0%	0%	0%	0%	
		- One (1) yearly face-to-face learning event is organized per country and per year.	100%	100%	100%	100%	
		- One (1) online learning event is organized virtually for all four (4) participating countries.	0%	0%	0%	0%	
	Ac.2.2.1. Develop and test a framework for effective rural advisory and service provision for machinery, agronomic and livestock services with special emphasis on young rural.	- Diagnosis of actual rural advisory services in the respective countries.	0%	0%	0%	0%	- Report. Rural advisory services diagnostic document
		- Framework for designing, analyzing and implementing effective pluralistic agricultural advisory services co-developed with stakeholders in each country	0%	0%	0%	0%	- Report. Rural advisory services framework document
		- Extension/advisory services providing efficient and effective support to the beneficiaries allowing for a successful implementation of the framework.	0%	0%	0%	0%	- Report. Progress and final reports on rural advisory services per country
		- CLCA guidelines for extension and advisory services are developed with partner organizations.	0%	0%	0%	0%	
		- Private machinery service providers are supported through facilitation in access conventional finance sources, and where required through public-private partnerships in order to foster investment in machinery required to facilitate broad uptake of CA.	30%	40%	40%	0%	
		- NARES and advisory services participate in formative research activities.	100%	100%	100%	100%	
		- Two (2) web based five-day training on CLCA guidelines for NARES and advisory services, one (1) in French/Arabic for three (3) NARES in Tunisia and Algeria, and one (1) in Spanish for two (2) NARES in Bolivia and Nicaragua are implemented.	0%	0%	0%	0%	

Annex 3. Cont'd

	Objectives-hierarchy	Objectively verifiable indicators	Overall	Tunisia	Algeria	Bolivia	Means of verification
Key Activities (Cont'd)	**Ac**.2.2.2. To fine-tune and implement a gender/youth sensitive KM strategy of the project by developing a network of on-field, multiscale testing and validation sites, and multi-level capacities to manage interventions from field to food through the integration of scaling partners.	- 500 farmers, 50 extension staff, 20 scientists, 2 NGOs, and 2 traders per country participating in courses, workshops and field days in relation to CLCA	30%	50%	50%	15%	- Database and related narrative reports. Project documents, survey tools and data generated including field books per site and lists of participants in courses.
		- At least one (1) training platform and ten (10) validation sites per country installed and operating	0%	0%	0%	0%	- Database and related narrative reports. Evidence of each knowledge product generated including SMS, video, printed material and online dissemination tools.
		- Participatory research on CLCA is implemented throughout the delivery process.	0%	0%	0%	0%	- MSc thesis. MSc degree/thesis obtained within the activities of the project.
		- CLCA trainings take place for farmers, extension agents and stakeholders.	100%	100%	100%	100%	- Report. KM and scaling-up progress and final reports.
		- Farmers' feedback indicators available and shared with different project stakeholders.	0%	0%	0%	0%	- Report. Report on projects funded by complementary investment from IFAD loans at the country level using methodologies and knowledge generated in the project.
		- Knowledge products generated for different stakeholders disseminated through relevant channels	100%	100%	100%	100%	
		- Exchange visits from non-beneficiary farmers' groups, extension staff, and interested stakeholders.	100%	100%	100%	100%	- Brief. CLCA adoption rates indicator.
		-Three (3) NARES researchers trained for MSc degree during project implementation in respective countries.	60%	100%	100%	0%	
		- Identified plan to integrate efforts and knowledge of the project into the existing IFAD scaling-up methodology.	15%	20%	0%	30%	
		- At least ten (10) scaling partners using methodologies and knowledge generated in the project.	0%	0%	0%	0%	
		- At least ten (10) scaling partners using a system for field-based data generation.	0%	0%	0%	0%	
		- Project evidence for success stories, best practices and lessons learnt available	100%	100%	100%	100%	
		- ICT-based survey tools and data analysis within an M&E framework developed and used by collaborators including women involvement in CLCA systems as well as the effect of enhanced integration between crop and livestock on women and other marginal groups.	30%	30%	30%	30%	
		- A strategy for empowerment of women under CLCA systems is developed, and disseminated.	30%	30%	30%	30%	

CLCA Facility logframe

Impact/Goal	To sustainably increase production and enhance the resilience of smallholder crop-livestock production systems to climate variability in drylands in NEN and LAC countries.																			
Country	Tunisia					Algeria					Bolivia					Mexico				
Goal_Indicator-I: Crop yield gaps reduced by as much as 40% in both rain ed and irrigated systems																				
	Planned					Planned					Planned					Planned				
	Achieved					Achieved					Achieved					Achieved				
Goal_Indicator-II: livestock offtake rate by 30% in both rain ed and irrigated systems.																				
	Planned					Planned					Planned					Planned				
	Achieved					Achieved					Achieved					Achieved				

Objectives	To develop in participation with smallholder crop livestock producers contextually relevant and gender sensitive processes for enhancing the broad uptake of CA within integrated CL systems in drylands in LAC and NEN regions.															Overall				
Country	Tunisia					Algeria					Bolivia									
Objectives_Indicator-I	Year	2018/19	2019/20	2020/21	2021/22	Year	2018/19	2019/20	2020/21	2021/22	Year	2018/19	2019/20	2020/21	2021/22	Year	2018/19	2019/20	2020/21	2021/22
	Planned	40%	60%	80%	100%	Planned	40%	60%	80%	100%	Planned	40%	60%	80%	100%	Planned	40%	60%	80%	100%
	Achieved	40%				Achieved	40%				Achieved	40%				Achieved	40%			
Objectives_Indicator-II	Year	2018/19	2019/20	2020/21	2021/22	Year	2018/19	2019/20	2020/21	2021/22	Year	2018/19	2019/20	2020/21	2021/22	Year	2018/19	2019/20	2020/21	2021/22
	Planned	30%	50%	75%	100%	Planned	30%	50%	75%	100%	Planned	40%	60%	80%	100%	Planned	35%	55%	80%	100%
	Achieved	10%				Achieved	10%				Achieved	0%				Achieved	10%			
Objectives_Indicator-III	Year	2018/19	2019/20	2020/21	2021/22	Year	2018/19	2019/20	2020/21	2021/22	Year	2018/19	2019/20	2020/21	2021/22	Year	2018/19	2019/20	2020/21	2021/22
	Planned	40%	60%	80%	100%	Planned	40%	60%	80%	100%	Planned	40%	70%	85%	100%	Planned	40%	65%	85%	100%
	Achieved	30%				Achieved	30%				Achieved	20%				Achieved	25%			
Objectives_Indicator-IV	Year	2018/19	2019/20	2020/21	2021/22	Year	2018/19	2019/20	2020/21	2021/22	Year	2018/19	2019/20	2020/21	2021/22	Year	2018/19	2019/20	2020/21	2021/22
	Planned	40%	60%	80%	100%	Planned	40%	60%	80%	100%	Planned	40%	60%	80%	100%	Planned	40%	60%	80%	100%
	Achieved	30%				Achieved	20%				Achieved	0%				Achieved	15%			
Objectives_Indicator-V	Year	2018/19	2019/20	2020/21	2021/22	Year	2018/19	2019/20	2020/21	2021/22	Year	2018/19	2019/20	2020/21	2021/22	Year	2018/19	2019/20	2020/21	2021/22
	Planned	40%	60%	80%	100%	Planned	40%	60%	80%	100%	Planned	40%	60%	80%	100%	Planned	40%	60%	80%	100%
	Achieved	30%				Achieved	20%				Achieved	10%				Achieved	20%			
Objectives_Indicator-VI	Year	2018/19	2019/20	2020/21	2021/22	Year	2018/19	2019/20	2020/21	2021/22	Year	2018/19	2019/20	2020/21	2021/22	Year	2018/19	2019/20	2020/21	2021/22
	Planned	40%	60%	80%	100%	Planned	40%	60%	80%	100%	Planned	40%	60%	80%	100%	Planned	40%	60%	80%	100%
	Achieved	30%				Achieved	10%				Achieved	0%				Achieved	15%			

CLCA Facility logframe (Cont'd)

Outcome																Overall				
Country	Tunisia					Algeria					Bolivia									
Outcome-I	Year	2018/19	2019/20	2020/21	2021/22	Year	2018/19	2019/20	2020/21	2021/22	Year	2018/19	2019/20	2020/21	2021/22	Year	2018/19	2019/20	2020/21	2021/22
	Planned	45%	70%	85%	100%	Planned	45%	60%	85%	100%	Planned	30%	50%	70%	100%	Planned	40%	60%	80%	100%
	Achieved	20%				Achieved	20%				Achieved	10%				Achieved	15%			
Outcome-II	Year	2018/19	2019/20	2020/21	2021/22	Year	2018/19	2019/20	2020/21	2021/22	Year	2018/19	2019/20	2020/21	2021/22	Year	2018/19	2019/20	2020/21	2021/22
	Planned	50%	70%	85%	100%	Planned	45%	60%	85%	100%	Planned	40%	60%	85%	100%	Planned	45%	65%	85%	100%
	Achieved	30%				Achieved	20%				Achieved	0%				Achieved	15%			
Outcome-III	Year	2018/19	2019/20	2020/21	2021/22	Year	2018/19	2019/20	2020/21	2021/22	Year	2018/19	2019/20	2020/21	2021/22	Year	2018/19	2019/20	2020/21	2021/22
	Planned	40%	60%	80%	100%	Planned	40%	60%	80%	100%	Planned	40%	60%	80%	100%	Planned	40%	60%	80%	100%
	Achieved	50%				Achieved	20%				Achieved	10%				Achieved	30%			
Output-1.1	An extended technical CLCA framework (including crop production, stubble management, forage production, livestock and manure management resilient to shocks) is developed and applied, taking into consideration farming systems and agro-ecological specificities as well as farmers' needs for sustainable livelihood development.															Overall				
Country	Tunisia					Algeria					Bolivia									
Indicator-I	Year	2018/19	2019/20	2020/21	2021/22	Year	2018/19	2019/20	2020/21	2021/22	Year	2018/19	2019/20	2020/21	2021/22	Year	2018/19	2019/20	2020/21	2021/22
	Planned	40%	60%	80%	100%	Planned	40%	60%	80%	100%	Planned	NA	NA	NA	NA	Planned	40%	60%	80%	100%
	Achieved	0%				Achieved	0%				Achieved	NA				Achieved	0%			
Indicator-II	Year	2018/19	2019/20	2020/21	2021/22	Year	2018/19	2019/20	2020/21	2021/22	Year	2018/19	2019/20	2020/21	2021/22	Year	2018/19	2019/20	2020/21	2021/22
	Planned	30%	50%	75%	100%	Planned	30%	50%	75%	100%	Planned	NA	NA	NA	NA	Planned	30%	50%	75%	100%
	Achieved	0%				Achieved	0%				Achieved	NA				Achieved	0%			
Indicator-III	Year	2018/19	2019/20	2020/21	2021/22	Year	2018/19	2019/20	2020/21	2021/22	Year	2018/19	2019/20	2020/21	2021/22	Year	2018/19	2019/20	2020/21	2021/22
	Planned	NA	NA	NA	NA	Planned	NA	NA	NA	NA	Planned	40%	70%	85%	100%	Planned	40%	70%	85%	100%
	Achieved	NA				Achieved	NA				Achieved	0%				Achieved	0%			
Indicator-IV	Year	2018/19	2019/20	2020/21	2021/22	Year	2018/19	2019/20	2020/21	2021/22	Year	2018/19	2019/20	2020/21	2021/22	Year	2018/19	2019/20	2020/21	2021/22
	Planned	40%	60%	80%	100%	Planned	40%	60%	80%	100%	Planned	40%	60%	80%	100%	Planned	40%	60%	80%	100%
	Achieved	40%				Achieved	40%				Achieved	10%				Achieved	20%			

CLCA Facility logframe (Cont'd)

Output-1.2	**Increased water use efficiency in rainfed and irrigated systems and reduction of erosion in soils with steep slopes.**															**Overall**				
Country	**Tunisia**					**Algeria**					**Bolivia**									
Indicator-I	**Year**	**2018/19**	**2019/20**	**2020/21**	**2021/22**	**Year**	**2018/19**	**2019/20**	**2020/21**	**2021/22**	**Year**	**2018/19**	**2019/20**	**2020/21**	**2021/22**	**Year**	**2018/19**	**2019/20**	**2020/21**	**2021/22**
	Planned	NA	NA	NA	NA	**Planned**	NA	NA	NA	NA	**Planned**	40	60	80	100%	**Planned**	40%	60%	80%	100%
	Achieved	NA				**Achieved**	NA				**Achieved**	0%				**Achieved**	0%			
Output-1.3	**Comprehensive trade-off models between competing uses for crop residue biomass developed and simplified for wider use.**															**Overall**				
Country	**Tunisia**					**Algeria**					**Bolivia**									
Indicator-I	**Year**	**2018/19**	**2019/20**	**2020/21**	**2021/22**	**Year**	**2018/19**	**2019/20**	**2020/21**	**2021/22**	**Year**	**2018/19**	**2019/20**	**2020/21**	**2021/22**	**Year**	**2018/19**	**2019/20**	**2020/21**	**2021/22**
	Planned	40%	60%	80%	100%	**Planned**	40%	60%	80%	100%	**Planned**	40%	60%	80%	100%	**Planned**	40%	60%	80%	100%
	Achieved	10%				**Achieved**	10%				**Achieved**	10%				**Achieved**	10%			
Indicator-II	**Year**	**2018/19**	**2019/20**	**2020/21**	**2021/22**	**Year**	**2018/19**	**2019/20**	**2020/21**	**2021/22**	**Year**	**2018/19**	**2019/20**	**2020/21**	**2021/22**	**Year**	**2018/19**	**2019/20**	**2020/21**	**2021/22**
	Planned	30%	50%	75%	100%	**Planned**	30%	50%	75%	100%	**Planned**	30%	50%	75%	100%	**Planned**	30%	50%	75%	100%
	Achieved	10%				**Achieved**	10%				**Achieved**	10%				**Achieved**	10%			
Indicator-III	**Year**	**2018/19**	**2019/20**	**2020/21**	**2021/22**	**Year**	**2018/19**	**2019/20**	**2020/21**	**2021/22**	**Year**	**2018/19**	**2019/20**	**2020/21**	**2021/22**	**Year**	**2018/19**	**2019/20**	**2020/21**	**2021/22**
	Planned	40%	70%	85%	100%	**Planned**	40%	70%	85%	100%	**Planned**	40%	70%	85%	100%	**Planned**	40%	70%	85%	100%
	Achieved	0%				**Achieved**	0%				**Achieved**	0%				**Achieved**	0%			
Output-1.4	**Appropriate monitoring and evaluation frameworks are established.**															**Overall**				
Country	**Tunisia**					**Algeria**					**Bolivia**									
Indicator-I	**Year**	**2018/19**	**2019/20**	**2020/21**	**2021/22**	**Year**	**2018/19**	**2019/20**	**2020/21**	**2021/22**	**Year**	**2018/19**	**2019/20**	**2020/21**	**2021/22**	**Year**	**2018/19**	**2019/20**	**2020/21**	**2021/22**
	Planned	40%	60%	80%	100%	**Planned**	40%	60%	80%	100%	**Planned**	40%	60%	80%	100%	**Planned**	40%	60%	80%	100%
	Achieved	30%				**Achieved**	10%				**Achieved**	40%				**Achieved**	25%			
Indicator-II	**Year**	**2018/19**	**2019/20**	**2020/21**	**2021/22**	**Year**	**2018/19**	**2019/20**	**2020/21**	**2021/22**	**Year**	**2018/19**	**2019/20**	**2020/21**	**2021/22**	**Year**	**2018/19**	**2019/20**	**2020/21**	**2021/22**
	Planned	30%	50%	75%	100%	**Planned**	30%	50%	75%	100%	**Planned**	40%	60%	80%	100%	**Planned**	35%	55%	80%	100%
	Achieved	0%				**Achieved**	0%				**Achieved**	0%				**Achieved**	0%			
Indicator-III	**Year**	**2018/19**	**2019/20**	**2020/21**	**2021/22**	**Year**	**2018/19**	**2019/20**	**2020/21**	**2021/22**	**Year**	**2018/19**	**2019/20**	**2020/21**	**2021/22**	**Year**	**2018/19**	**2019/20**	**2020/21**	**2021/22**
	Planned	40%	60%	80%	100%	**Planned**	40%	60%	80%	100%	**Planned**	40%	70%	85%	100%	**Planned**	40%	65%	85%	100%
	Achieved	0%				**Achieved**	0%				**Achieved**	0%				**Achieved**	0%			
Indicator-IV	**Year**	**2018/19**	**2019/20**	**2020/21**	**2021/22**	**Year**	**2018/19**	**2019/20**	**2020/21**	**2021/22**	**Year**	**2018/19**	**2019/20**	**2020/21**	**2021/22**	**Year**	**2018/19**	**2019/20**	**2020/21**	**2021/22**
	Planned	40%	60%	80%	100%	**Planned**	40%	60%	80%	100%	**Planned**	40%	60%	80%	100%	**Planned**	40%	60%	80%	100%
	Achieved	0%				**Achieved**	0%				**Achieved**	0%				**Achieved**	0%			

CLCA Facility logframe (Cont'd)

Output-2.1	Contextually relevant processes for enhancing broad uptake of CA – different from traditional (linear) processes of technology transfer - are refined in Tunisia (from a previous engagement), adapted and fine-tuned in both Algeria and Latin America (Bolivia and Nicaragua), through participatory processes.															Overall				
Country	Tunisia					Algeria					Bolivia									
Indicator-I	Year	2018/19	2019/20	2020/21	2021/22	Year	2018/19	2019/20	2020/21	2021/22	Year	2018/19	2019/20	2020/21	2021/22	Year	2018/19	2019/20	2020/21	2021/22
	Planned	40%	60%	80%	100%	Planned	40%	60%	80%	100%	Planned	40%	60%	80%	100%	Planned	40%	60%	80%	100%
	Achieved	0%				Achieved	0%				Achieved	0%				Achieved	0%			
Output-2.2	**Effective delivery systems for machinery, agronomic and livestock services through facilitation of access to finance, private investment and public-private partnerships.**															**Overall**				
Country	**Tunisia**					**Algeria**					**Bolivia**									
Indicator-I	Year	2018/19	2019/20	2020/21	2021/22	Year	2018/19	2019/20	2020/21	2021/22	Year	2018/19	2019/20	2020/21	2021/22	Year	2018/19	2019/20	2020/21	2021/22
	Planned	40%	60%	80%	100%	Planned	40%	60%	80%	100%	Planned	40%	60%	80%	100%	Planned	40%	60%	80%	100%
	Achieved	30%				Achieved	30%				Achieved	30%				Achieved	30%			
Indicator-II	Year	2018/19	2019/20	2020/21	2021/22	Year	2018/19	2019/20	2020/21	2021/22	Year	2018/19	2019/20	2020/21	2021/22	Year	2018/19	2019/20	2020/21	2021/22
	Planned	30%	50%	75%	100%	Planned	30%	50%	75%	100%	Planned	40%	60%	80%	100%	Planned	35%	55%	80%	100%
	Achieved	20%				Achieved	20%				Achieved	20%				Achieved	20%			
Indicator-III	Year	2018/19	2019/20	2020/21	2021/22	Year	2018/19	2019/20	2020/21	2021/22	Year	2018/19	2019/20	2020/21	2021/22	Year	2018/19	2019/20	2020/21	2021/22
	Planned	40%	60%	80%	100%	Planned	40%	60%	80%	100%	Planned	40%	70%	85%	100%	Planned	40%	65%	85%	100%
	Achieved	20%				Achieved	20%				Achieved	10%				Achieved	15%			
Indicator-IV	Year	2018/19	2019/20	2020/21	2021/22	Year	2018/19	2019/20	2020/21	2021/22	Year	2018/19	2019/20	2020/21	2021/22	Year	2018/19	2019/20	2020/21	2021/22
	Planned	40%	60%	80%	100%	Planned	40%	60%	80%	100%	Planned	40%	60%	80%	100%	Planned	40%	60%	80%	100%
	Achieved	50%				Achieved	50%				Achieved	15%				Achieved	30%			
Indicator-V	Year	2018/19	2019/20	2020/21	2021/22	Year	2018/19	2019/20	2020/21	2021/22	Year	2018/19	2019/20	2020/21	2021/22	Year	2018/19	2019/20	2020/21	2021/22
	Planned	40%	60%	80%	100%	Planned	40%	60%	80%	100%	Planned	40%	60%	80%	100%	Planned	40%	60%	80%	100%
	Achieved	0%				Achieved	0%				Achieved	0%				Achieved	0%			
Indicator-VI	Year	2018/19	2019/20	2020/21	2021/22	Year	2018/19	2019/20	2020/21	2021/22	Year	2018/19	2019/20	2020/21	2021/22	Year	2018/19	2019/20	2020/21	2021/22
	Planned	40%	60%	80%	100%	Planned	40%	60%	80%	100%	Planned	40%	60%	80%	100%	Planned	40%	60%	80%	100%
	Achieved	50%				Achieved	50%				Achieved	50%				Achieved	50%			

Annex 4. Financial statement for the period between April 13, 2018 and March 31, 2019

Name of the Centre: ICARDA
Grant Number: 2000001630
Name of the Programme: Integrated Crop-Livestock under Conservation Agriculture Phase II
Reporting period from: 13 April 2018 to 31 March 2019
Amounts in US Dollars

Project Code 200116
BUS Number 200341 &200376

	Budget in USD			Actual 13 Apr 18 to 31 Dec 18			Actual 01 Jan 19 to 31 Mar 19			Balance avalibale			Co-financing
Category of Expenditures	ICARDA	CIMMYT	Total Budget	ICARDA	CIMMYT	Total	ICARDA	CIMMYT	Total	ICARDA	CIMMYT	Total	
Salaries and allowances	331,000	288,000	619,000	46,543	36,731	83,274	37,298	15,715	53,013	247,159	235,554	482,713	58,600
Travel and allowances	60,000	139,000	199,000	13,364	26,169	39,533	7,974	(4,946)	3,028	38,662	117,777	156,439	8,600
Workshop + Training + Consultant	190,000	180,000	370,000	38,125	-	38,125	7,578	6,009	13,587	144,297	173,991	318,288	600
Goods, Services and Inputs	341,000	277,000	618,000	70,940	34,195	105,135	1,484	9,280	10,764	268,576	233,525	502,101	10,400
Equipment and Material	115,000	120,000	235,000	-	-	-	-	-	-	115,000	120,000	235,000	12,200
Opertaional Costs	117,000	110,000	227,000	22,775	6,212	28,987	19,896	2,530	22,426	74,329	101,258	175,587	9,600
Total Direct Costs	**1,154,000**	**1,114,000**	**2,268,000**	**191,747**	**103,307**	**295,054**	**74,230**	**28,588**	**102,818**	**888,023**	**982,105**	**1,870,128**	**100,000**
Management Fee	92,605	89,395	182,000	15,340	11,364	26,704	5,938	3,144	9,082	71,327	74,887	146,214	-
CSP 2%	25,441	24,559	50,000	12,330	-	12,330	-	-	-	13,111	24,559	37,670	-
Total	**1,272,046**	**1,227,954**	**2,500,000**	**219,417**	**114,671**	**334,088**	**80,168**	**31,732**	**111,900**	**972,460**	**1,081,551**	**2,054,011**	**100,000**