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The efforts of the national institutions that were involved in this project preparation and elaboration (ITGC of Algeria, INRA of Morocco and IRESA of Tunisia and partner organizations) are to be commended for the resources they committed to this project and for the quality of their responsiveness in facilitatingits implementation. In particular the dedication and commitment of the Staff and institutions of ITGC, INRA, INRAT, INAT and INGC are to be recognized for not only supplementing the international resources but also for working around the day-to-day difficulties and in particular making interactions with local farmers and other stakeholders as smooth as possible.

The participatory role of the targeted farmers themselves in all three countries has been essential to get the project going is to be recognized as well. Despite their limited experience with the CA knowhow at the start of the project they were all eager to learn about alternative and new ways that could make their resources more productive and improve their livelihoods as a result.

Rural Solutions of Australia played a crucial role in mobilizing the needed expertise and guidance in research methodology and evaluation during visits to the region as well as in organizing visits to Australia for more than 15 NARS scientists.

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Finally the researchers and scientists themselves, on both sides - the Australian and North African nationalsand ICARDA scientists, whose professional involvement in, and dedication to, the conservation spirit were not only quite visible from the start of the project, they were even more focused when difficulties arose and the search for alternative and innovative solutions were needed. They deserve professional recognition.

We acknowledge the efforts made by Prof. Boubaker Thabet to put this report together in consultation with NARS, Rural Solutions and ICARDA.

2 Executive summary

In aiming at promoting and speeding up the overall adoption process of CA) practices by smallholder farmers in North African, the CSE-2011-025 project focused from the start on understanding and alleviating the main constraintslearned from earlier experiences that limitCA adoption; namely the heavy investment in the direct drilling equipment,the key to successful CA practice. To achieve this, major areas (referred to as platforms) were identified in each of the countries for survey, research and development activities. These were Setif (Algeria), Chaouia-Ouardigha (Morocco) and Fernana (Tunisia).

Significant success has been achieved in all three countries as all major activities planned by the projectwere accomplished. Some weather induced delays did limit outcomes but this is to be anticipated in rain-fed environments. Majoremphasis was also placed on the role of leading farmers in project implementation. Duringthe first year the project priorities were to work on gaining the farmers confidence and then helping them organize themselves to resolve some of the difficulties that arose. During the second year the project embarked on expanding the working platform to an additional set of farmers where the farmers that collaborated with the projectduring the first year played animportant role in passing the CA knowledge to the new farmers. The setting up of the innovation platform is due to continue during the ongoing third year with strong support from the national organizationsand will include yet another and larger set of farmers.

As regards the direct drilling equipment, significant progress was accomplished during the first two years of project activities whereby all three platforms identified alternatives to the large disc seeder equipment commonly imported from Brazil, US or southern Europe which involve major investment costs for farmers. The country teams in collaboration with Australian expertise and local industry partners have developed and/or adapted a range of lower-cost direct drill options and established initial agreements for the commercial manufacturing of some of those drill options. A number of low-cost commercial drills were also identified on the international market with a small number acquired by the project for benchmarking purpose. A programme of field evaluation was put in place to provide guidance on suitable technological solutions for the 3 platforms.

All three teams carried out their respective baseline surveys to characterize the research and demonstration platforms mostly during the first year of project activities.These surveys were completed and fine-tuned during the second year. The sampling scope was more extensive than initially planned to capture as much farm and farmerdiversity as possible. Furthermore in all three platforms it was necessary to include larger farm sizes than initially planned in the project document (20 hectares or less) as it was found that most surveyed small farmers did not own the equipment they used but were renting it. To analyze the response of farmers to the question asked about their predisposition to adapt their own conventional seeders into direct drills it was necessary to include farms larger than 20 hectare.

Surveys were conducted using the same initially prepared questionnaire[1]and distributed to all three teams and the characterization analyses were carried using the same set of indicators that were discussed and agreed upon during a socioeconomics workshop that took place in Tunisia in

[1] *See appendix 3*

July 2013[2].During the second year further limited explorations were conducted on the evolution of farmers' attitudes and perceptions of the CA potential after two years of exposure to the technology. In parallel, farm budget calculations were performed to appraise the gross margin differential between conservation agriculture and conventional cropping systems. Preliminary results suggest that while it is too soon to draw firm conclusions, gross margin differentials vary from farm to farm and depend heavily on the climatic conditions of the year. This is consistent with international findings that conclude that a minimum of five to six years of accumulated CA experience with the conservation mode is necessary before profitability trends begin to change in its favor (FAO, 2010).

Constraints to CA adoption,other than from the cost of drilling equipment, includedthe availability of equipment to spray crop protection chemicals and the availabilityof quality forage crop seeds for livestock feed.

In a system that has traditionally included weedy fallows that are exploited for animal production, the change to CA represented a challenge. This arose from limited weed control where only a single pre-seeding glyphosate spray was used, associated with farmers' perceptions of a loss when weeds were not available for grazing. This type of systems change can be complex and will require further research and extension efforts if farmers are to recognize that these issues can be managed. A further complication for the adoption of CA was the limited availability of adequate forage seeds which limits the supply of quality feed within the practiced crop rotations. In some cases this also could result in overgrazing of crop residues which is counterproductive to conservation practices.

Agronomic results were also very climate dependent as yields varied not only with annual rainfall, they also depended on its distribution during the year and also on the intensity of the rainfall in some locations. In Morocco for example the two crop years were completely different in terms of annual rainfall from particularly dry during the first year of the project to relatively humid during the second, and the yields varied accordingly of course. In Tunisia a number of agricultural operations had to be delayed considerably during the first crop year due to heavy rains which significantly affected the crop yields. Despite this, crop sequencing and weed management have made significant progress across the three platforms.

In terms of feed supply, the demonstration of forage mixtures (cereals of barley/oat/triticale with feed legumes: vetch or peas) gave encouraging results reaching 8t/ha. This has been a major success of the project as it opens the possibility of doing away with the so-called "weedy fallow" that farmers value as cheap animal feed. The project has shown that more and better fodder can be produced by a cereal/legume mix which also enables weed populations in the farming system to be reduced over time. However alley cropping did not seem to meet with farmer preferences due to difficulties of establishing perennials in these farming systems and need better targeting of farms and more years of research.

In terms of stakeholder involvement in the activities of the project one can fairly saythat the project has drawn the participation of significantly large numbers of diversified and interested ~~audiences~~stakeholders going from farmers to university scientistsand students to extension agents to policy makers to service and input providers. Registerednumbers showthat anywhere between 1500 and 2000 stakeholders took part in the project activities directly over the last two

Mis en forme : Surlignage

[2] *See appendix 4 for a comparative description of the three platforms.*

years(workshop and training programs, field days, farmer field schools, etc.)If one adds the indirect impacts through leaflets and brochures (more that 2000 per country) probably anywhere between 3000 and 4000 stakeholders altogether got to know about the project and what conservation agriculture is about. In addition, the organisation of some of the project events drew the attention of the media as TV programs and radio broadcasts took place in all three countries. Depending on how one measures the impact of these media events one can say that the project's objective of reaching 15000 stakeholders by the end of the project (5000 per country) may have been reached already and the project is not finished yet.

~~The Perhaps t~~The biggest accomplishments of the CANA project are in two areas. One is the constitution of a network of scientists and NGOs in the Maghreb countries, and the introduction of a working research methodology and ethics in terms of multi-country and multi-institutional teamwork on CA, especially during a period of time characterized by political and social unrests. The other area concerns the big investment in capacity building through the various training occasions organized both in the region and in Australia. This investment involved researchers from different institutions but also farmers, extension specialistsand policy makers, etc. This legacy will significantly improve the capacity of the ~~north~~North African partners to continue R~~&~~, D~~&~~ and E activities for the development and adoption of viable CA packages in the region.

3 Background

North Africa is a net importing region of staple food commodities, importing on average more than a quarter of its cereal grain requirements to meet the food security needs of its population. Low productivities from its internal natural resources, increasingly high and volatile world prices, and consequently uncertain availability of food commodities, affect the domestic livelihoods, particularly those of the poor.This puts additional pressures on public policy makers to find alternative ways to increase internal food supplies so as to meet the multiplesocial demands.

Furthermore the region has a Mediterranean climate with highly variable and generally low rainfall that is further exacerbated by unfavorable climate change. Even in areas where rainfall may not be so limiting other serious natural difficulties arise, such as rough or hilly landscapes, thus making water erosion a severe factor to manage. In addition, soil organic matter in these areas isgenerallylow andhighly vulnerable to the impacts of erosion.

Expansion of soil cultivation attempting to increase yields of basic food commodities to satisfy national food demands and intensification and increased use of modern inputs and chemicals has presented challenges. In many cases excessive use of mechanicalsoil tillinghas led to further fragility of soilsboth in terms of additional exposure to erosion and in terms of loss of organic matter.At the same time, excessive soil tilling has accelerated soil carbon dioxide emission thereby contributing toatmospheric change and depriving soils of organic matter content accumulation. Furthermore excessive use of pesticides and chemicals has in a number of cases contributed to polluting the increasingly limited water resourcesand aquifers.

International research and various countries' experiences(e.g. Brazil, Australia, Canada) suggest that CA (CA) practices[3]can offer an opportunity to slow down the processof natural resourcesdegradation, cut down on production costsand, with time,lead to reducing yield fluctuations and associated economic risks that are experienced by farmers(FAO, 2010). Experiences from North African countries themselves, particularly Morocco and Tunisia, do confirm these hypotheses. However most of the previous work and experimentation was carried out either in publically controlled agricultural experiment stations or on large private farms which are typically endowed with the required resources and means that allow them to meet CA investment needs, particularly in terms of machineryand equipment.Small farmer conditions are quite different which limits the opportunities for change through the adoption of new technologies.

On the other hand land tenure in the targeted North African Countries is by-in-large skewed towards small land holders with more than 80% of the farmers cultivating10 Ha or less in dry land conditions. Hence a suitable and integrated development packagewas needed to cope with the constraints that characterize these small sized farmers.

This project rests on the hypothesis that the CA package can bring about needed solutions to the specific problems encountered by small farmers provided adequate technical and institutional mechanisms are identified and put into place to make the CA package more attractive to the targeted smallholders.For that reason and unlike other development projects, the present CANA project attempted to tackle and understand as a first step the socioeconomic characteristics of the targeted small farmers and see to what extent they could be limiting the CA adoption process. The aimof the project was also to analyzethe accompanying extension services and the

[3]Essentially consisting of three cultural pillars: limited or no disturbance of the soil, adequate management of crop residues and the adoption of appropriate crop rotations and sequences (Mrabet).

supply channels that provide the necessary inputsto these farmers and to search for appropriate and affordable technologiesso as todesignand provide the best practical and completepossible advice to them.

The main endeavor of this project was to promote and speed up the adoption of CA practices by smallholder farmers in North Africa for the purpose ofslowing down thenatural resource deteriorationthat characterize their farming environments, improvingtheir resource productivityand increasingprofitability and sustainability of the existingcrop/livestock systems foundin the region more generally.

For that purpose, the project has identifiedthree operating areas called platforms, one in each country Setif, Chaouia and Fernana, respectively in Algeria, Morocco and Tunisia and corresponding to different agro-climatic zones. These platforms areknown for their resource degradation in terms of soil erosion through water and/or wind along with limited and variable rainfall. They correspond to what is classified as arid, semi-arid and sub-humidzones respectively.

In terms of genesis this project is a continuation of the involvement ofAustralian agricultural scientists with researchers from the Maghreb region that has been going on for more than 25 years covering Libya, Morocco, Tunisia and Algeria[4]. Many of the earlier attempts focused on extending and adapting the known Australian "ley" farming system and incorporating medics (annual *Medicago* sp)for improved livestock feed and rotational benefits. Typical programs involved farm planning, including the establishment of demonstration farms and training of local agricultural extension personnel.

These programs had a fundamental aim of adapting the known Australian dryland farming technology to the North African situationsto improve local food security. While the use of original Australian methods of shallow tillage was widely demonstrated through these projects, the more recent evolution towards the no-till style of crop establishment was not emphasized in past programs. This is why no-tilling was given a priority in this project.

Australians and others with expertise in CA, no-till mechanization and participatory research have more recently been investigating opportunities and collaborating with partners in Algeria, Tunisia and Morocco through small-scale pilot studies and workshops to identify opportunities to increase crop yields in North Africa through research and adoption of new technology.

A scoping study mission which led to the production of a document titled "*CA: Constraints and Opportunities in the North African Region*" was carried out in Tunisia in July 2010 (ACIAR Report CSE 2010/027) and involved participants from Morocco, Algeria, Tunisia, Libya, Eritrea and Sudan, Australia and ICARDA. This study identified issues and priorities for research and development in CA that are shared across northern Africa.

The study found there was a need for socio-economic strategies for supporting smallholder adoption, for optimizing biomass production and management through enhancing crop water use efficiency, developing integrated agronomic management systems which take account of the fodder needs of livestock, and developing no-till crop establishment systems and machinery that are appropriate to targeted local farm sizes. The present project was built around these shared ideas.

[4] *See project document*

A workshop to review past Maghreb/Australian involvement held in Adelaide in September, 2011 confirmed the advantages that can be achieved through collaboration between Australian and North African research, development and extension (RDE) communities. This workshop stressed that the main factors for success learned from past projects were local community ownership, national commitment, and developing and maintaining strong linkages and relationships between local and Australian research and development efforts. These findings were taken into account in project development.Recent research endeavors in the CA practice in the targeted countries are listed in Appendix 2 of this report.

4 Objectives

This project's ultimate objective is to promote the adoption of CApractices by smallholder farmers in North Africa (Algeria, Morocco, and Tunisia) in order to contribute to the reduction of the observed natural resource degradation in these targeted countries thereby increasingtheir natural resource productivityand enhancing the profitability and sustainability of the crop/livestock systems they have in the region and improve small farmer livelihoods as a result. More specifically, the project is built around tree main ideas qualifiedin the project document as specific objectives:

1. identify the constraints to adoption of CA practices by smallholder farmers of the three countries and suggest ways of enhancing that adoption through practical and viable socioeconomic options,
2. identify and test improvements in existing seeding machinery and in weed and biomass management of CA systems,
3. enhance the capacity of NARES staff and other stakeholders to practice and promote CA practices

These objectives can briefly be detailed as follows:

For **objective 1**, the specific aims were:

- To adequately characterize the three selected research platformsthrough baseline surveys, in terms of resource endowments, a-priori information available to farmers on CA practices, their perceptions of these practices and of the potential they may offer in bringing about improvements in their livelihoods. This initial characterization needs to be revised and updated through time as the project activities are implemented to enablethe analysis of the evolution of the nature of the constraints that are inhibiting the adoption process. Ultimately this would provide and contribute to similarity studies within countries and across the region to understand the efficiency of project implementation and out-scaling to other areas;
- Through repeated rapid rural surveys the farmers behavioral change towards CA practices and to analyzethe evolution of the perceived constraints to,and adoption of, CA practices in the three platforms,
- Undertake appropriate household surveys to assess likely project impacts on farmers,
- Identify and suggestrelevant policy and/or institutional options that could promote CA adoption,
- Characterize farmers' perceptions of the CA potential and appraise their degree of adoption over the duration of the project for the three platforms,in comparison with the those found at the outset of the project.

In terms of **objective 2**, the general aim of the project is not to initiate agricultural research on CA practices but rather to use, disseminate and further adapt existing research findings obtained in other parts of the targeted countries or outside, but with relevance to the region and active participation of farmers themselves. This reasoning applies to machinery as well as agronomic considerations. The specific sub-objectives are:

- In the field of **seeding machinery** and since previous research identified its highly limiting effect on the CA adoption process, the objective was to develop affordable no-till seeding equipment for small to medium sized farms along with adapted cropping

systems. This involved a 3 prong strategy with (i) investigating ways to upgrade existing conventional seeding equipment to support a low-cost transition to CA (ii) identifying suitable commercial low-cost no-till seeders and iii) developing locally adapted no-till drill technologies for use by the targeted smaller farmers. This strategy was to involve:

- Designing, adapting and testingnew no-till drill options to meet key specifications to be identified in the target platforms,
- Undertaking field performance assessment of a range of no-till drill options for successful crop establishment in relevant CA cropping contexts,
- Engaging local manufacturers and farmers in the development, manufacturing and promotion of low cost appropriate machinery options,
- Conducting economic assessment of the investment opportunities of the new drills in the relevant CA systems,
- Conducting farmer field schools to enhance stakeholder co-learning and farmer-to-farmer innovation.

In terms of **weed management** and **crop sequence establishment** the specific sub-objectives deal with:

- Studying the dynamics of weeds and developing integrated management for weed control under CA systems,
- Testing crop sequence options to enhance diversification and sustainable productivity,
- Assessing soil quality/ health and water productivity under CA system,
- Testing and validating decision tools for crop monitoring and risk management.

Concerning the crop residue management and livestock feeding the focal points identified in the project document were:

- To assess the technical and economic assessment of trade-off between surface cover and animal productivity,
- To develop and test alternative integrated feeding options (forage crops, alley-cropping, by-products), and
- To evaluate the profitability and productivity of appropriate integrated crop/livestock production systems under CA utilizing decision support and modeling tools

For**objective 3** the main issues were to**:**

- Raise awareness of not only farmers but of all stakeholders that are or can contribute tothe CA system potential benefits and understanding of shortcomings (private sector including manufacturers, NGOs, and decision-makers)
- Conduct on-job training of all stakeholders (farmers, extension specialists, traders, scientists, NGOs),
- Use Australian experience to upgrade national expertise in CA practice through scientific and technical support, and exchange of visits and training that focus on integrated systems analysis of longer term outcomes of CA,
- Enhance knowledge sharing and dissemination through brochures, newsletters, website and media,

- Promote CA networking in the region aiming at establishing a CA hub in North Africa

5 Methodology

Following the recommendations of the scoping mission that was conducted by the Australian team toNorth Africa, with interactions with national researchers and institutions the choice was made on three platforms, one in each country: Setif in Algeria, Chaouia in Morocco and Fernana in Tunisia. These platforms were chosen for a number of reasons. First, they are characterized by natural resource degradation which is the main thrust that CA practices address. Second, the platforms, even though similar in terms of resource limitations, they are representative of significantly different agro-climatic zones as they reflect the arid, semiarid and sub-humid zones of their respective countries. Thirdly, these three platforms represent areas where a significant amount of research has been conducted on CA by the respective national teams and in which most research findings were already accumulated and ready to be disseminated to farmers.

The work was carried out in a number of sequential steps. First there was an inception meeting for the whole project which took place in Hammamet, Tunisia, in September 2012, where the objectives of the project and its methodology were discussed. At the end, the work plan for the first year was elaborated, discussed and adopted. Even though it included activities that were to be implemented separately in each country, the work plan was built around the samelogic that aimed to understand the constraints tothe adoption of CA practices by smallholder farmers operating in different agro-climatic conditions that are reflected through the three chosen platforms. On the basis on the knowledge and interpretation of these constraints, the issue was to develop working options that could help farmers overcome those constraints. This meeting was attended by all three research teams representing the partner countries involved along with the Australian counterparts and representatives of ACIAR and ICARDA.

Following the inception meeting in Tunisia where anannual work plan was adopted, separate national inception meetings were organized by country teams to present and discuss the work plan particularly with farmers but also other stakeholders to facilitate involvement in the project.

Following the introductory meetings in each country, work was established for the three main objectives and several sub-objectives[5]. Due to the importance of the sowing operation in CA which involved direct drilling as opposed to conventional, work on the machinery commenced somewhat earlier than the other activities so as to have the equipment ready at the time of sowing.

This work was done with farmers using participatory research methods. On farm research trials dealt with cereal crops (wheat and barley), food legumes (mainly faba beans) and forage crops to improve the farmer feed supplies, while planning was for the comparison of CA crop resultswith those of traditional practices of selected farmers, both in terms of activities and yields.Again the work involved three main aspects (i) the platform socioeconomic characterization, (ii) the technical refinements to be introduced on the mechanical engineering, agronomic, plant disease control and livestock resources and (iii) the information dissemination and capacity building. All teams carried out the three types ofactivities simultaneously in the three countries. The implementation of the activities was meant to expand progressively following the innovation platform shown in Figure 1.

[5] *A shortened version of the logframe showing the main activities retained for the project appear in appendix5*

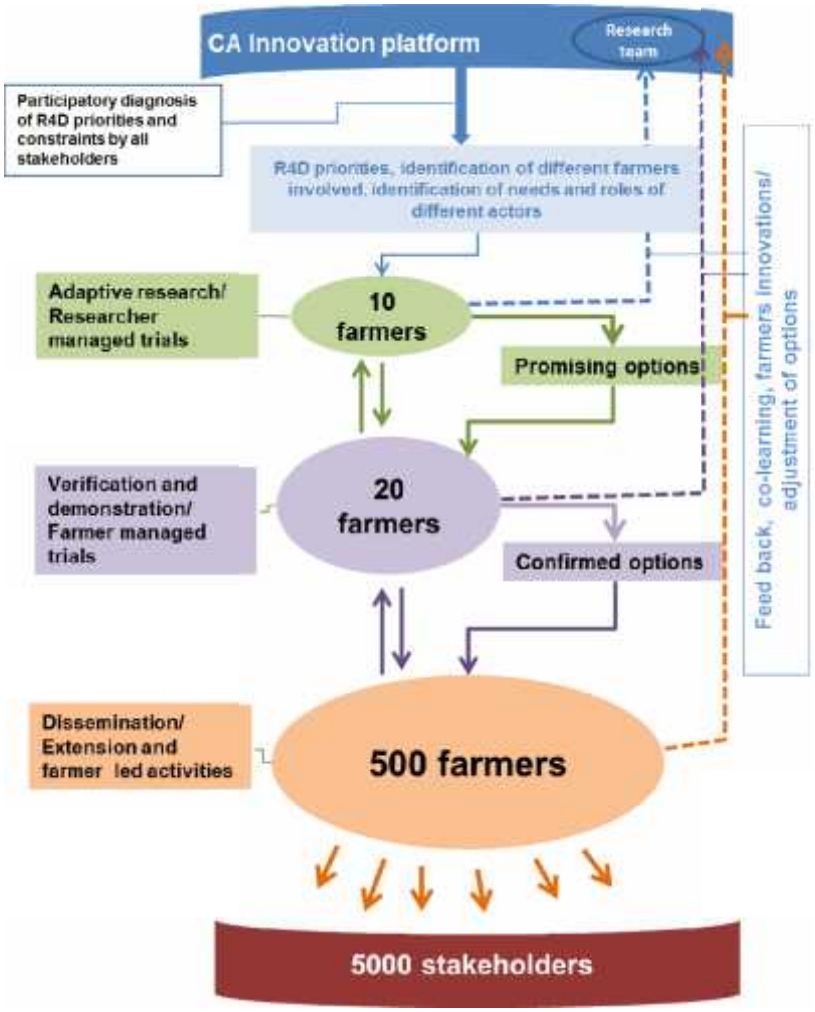

Figure 1. A schematic representation of the CA innovation platform for North Africa

As indicated in the project document and shown above, the adaptive research utilizing the most relevant research findings obtained prior to the project initiation were carried out on 10 farms in each country. The most promising results were to be carried over to the next set of 20 farmers identified in each country. The idea was to move from year one to year two from on-farm researcher managed research (OFRMT) under farmer conditions, to on-farm farmer managed trials (OFFMT) where farmers themselves play a leading role in choosing CA options suggested by researchers and in some cases by their fellow farmers.The OFRMT addressed the major research questions of pertinence to a given farmer and farming conditions, with the OFFMT aim being to validatethese under farmer management and control.

During the third year, the innovation process is expected to continue through disseminating the most relevant research findings to another set of 500 farmers by country where most of extension and dissemination work is to be done by farmers themselves. Ultimately the objective of

reaching 5000 farmers in each country is expected to be reached by the dissemination process of the new information regarding the potential of CA

At all steps from the planning of activities to their implementation close interaction was maintained between stakeholders involved in the shaping of agricultural activities: service and input providers, policy makers, extension specialists, local development organizations, farmers union etc. These interactions are summarized in this diagram provided in the project document and shown below.

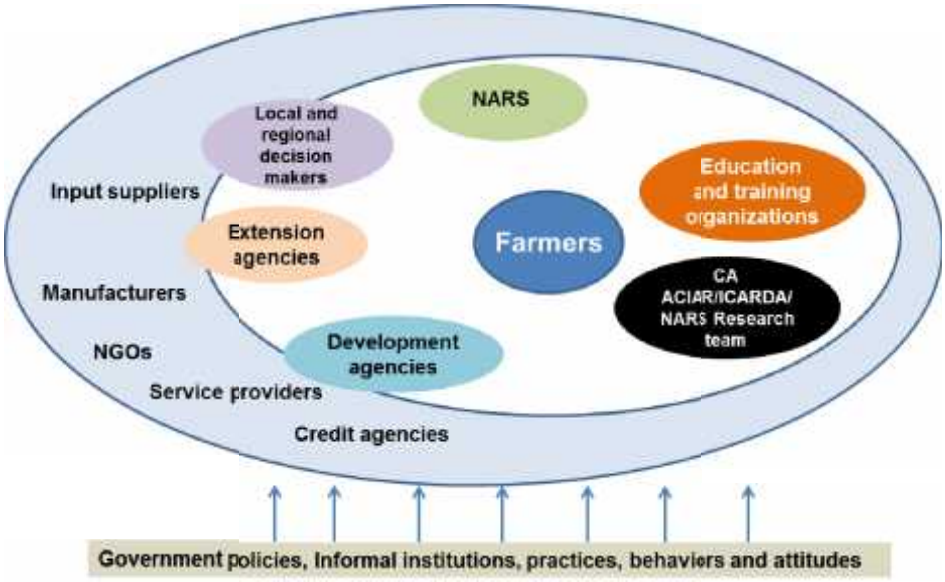

Figure 2. CA innovation system framework (Adapted from The World Bank, 2011)

The first annual meeting (Sept 2013) took place in Algiers, Algeria and the second one (Oct 2014) in Marrakech, Morocco. During the annual meetings which coincide with the executive committee meetings, participation is extended to several stakeholders from the host country.

The purpose of the annual meetings is twofold: discuss the progress achieved in all activities conducted in all three platforms during the ending year and establish the plan of work for the coming year.

Between annual meetings several gatherings take place from the planning stages of the activities to the time of harvesting crops. Often these gathering take place in farmers' fields and they are frequently followed by discussions on various topics depending the timing ofthe growing season and the specific problems being addressed.

Throughout the project several training sessions took place either in the partner countries or in Australia. Training topics werevaried; going from socioeconomics to machinery handling and management to weed control to soil analyses to crop and livestock management. To increase efficiency and opportunities for continued collaboration, most training sessions involved participants from all three partner countries.

Specific methods of analyses vary from one objective to another, but they all involve statistical analyses to analyze variability in crop and livestock performance to farmers' attitudes towards CA practices.

One other important methodology was introduced during the Algiers meeting. This related to methodology for the monitoring of project activities and their evaluation during the lifespan of the project to appraise the magnitude of achievements but also to make the necessary adjustments as the project identified key changes.Experts were invited to present and discuss the methodology. A one week detailed training program was subsequently organized for all three team members in February 2014 in Morocco.

6 Achievements against activities and outputs/milestones

Objective 1. To identify constraints to adoption of CA by smallholder farmers and ways of enhancing adoption, most importantly identifying and testing socioeconomic options

In terms of the first objective of the project, all three teams have performed their baseline characterization of their respective platforms. The general characteristics of farms and farmers were described. Information about and attitudes towards the new CA technology were described: they go from the limited farm size, to the lack of financial means to cover the expenses of activities to the limited information available to them about CA to the cost of investing in the required machinery[6].

The plan of work for the first year indicated the need to conduct specific studies that would help determine investment ceilings in farm equipment that would be affordable by farmers of different categories. On the basis of the baseline survey results it was concluded that small farmers by-and-large did not own equipment and accessed rental machinery. Furthermore they showed little interested in making those investments themselves. This was discussed at length during the Algiers meeting and it was concluded that it would preferable to use additional rapid surveys of service providers, as opposed to farmers, to explore their willingness to invest in the machinery required by the CA practice. This pathway has proven to be very successful for smallholder mechanization and productivity improvement elsewhere (e.g. Yang *et al*., 2013)

It was also necessary to carry out comparative farm budget calculations on the financial performance of the proposed CA options for farmers with their conventional practice. Some calculations were performed in all three countries but the results were not sufficiently conclusive. In some cases CA activities outperformed the conventional ones and in many others it was not as clear as the two years of the project were so climatically different not only from year to year but also from farm to farm. That amplified the variability of the budget calculation results. An additional years' data are needed before clearer conclusions can be made.

The plan of work calls also for monitoring through time of farmers and farmers' attitudes towards CA. Among the important issues was the exploration of the introduction of the CAon the economy of households both for additional food supplies and incomes. It was agreed that making inventories of existing policy measures and their relevance for enhancement of the adoption of conservation agriculture was needed. On the basis of this information the expectations was the provision of policy suggestions that would help increase the attractiveness of CA practices to small farmers. However, given the short duration of the project this has still not been achieved.

Objective 2: To identify and test improvement in seeding machinery, and in weed and biomass management of CA systems

In terms of the second objective a number of accomplishments were achieved.

On sub-objective 2.1 (*Develop and test affordable ZT seeding machinery and crop establishment systems for small to medium sized farms*), rapid progress was made in all three platforms along a three prong approach: Firstly, a selection of low-cost ZT tine seeder technologies was identified on the international market and 2 models were acquired (from Australia and Spain) to provide a baseline for low-cost tine seeder performance and technology (Note: this activity was paralleled by similar seeder technology development in Jordan (ACIAR-IRAQ project CIM-2008-027) aimed to become commercially available in 2014 at 50% of the Australian/Spanish price and thus become a potentially attractive ZT seeder importing option for the region, wherever price may primarily drive the adoption process). . Secondly, prototype seeders are being developed in all three countries which are currently in early stages of evaluation

[6] *Specific details appear in the respective technical reports of the teams*

and, subject to field performance and farmer feedback, plans have been initiated to organise commercial manufacturing within country,. Thirdly, work on low-cost zero-till upgrade of existing conventional seeders has been initiated in two platforms (Algeria, Tunisia) where this option was assessed as commercially viable. A mentoring process of research and development involving collaborative exchanges between the country machinery teams and with local industry partners under the guidance of Australian expertise (Dr. Desbiolles, UniSA) was used to facilitate these achievements. With the development of a ZT seeder evaluation protocol, the field performance assessment of low-cost ZT seeders was initiated in Year 2 with a focussed programme planned in the coming 3rd season to broaden the context of evaluation and confirm recommendations for commercial design solutions.

Weed control work is advancing significantly but different issues have occurred. First the weather variability has prevented from drawing definite conclusions as to the relative effectiveness of alternative chemical weed control. While chemically treatment is necessary in view of the multitude of weeds that developed in the CA plots, over treating can be damaging to the natural flora that farmers are accustomed to using to feed their animals. In addition chemical weeding involves a high costs.

Fodder combinations of grains and legumes have given results that caught farmers' interests; whereas alley cropping is to be further studied in order to further convince farmers of its relevance for their environment.The interest of farmers in fodder crops is a major outcome of the project, as this opens the possibility of replacing the common weedy fallow that farmers leave after every three or four years of cereal cropping. Farmers have seen that a mixed cereal/legume fodder crop produces more, higher quality feed, tan do the weeds of the weedy fallow, allowing for the intensification of the farming system , while at the same time gradually reducing the weed seed bank in the soil, thus facilitating weed control.

In terms of crop rotations some positive results were obtained with wheat and barley when legumes and forage or forage mixtures are used as the preceding crop. The issue of appropriate fertilizer rates for different crops in the various locations requires more attention and research before conclusions can be drawn.

Agronomic results also show that soil microbial activities were enhanced under conservation systems and so has soil stability under the same conditions.

Objective 3: To enhance the capacity of NARES staff and other stakeholders to practice and promote CA

Within objective three, the areas of project success were most significant. Perhaps the area that was most emphasized was the diverse forms of capacity building. The multiple training occasions and topics that were organized during the first two years of the project, both in the region and Australia are impressive. The original idea introduced by the project of the travelling workshop in all three countries where there were opportunities to witness, discuss and assess activity implementation and development in interaction with farmers and typical stakeholders was definitely to the credit of the project.On every occasion material was presented and discussed in the middle of the fields, along with brochures and pamphlets provided that were a further part of information sharing.

The high number of farmer field schools that were organized in every platform where farmers substitute for researchers and other experts in explaining and highlighting the virtues of CA, and in the end disseminating information about CA was key to the project success.

7 Key results and discussion

Objective 1. To identify constraints to adoption of CA by smallholder farmers and ways of enhancing adoption, most importantly identifying and testing socioeconomic options

no.	Activity	Algeria	Morocco	Tunisia
1.1	Characterize the 3 platforms and conduct similarity studies within country and across the region for efficient project implementation and result out-scaling	**7.1** Characterization of platforms competed (see attached comparative table in appendix 4) **7.2** Adoption of CA practices seems to be mostly determined by: **3** - Degree of information available on the package **4** - Cost of investment in the required machinery **5** - The small farm size **6** -The limited availability of quality forage seeds the meet livestock feed needs **7** - The introduction of new weeds following the direct drilling of the soil **8** - The limited control of introduced weeds **9** - The cost of chemical weeding		
7.10	**7.11** Study farmers behavioural change and analyse constraints to adoption of CA systems in the three platforms (including mechanisation aspects and machinery supply industry)	**7.12** Most small farmers use machinery equipment on a rental basis **7.13** The likely investment in the appropriate equipment is by service providers, not farmers		
1.3	Undertake a household survey to assess economic, environmental and social project impact through ex-ante analysis	No results as yet		
1.4	Investigate enabling policy and institutional options to promote CA adoption	Yet to be done But by-and-large no specific incentive measures to CA programs. (Support by each country for the project following the Australian decision to withdraw has been a strong indication of the level of commitment by national organizations.) In Algeria: In Morocco, the Green Morocco plan has allocated funds to promote CA/CC over more than 10,000 ha. There is also subsidy for no-till drill amounting 75,000 MDH (almost 10,000 Aus Dollars) per unit. Encouraging CA Associations NGOs (there are today around 25 in Morocco) In Tunisia to there is an Association hat got create to promote CA practice. While there no special subsidy for CA equipment yt, provision do exist for high rates of subsidies (increases from 25 to 40%) if equipment financing request originated frm farm associations as opposed to individuals.		
1.5	Analyse and quantify the degree and rate of CA adoption at the three platforms at the end of the project	Yet to be done		

1.6	Conduct farmers perception study on CA system by end of project at the three platforms	Gross margin calculations seem to show the advantage of crops grown under the conservation regime but: Life of project is too short to draw conclusions Economic performance of AC practice very dependent on annual climatic conditions which are highly variable Partial freeing farmers to use their time for alternative activities

Objective 2: To identify and test improvement in seeding machinery, and in weed and biomass management of CA systems

no.	Activity	Algeria	Morocco	Tunisia
2.1	Develop and test affordable ZT seeding machinery and crop establishment systems for small to medium sized farms	Suitable lower-cost tine seeder technologies were identified and selected A common seeder evaluation protocol was developed and a programme of field evaluations was initiated in Year 1-2.		
		Two Australian ZT tine seeders were purchased One ZT seeder prototype locally developed and evaluated in Setif A concept of ZT drill prototype was developed with a large scale industry partner (CMA) in Sidi Bel Abbes (Western Algeria) comparative field evaluations conducted in Year 1-2 Including on-farm evaluations of: - A sample conventional seeder upgraded for ZT - Low-cost alternative ZT seeder imported from Pakistan	Two Australian ZT tine seeders were purchased Development of new generation Moroccan seeder now commercialised via INRA/ATMAR partnership Low-cost Direct drill prototype under development ?#? comparative field evaluations conducted in Year 1-2	One Australian and one Spanish ZT tine seeders were purchased AA ZT drill prototype was developed at INGC with an interest in manufacturing expressed by an industry partner in Sfax (Eastern Tunisia) comparative field evaluations conducted in Year 1-2

2.2	Fine-tune weed management and crop sequences for sustainable land & water management	Some aspects of weed management have been tested: sowing date, crop sequences, in combination of the use of chemical treatments, the first results show the importance of each in the global integrate weeds management in ZT. At this earlier stage of CA adoption the use of the total chemical weeding, is essential for weeds control. The PH of spraying water has a significant efficiency of the quality of chemical treatments. The weeds flora of the region has been identified Prominent crop sequences would unless be useful to replace fallow.	- Better knowledge of a) the soil seed bank, b) the dynamics of weeds in various crops, c) yield loss due to weeds, and d) weed management options in different situations. Results showed a) a potential weed flora exceeding 8000 seeds/m², b) glyphosate at rates >= 720 g/ha was effective on most weeds before planting, c) 2,4-D was effective on pignut weed in small grain cereals, d) broadleaf herbicides were very effective in controlling weeds and increasing yields in small grain cereals, and e) hand weeding was effective on controlling weeds and increasing yields in lentils. - Initial soil heath status identified and its evolution monitored. Causal agents of small Cereal grain dry root rot identified, and method of selection of resistance developed. use of fungicide adopted, and yield losses under CA quantified - Forage crops, peas/barley or vetch/oat mixtures (75/25 %) are excellent for feed and alleviating weed seed stocks in the soil.	Better understanding of the highly diversified weed flora in three experimental sites Identification of dominant weed species and weed problems. Chemical treatment of weeds prior to sowing and after emergence are necessary Weed management biggest challenge for farmers adopting conservation agriculture. Results of this study revealed a highly diversified weed flora, Lack of own equipment to spread chemicals is also a constraint
2.3	Optimize crop residue management and livestock feeding under CA systems	Good establishment of shrub plants in Alley cropping in some sites, and look like prominent option with forage associations for livestock feeding, introduced for crop/livestock system integration under CA, but it remains unknown by farmers and faces some issues.	- Better alternative for the weedy follow was implemented and adopted by farmers. - More competitive forage crops are tested and evaluated (triticale, oat, and vetch). - Crop residues management is pursued under controlled conditions in the research station.	Study of impacts of crops rotations on succeeding crop performance WUE for wheat increased when following vetch WUE for durum wheat slightly better under conservation increased soil organic matter biodegradability due to higher crop residues under CA CA increased soil stability

Objective 3: To enhance the capacity of NARES staff and other stakeholders to practice and promote CA

no.	Activity	Algeria	Morocco	Tunisia
3.1	Raise awareness on CA system potential benefits and shortcomings among farmers, private sector including manufacturers, NGOs, and decision-makers	Inception workshop with 52 participants representing all stakeholders Setif radio station broadcast on the CANA project Field days organized to demonstrate ZT seeding technology and relevant mechanical adjustments 70 participants attended. One Algerian took part in the training course on innovation platforms organized by ICARDA in Morocco. One Algerian from CANA took part in the Training Workshop on Monitoring and Evaluation (M&E) *Rabat, 03 - 07 February 2014* Three scientists attended the pesticides application and best practice methods training organized in Morocco. One person from HCDS attended the 8th international congress on Cactus pear and cochineal in Palermo, Italy. 28-31 October 2013. A training course organized by ITGC Setif Station with Dr Desbiolles on Seed drills performance tests (assembly, calibration...). Two scientists visited Australia CA technologies. An Algerian attended the First African Congress on CA in Lusaka, Zambia. Training on ZT machinery was conducted in Tunisia from 8 to 11 April, 2013, for the benefit of 3 scientists A training on water efficiency was given by Australian experts from 24 to 6 April, 2013 for 2 Algerian scientists	Inception meeting with 50 participants A five day regional training course on innovation platforms was organized by ICARDA and attended by Al Baraka association president and CANA scientists. A six day regional training course on Pesticides application and best practice methods was organized at INRA Settat for researchers, scientists and PhD students. One researcher attended the VIIIth international congress on Cactus pear and cochineal in Palermo, Italy. 28-31 October 2013. One researcher attended a training course in Algeria on Seed drills performance tests organized by ITGC with Dr Desbiolles. Three scientists, the president of AGANDA Association and the regional director of Agriculture visited Australia under different programs; socioeconomic, plant pathology, forage and animal production, agronomy and crops production and CA farmers' organizations. One scientist and AGENDA president attended the First African Congress on CA in Lusaka, Zambia.	6 national workshops held with attendance of farm leaders, extension agents, regional authorities, input and service providers, NGO representatives, members of service cooperatives, etc. Training on ZT technology for members of all three platforms Training on water use efficiency for members of all three platforms Travelling workshop One researcher attended the VIIIth international congress on Cactus pear and cochineal in Palermo, Italy. 28-31 October 2013.

3.2	Conduct on-job training of all stakeholders (farmers, extension, traders, scientists, NGOs)	Workshop organized with Australian participation on direct seeding technology and discussions with farmers	Training on CA concepts and principles in Bir M'zoui Agricultural school with 80 participants. Workshop organized with Australian participation on direct seeding technology and discussions with farmers Three days training on CA principles and concepts organized in Ouled Moumen Agricultural school. A six day regional training course on Pesticides application and best practice methods was organized at INRA Settat for researchers, scientists and PhD students. Three days training on sustainability analysis of adaptation to CC of mediteranean region. Three days training on grains' harvest aznd storage technologies.	6 training programs organized with 284 stakeholder attendance 6 extension agents and 3 scientists attended training programs in Morocco
3.3	Use Australian experience to upgrade national expertise in CA through scientific and technical support, and exchange of visits and training that focus on systems analysis of longer term outcomes of CA	Participation in the regional project inception meeting in Tunisia Participation in training programs organized in Tunisia and Morocco Two scientists visited Australia on a CA study tour (August 2014) Seminar given on CA and seeder technologies at Setif University Ferhat Abbas I (Dec 2013)	Participation in the regional project inception meeting in Tunisia Participation in training programs organized in Algeria and Tunisia Three scientists, the president of AGENDA Association and the regional director of Agriculture visited Australia under different programs; socioeconomic, plant pathology, forage and animal production, agronomy and crops production and CA farmers' organizations.	5 team members attended training programs in Australia (machinery, risk management, weed management, forage crops) 6 visits of Australian experts 2 team members the world congress on CA in Canada in June 2014
3.4	Conduct farmer field schools to enhance stakeholder co-learning and farmer-to-farmer innovation	Farmer field school organized in Setif involving university students	Farmer field school organized in Settat Chaouia involving farmers and other stakeholders for three years (2010-2013).	5 farmer field schools organized with close to 400 farmer attendance
3.5	Enhance knowledge sharing and dissemination through brochures, newsletters, website and media	Production and distribution of leaflets TV and radio coverage	Production and distribution of leaflets on; - weeds and weed management, - Diseases and disease management, - Sprayers and spraying technology, - Harvest and grain storage. TV and radio coverage	leaflets produced and distributed TV and radio coverage of events

3.6	Promote CA networking in the region aiming at establishing CA hub in North Africa	Project website where information on activities and events are described, updated and disseminated (www.cana-project.org)

8 Impacts

The Setif platform

8.1 Scientific impacts

In terms of scientific impacts one can mention the collaboration established between the CANA project and Setif University and students. The following publications were produced:

Zaghouane, O. "L'agriculture de conservation en Algérie" Bulletin des Grandes cultures September 2013. Institut des Grandes cultures.

Djenadi, F. and A. Laouar "Weed management in CA in North Algeria" Poster publication sent and accepted by the office of the 6th World Congress on CA (WCCA/Canada, 2014)

Other publications are planned:
Book on weed management and species inventory in Algeria, October 2014
- Book on CA in Algeria by Zaghouane, O. December 2014

8.2 Capacity impacts

- The Algerian team members were involved and attended all CANA project training events organized in Algeria and a number of them attended training programs organized in the other two platforms (Morocco and Tunisia)
- Two team members attended the monitoring and evaluation workshop organized in Morocco by ICARDA.
- Two team members attended the training programs on weed management in Australia and another one attended the training program on risk management in Australia as well
- Training on ZT machinery was conducted in Tunisia from 8 to 11 April, 2013, for the benefit of 3 scientists
- A training on water efficiency was given by Australian experts from 24 to 6 April, 2013 for 2 Algerian scientists
- Training on Innovation Platforms in Morocco, 21-25 Oct. 2013 panticipation of Mr Atef Amriche from INSID
- 4 Algerian persons took part in the pesticide application and best practices, Morocco 20- 25 January 2014
- Attendance of the First African AC congress Lusaka Zambia 17- 21 march 2014
- Field demonstration day on ZT machinery adjustment Khababa with the attendance of 70 persons
- Conference given by Dr desbiolles in the University of Setif on The ZT machinery technologies
- Training was held in the ITGC station of Setif and a course on Seed drills performance tests given by Dr Desbiolles to the CANA team.
- A travel workshop of 34 scientists from Australia, ICARDA and from the three platforms travelled cross the countries 4 scientists from CLCA project took part to this travel workshop from 6 to 14th April 2014
- One Algerian from CANA took part to the Training Workshop on Monitoring and Evaluation (M&E) and Results-Based Management (RBM) *Rabat, 03 - 07 February 2014*
- Two Algerians went to Australia for a training from 18-09 to 30-08-2014

- One person from HCDS attended the 8th international congress on Cactus pear and cochineal in Palermo, Italy. 28-31 October 2013.

8.3 Community

Several demonstration plots were established in different communities of the Setif platform.

8.3.1 Economic impacts

- Savings on fuel and machinery costs were demonstrated
- Gross margin calculations that showed the superiority of crops under CA systems
- Increased cereals yields und CA practice are likely to generate additional incomes for farmers

8.3.2 Social impacts

The CANA project was instrumental in activating farmer associations and drawing their interests to CA.

No-Till and CA practices are increasingly the subject matter of farmer and farmer organization discussions

8.3.3 Environmental impacts

These impacts are yet to be assessed but increasingly farmers are witnessing evidence of soil fixing and organic matter improvements where conservation systems are introduced

8.4 Communication and dissemination activities

Several leaflets describing CA practices have been produced and disseminated.

Several training workshops were organized in the Algerians platform which were attended by participants from the other platforms

Several field visits were organized with large numbers of farmers and other stakeholder participating

-2 radio broadcast was diffused in the local SETIF radio and held about the CANA project last year Nov 5th, 2013 and in April 15th, 2014

- One documentary movie was produced on the CANA project by ITGC and AVP Plus company 2 DVD (Agence de communication et de publicité)Setif

The Chaouia-Ouardigha platform

8.1 Scientific impacts

In terms of scientific impacts the collaboration established between the CANA project and the various research institutions and universities was valuable. An example of such collaboration has led the support of a PhD work which has led to a publication in the IJARET, (ISSN 0976-6499) with the title:

"Tillage effects on basic properties of a calcareous soil under Moroccan semi-arid climate" M. Belmeki; University of Science and technique, Hassan 1er, Settat.
M. El Gharous, O. El Gharras, M. Boughlala, and O. IbenHalima; INRA Settat.
And B. Bencherki; University Hassan 1er, Settat.

8.2 Capacity impacts

The Al Baraka association has been established and is presently involved in CA development and promotion. Its president and members of its the governing body are actively involved in training organized by ICARDA or other CA projects at the national level. The association has developed in collaboration with INRA scientists two proposals that have been submitted. The first under the Green Morocco Plan, Pillar 2 for smallholders on wheat production improvements under CA and the second for the OCP foundation for livestock production development under CA.

- One scientist attended the third International Agronomy Congress, New Delhi, INDIA. 25 Nov. to 01 Dec 2012.
- Five scientists from CANA team attended the regional training in Tunisia on Zero Till seeders development organized by INGC and Dr Desbiolles.
- A five day regional training course on innovation platforms was organized by ICARDA and attended by Al Baraka association president and CANA scientists.
- A six day regional training course on Pesticides application and best practice methods was organized at INRA Settat for researchers, scientists and PhD students.
- One researcher attended the VIIIth international congress on Cactus pear and cochineal in Palermo, Italy. 28-31 October 2013.
- One researcher attended a training course in Algeria on Seed drill performance tests organized by ITGC with Dr Desbiolles.
- Three scientists, the president of AGANDA Association and the regional director of Agriculture visited Australia under different programs; socioeconomic, plant pathology, forage and animal production, agronomy and crops production and CA farmers' organizations.
- Five scientists from CANA project attended the monitoring and evaluation workshop organized in Morocco by ICARDA.
- One scientist and AGENDA president attended the First African Congress on CA in Lusaka, Zambia.

8.3 Community

Thirty CA plots were established within the two communities and their productivities were superior to conventional fields mainly in the dry season. No-till, direct drilling and CA discussions are now taking place in every weekly market. The Al Baraka president and mechanization service providers are requested by neighbouring farmers to introduce them into CA practices and groups. The forage mixture production introduced as replacement of the weedy fallow is taking over very well. This allows farmers to improve their feed calendar as well.

8.3.1 Economic impacts

No-till practices that were promoted allowed farmers to;

- Eliminate all adverse tillage operations and reduce fuel consumption, labor demand and time presence on the fields.
- Reduce tractor maintenance, expenses and wear.
- Reduce the cereal seeding rates from 160-200 kg/ha to 80-120 kg/ha.
- Improve water productivity and crop production.
- Diversify the cropping systems and animal nutrition, and then reduce farmers' market dependency.
- Create more efficient opportunities for farming and farming businesses.

Furthermore, there is a real opportunity of No-Till seeder manufacturing through the involvement of the local industrial sector. Such an opportunity is employment creating and export enhancing.

8.3.2 Social impacts

The CANA project was instrumental in the creation of Al Baraka Association in Smaala and Beni Khirane and the improvement of social dynamics within the Chaouia-Ouardigha-Ouardigha region and outside. It is an example that many other groups are willing to reproduce in Oued Zem and other Moroccan regions mainly in the arid zones. Rhamna foundation, south of Chaouia, is one of the most powerful NGOs in Morocco and they are closely following the project activities.The OCP foundation is supporting a CA project for Rhamna starting 2014-15 cropping season.

No-Till and CA practices are now on the farmers' discussions in all official meetings and in every market mainly after the results of this dry cropping season. New employment opportunities are created within the communities through forage seed multiplication, chemical product dealers, forage production and marketing of ZT seeding, and professional chemical spraying.

There is also a promising opportunity for Al Baraka women that was just initiated, in collaboration with ICARDA and barley breeders, about traditional food product making based on barley that the Oued Zem area is known for.

8.3.3 Environmental impacts

There is not yet any clear evidence that any environmental impacts could be quantified. Farmers' impressions are that their No-Till cultivated fields and landscapes are somewhat levelled and more stable.

8.4 Communication and dissemination activities

Several leaflets describing CA practices have been produced and disseminated.

Several training workshops were organized in Morocco by the Chaouia-Ouardigha platform which were attended by participants from the other platforms

Several field visits were organized with a large number of farmers and other stakeholder participation

Participation in the World Congress on CA in Canada, June 2014

The Fernana platform

8.1 Scientific impacts

The Innovation Platform approach used by the CANA project is being adopted by other projects such as Food Security in the areas of Kairouan and Fernana and it is likely that it will be the methodology that national institutions involved in research and development such as the INGC will adopt in their future CA dissemination work.

CANA project have developed synergies and complementarities with other projects in Tunisia, managed by ICARDA concerning CA such as CLCA-project in the area of Siliana and CRP.1.1 project in the area of Sidi-Bouzid.

University teachers, researchers and students are increasingly involved in a number of scientific research activities dealing with different topics in relation with the CANA project.

The development ofCAwithin theCANAprojecthas induced a number of agriculturalschools to introduce the concept of CAin their training curricula.

The work within the CANAteam has created an environment for multidisciplinary and multi-institutional team work. Among the positive developments it has led to the identification of a o aline of researchonCAinthe agronomylaboratory of INRAT which alsomadethe participation inother AC projects possible.

The CANA team work has contributed to a deepening of the scientific knowledge and expertise available on CA. This should help better conduct research on CA in the future and consolidate the CANA achievements.

Some results of the CANA project have been published in national and international congresses (communications and posters) and thorough papers are presently under preparation by the team members and are due to be submitted for publication soon.

8.2 Capacity building

During the last two years of the project **6** national workshops were organized in the Tunisian platform: two at the start of the growing season, two at the mid growing season and two at the end of the season, with **250** stakeholder participation (Farmers, scientists, extension agents, traders, NGOs, etc.). Local radio stations and national TV covered these workshops.

6 on-the- job training programs were organized during the first two years of CANA project and **293** participants were trained.

5 scientists from the Tunisian platform visited Australia for different training programs

2 Tunisian Scientists have attended the World Congress on CA held in Canada on June 2014.

6 visits of Australian scientists were organized in the Tunisian platform

36 scientists and extension agents from the Tunisian platform have visited the Algerian and Moroccan platforms.

38 scientists from the Algerian and Moroccan platforms have visited the Tunisian platform for trainings, Workshops or meetings.

05 Farm Field Schools (FFS) were organized during the first year and **3** field days during the second year.

391 farmers have participated in t all the FFS and Field days.

3 informative leaflets have been produced. The first was about the project in Arabic language, the second in English language and the third one about *Orobanche* weed control, More than **1000** of those leaflets have been disseminated and **2** other leaflets about wheat management are under preparation.

5 topical factsheets on ZT seeder technology aspects have been produced for the ZT seeder training

More than **200** flyers on CA (in Arabic and French) initially produced by INGC were distributed to farmers and stakeholders.

A Web site has been setup and it is often updated. (www.cana-project.org)

A farmer association gathering more than **190** farmers has been set up around the Tunisian platform.

8.3 Community impacts

From the start of the project farmers are encouraged to establish and develop contacts with other farmers and other members of their communities to seek solutions for the encountered difficulties and problems. These interactions have probably contributed to the creation of a local farm association which now involved in joint purchasing of inputs, possibilities of machinery rental, etc.

8.3.1 Economic impacts

Although refined economic assessment is still underway, most farmers have concluded that one of the main advantages of the No Till system lies in the production cost reduction through savings in labor, fuel consumption, and lower machinery use.

Farmers who tested forage mixture (vetch & triticale) have expressed interest using it for dairy cattle. They registered a significant increase of 25% in milk yield and an improvement in the quality of the feed, as compared with conventional feed sauces. The increase in milk yield is synonymous of economic gain and improvements in farmer livelihoods. The current high price of feed concentrates is another motivation for farmers to seek adequate forage alternatives that can be produced in their own environments.

8.3.2 Social impacts

The awareness about the need for farmers organizing has increased. A farmer association has been created around the platform.

Farmers' degree of satisfaction should enhance a wider adoption of forage mixtures such as vetch/triticale by neighboring farmers as the majority of Fernana farmers rely on dairy and sheep production as the main sources of their incomes.

8.3.3 Environmental impacts

Environmental impacts have yet to be quantitatively but it is quite visible that the involved farmers that water erosion is being increasingly controlled.

According to farmers, the access to the fields during rainy seasons has been facilitated under CA practice, enabling the timely implementation of agricultural activities (fertilization, herbicide treatments, etc.) at their appropriate times.

Traditionally at Fernana region, the main forage species used for animal feeding is oaten hay. Adoption of new mixtures which has been made possible through the no-till technology, should contribute to enhancing soil nitrogen accumulation by using legumes such as vetch and

lower input costs due to the reduced application of post emergence herbicides and nitrogen fertilizers.

8.4 Communication and dissemination activities

250 stakeholders have attended workshops organized by the CANA project.

293 participants have been trained.

2 Tunisian Scientists have attended the World Congress on CA held in Canada on June 2014 and **06** posters were presented.

1 researcher attended the VIIIth international congress on Cactus pear and cochineal in Palermo, Italy. 28-31 October 2013.

1 scientist attended the First African Congress on CA in Lusaka, Zambia

36 scientists and extension agents from the Tunisian platform have visited the Algerian and Moroccan platforms.

38 scientists from the Algerian and Moroccan platforms have visited the Tunisian platform for trainings, Workshops or meetings.

391 farmers have assisted to all the FFS and Field days.

More than **1200** leaflets have been disseminated.

A Web site has been setup and it is frequently updated. (www.cana-project.org)

9 Conclusions and recommendations

This section is made up of two parts. First we will focus on the main lessons learned from the last two years of the project CANA activity implementation. These will highlight the major accomplishments of the project so far. It will draw the attention to a number of shortcomings that have also been observed. Once that picture is described, a number of recommendations are presented. Some of these recommendations will be addressed to researchers and scientists, others to national policy makers and institutions, some to farmers and lastly some to international fund donors and support providers.

9.1 Conclusions

Perhaps the most important positive lesson to be drawn from these first two years of the CANA project is the synergy it has created among the three platforms with the diversity of their stakeholders, not only the development researchers and scientists. The project implementers (ICARDA) worked hard to make the project function as an integrated entity not just an assembly of three platforms from the three partner countries. All organized events (field visits, workshops, etc.) were preceded by regional preparation; i.e. involving members from all three platforms.

Workshops were never organized by country teams in isolation of the others but rather they were discussed by theme, with all team members interacting and discussing different aspects pertaining to that given theme (socioeconomics, machinery, agronomy, weed control, etc.)

Another big plus of the project is the effective targeting of small landholders that were chosen in view of their importance and dominance in the three selected countries. It is true that CA has demonstrated its virtues in big countries with relatively large farms (e.g. Australia, Brazil, Argentina) or even in favorable climatic conditions such as in some European countries. The challenge is however completely different in countries that are dominated by small scale farming such as the three selected North African countries.

While CA potential is likely to improve and sustain farmers welfare with time, in the immediate term it does involve costs in changing the required equipment from conventional systems, and chemically controlling the rapid weed growth that results from limiting the tilling of the soils. These direct investment and operational costs may not be affordable by small scale farmers.

The primary results, while not conclusive yet, are somewhat encouraging with the identification of relatively inexpensive drills on the world market, in comparison with the machinery costs at which the conservation package was first introduced in the region 10 to 15 years ago. They are also encouraging in view of the potential success of locally developped and/or adapted lower-cost CA drill equipment in Algeria, Morocco and Tunisia currently under evaluation and with good progress towards commercialization (e.g. Morocco). On this aspect, the project has created a new vision for the partner teams on the use and benefits of lower-cost seeder alternatives and their suitability for CA systems in north Africa.

The large amount of weeds that developed in the platforms following the limited tilling of the soils, while creating a problem in-and-of-itself by generating higher chemical treatment costs is challenging in terms of needed additional research on developing alternative feed sources.

Crop rotations involving legumes as preceding crops for cereals and particularly wheat has given satisfactory comparable results to the conventional tillage system. Soil microbial activity has also improved under the CA cropping system and so has soil stability which is synonymous to reducing the erosion and degradation risks that are confronted by farmers.

It is clear that the major constraint to adopting the CA knowhow will remain the initial investment cost in the appropriate machinery and in the availability of operating credit to cover the relatively larger expenses associated building a CA culture. But higher costs do not necessarily imply lower profitability, particularly as time goes by. If somehow the associative work and/or appropriate public incentives are identified for private entrepreneurs to invest in servicing small farmers with machinery and other required inputs, CA practices in the region are likely to experience a significant take-off (see Yang et al, 2013 for an example).

One important advantage with adopting the CA technology will remain the partial freeing of the labor force from agricultural work. This could mean alternative employment and opportunity creation which could involve additional availability of some farmers for investment in service providing for them and for other farmers and in all cases improving livelihoods.

One important constraint to the adoption of new technologies, such as CA practices, in all of the North African region and perhaps other regions as well is the inertia developed over time in these countries to self-reliance for seeking solutions to encountered difficulties. Past and recent public policies have accustomed many farmers and other segments of society as well, to finding public solutions for private problems. This has been done many times in the name of food security and at times in view of their social importance.

The CA spirit involves the implementation of a number of mechanisms that are aimed at solving the problems that are generating fragility of livelihoods and limiting the profitability of the agricultural activity in general. These limit productivities of natural resources and cause degradation of those same resources due to inappropriate technology usage.

While the reasons for shortening of the lifespan of the CANA project could be understandable, it would be unfortunate if additional resources cannot be secured for the activities identified within this project to be continued to further test and disseminate a number of options. The expansion of the innovation platform idea, along with the planned similarity analysis studies, require additional time and resources if the CA spirit is to reach a critical mass of farmers.

Lastly, the CANA project may not have fully addressed all the activities that it was set out to accomplish which are described in the project document. But it has succeeded in developing a common methodology to address the adoption issue of CA practice in less than favorable conditions. It also has succeeded in building a sound network of scientists and researchers with strong links with farmers and other stakeholders particularly from the private sector. The strong network links go beyond specific country borders but involve not only members from the three identified platforms; they also include the Australian experts and expertise that has developed since the initiation of the project.

9.2 Recommendations

The research staff and scientists:

While the positive interaction demonstrated among the team members and teams across North Africa, ICARDA Australia is to be commended and recognized, additional professional effectiveness can be achieved by progressively including stronger and more focused priority setting processes among team members, national institutions and teams. Resources are always scarce, and their sound management always involves choices, sacrifices and compromises.

The national institutions:

Additional explicit recognition needs to be shown that internationally partially funded projects are to great extent national endeavors, in the sense that they are tackling local difficulties and problems. The CANA project is no exception. The North African countries allocate large budgets to irrigation and water mobilization. In many cases those mobilized resources are only partially unutilized and therefore physically wasted. CA practices, despite the elevated initial costs they may apply for farmers individually, offer an inexpensive way of mobilizing and simultaneously utilizing soil and water resources in non-irrigable areas which cover more than 90% of the arable land available in the three North African countries. Additional national resources can be identified and allocated to endeavors such as CA.

The farmers

When agricultural resources are depleted, the farmers are the first to feel the costs of degradation in their economic situations and livelihoods in general. If solutions can be found for those problems, they are the first to benefit as well. Many of the constraints to the adoption of CA package require solutions that could lie beyond the reach of those farmers individually. In those cases public help may be needed. Large and increasing amounts of public funds are allocated to agricultural inputs, some of which are resource damaging, such as excessive mechanized tilling. Some of those resources could be earmarked for specific machinery that is resource preserving such as direct drills. Other resources can be identified by farmers themselves by pooling efforts in some cooperative work.

International fund donors and support providers:

It is true that international cooperative projects such as the CANA project would not have been initiated had it not been for the efforts deployed by the international counterparts, the Australians in this case. But by providing and demonstrating achievements, projects like CANA should be a reference to seek alternative funding in the event of unforeseen shortening or discontinuation of primary funding.

10 References

10.1 References cited in report

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Mrabet, R. (2014): "Practical Guide to CA in West Asia and North Africa". ICARDA

Yang, J., Huang, Z., Shang, X. and Reardon, T. (2013) The rapid rise of cross-regional agricultural mechanization services in China. American J Agricultural Economics **95**,1245-512.

10.2 List of publications produced by project

Algeria

Zaghouane, O."L'agriculture de conservation en Algérie" Bulletin des Grandes cultures sept 2013 Institut des Grandes cultures.

Djenadi, F. and A. Laouar.Weed management in CA in North Algeria". Poster publication sent and accepted by the office of the 6th World Congress on CA (WCCA/Canada, 2014)

Other publications in progress:

- Book on weed management and species inventory in Algeria, October 2014
- Book on CA in Algeria, Zaghouane, O., December 2014

Morocco

"Tillage effects on basic properties of a calcareous soil under Moroccan semi-arid climate"
M. Belmeki; University of Science and technique, Hassan 1er, Settat.
M. El Gharous, O. El Gharras, M. Boughlala, and O. IbenHalima; INRA Settat.
And B. Bencherki; University Hassan 1er, Settat.

Tunisia

Djennadi F., Houassin D., Khammassi M., Laouar A., Souissi T. and Tanji A, "control and grain yield losses in conservation cropping systems of North Africa" Forthcoming in Weed incidence

Cheikh M. H., Angar H. and M. Annabi "CA as an alternative to reduce impact of climate change for smallholder in North Africa: The Tunisian case"

Angar, H. "Adoption of CA in Tunisia: Approaches and StrategiesImplemented" INGC publication

Angar, H. "Comparison of Soil Compaction under Conventional Agriculture and CA Practices" Presented at the World Congress on CA. Canada, June 2014

11 Appendixes

11.1 Appendix 1: Acronyms

AusAid: Australian Agency for International Development
ACIAR: Australian Center for International Agricultural Research
ICARDA: International Center for Agricultural Research in the Dry Areas
INRA: Institut National de la Recherche Agronomique (Algeria, Morocco, Tunisia)
ITGC: Institut Technique des Grandes Cultures (Algeria)
IRESA: Institution pour la Recherche et l'Enseignement Supérieur Agricoles (Tunisia)
INGC: Institut National des Grandes Cultures (Tunisia)
FAO: Food and Agriculture Organization
OFRMT: On farm researcher managed trials
OFFMT: on farm farmer managed trials
FFS: Farmer Field Schools
ZT: Zero till
CA: CA
CANA: CA for North Africa

11.2 Appendix 2: Recent research efforts on CA in the North African region.

In **Tunisia**: AFD (Agence Française de Développement) funded project to support the development of CA from 2000 to 2011 focusing on large farmers (the agronomy results will be adapted for testing on smallholder systems);

In **Morocco**: INRA-ICARDA integrated natural resources management project implemented between 2003 and 2011; AAAID (Arab Agency for Agricultural Investment and Development) promoted no-till between 2007 and 2009 (the agronomy results will be adapted for testing under this project);.

In **Algeria**: The Government initiated limited CA activities from 2006 (the results will feed into the fine tuning of the CA systems for testing under this project);

In **Morocco** and **Tunisia**, CIRAD-led EU-funded project (CA2Africa) to assess the impact of CA (2010-2012) (the knowledge of CA successes compiled through CA2Africa project will be used in the finalization of the research designs in this project);

A Mediterranean Network on no-till (RMSD/ Rencontres Méditerranéennes sur le semi direct) involving Algeria, Morocco, Tunisia and other countries from Europe since 2000 (the knowledge of no-till from the network will be used in the finalization of the research designs in this project); .

Appendix 3: Questionnaire used for platform characterization

PROJET D'ADAPTATION DE L'AC EN VUE D'UNE ADOPTION RAPIDE PAR LES PETITS AGRICULTEURS EN TUNISIE
ENQUETE SOCIO-ECONOMIQUE (Campagne 2012-2013)

1. N° de l'enquêté……**Date de l'enquête**……**Nom de l'enquêteur**……

2. Localisation de l'exploitation:

Gouvernorat ……., Délégation ……..……., Imada ……..……..

3. Identification de l'exploitant:

3.1. Nom & prénom:…… ……N° Téléphone……

3.2. Age: ……Expérience agricole (années)……..

3.3. Niveau d'instruction: ☐périeur ☐condaire ☐maire ☐tteb ☐ Sans formation

Formation agricole: Longue…☐…… ☐ Courte……..

3.4. Activité principale: ☐griculture ☐tre activité

3.5. Résidence: ☐ploitation ☐rs exploitation Si hors: Distance/exploitation…….....

Bâtiments: Etable b☐n Etable ov☐ Magasin☐ Hangar ☐ Silo ☐sidenc☐ Autres……

3.6. Ménage: Taille…… Genre féminin …… Actifs dans l'agriculture……. Actifs hors agriculture……. Inactifs ……

3.7. Membre d'une association agricole: ☐i ☐on Si oui, laquelle…….

3.8. Agriculteur encadré : ☐i ☐on

Nature: Expérim☐ation Vulgaris☐n Autre….☐……..

Si oui, source d'encadrement: Administration publique INGC ☐CRDA ☐Privé…..☐…… ☐ Autre…….

Projects: ING☐☐CANA, Food security) ☐ Autre……

3.9. Mode faire valoir :

Propriét☐ Lot techn☐ien Location☐ SMVDA☐ Métayag☐ Gérance ☐ Autres……

3.10. Crédit: Bénéficiaire ☐i ☐n Si oui, nature: C☐dit bancaire C☐dit fournisseur Autres……..

Si non:
Raison……
…

3.11. Etes-vous satisfait par les services du crédit: ☐i ☐n

Si non:
Raison……
…

3.12. Participation aux journées d'information, des sessions de formation: ☐i ☐n

Si oui:
Thèmes……
..

Si non:
Raison……
…

4. Caractérisation de l'exploitation:

4.1. SAT: ……..… ha

4.2. Parcours & Incultes ……....ha

4.3. Parcours collectifs……ha Nombre de bénéficiaires……

4.4. SAU: ……..…ha En pluvial……ha En irrigué……ha

Si Irrigation: Continue☐ Appoint ☐ Source ……..... Débit (l/s)……..

Source d'énergie: Electriqu☐ Carburant☐ Autre…☐……

Modalité: Goutte à ☐utte Aspersio☐ Autre….☐……..

4.5. Assolement: ☐Biennal ……....☐ Triennal …… ☐ Quadriennal …… Autre……

4.6. Activités végétales:

Rubriques		**Campagne 2009/2010**			**Campagne 2010/2011**			**Campagne 2011/2012**		
		Superficie	**Mode (P/I)**	**Rendement (qx-balle)**	**Superficie**	**Mode (P/I)**	**Rendement (qx)**	**Superficie**	**Mode (P/I)**	**Rendement (qx-balle)**
Céréales	**Blé Dur**									
	Blé tendre									
	Orge									
	Avoine									
Fourrages	**Foin**									

Légumineuses	**Féve**									
	Féverole									
Jachère	**Travaillée**									
	Pâturée									
Cult. maraîchères										
Cult. industrielles	**Tabac**									
Arboriculture	**olivier**									

4.7. Production animale:

Catégorie	**Effectif (tête)**	**Effectif min**	**Effectif max**	**Potentiel**	**Système (I-E-M)**	**Rentabilité perçue**			**Principales contraintes**
						Faible	**Moyenne**	**Elevée**	**1-2-3-4-5**
Ovins									
Bovins									

I: Intensif E: Extensif M: Mixte1: Coût 2: Disponibilité M.O 3: Disponibilité alimentation 4- Taille exploitation. 5- Marché

Alimentation:

Catégorie	**Alimentation**		**Pâturage**	
	Nature	**Source (P-A)**	**Durée (mois/an)**	**Source (P-L)**
Ovins	☐ Concentré ☐ Foin ☐ - Paille ☐ 1.1.1.1. Autre……	☐ 1.1.1. ☐ ☐ ☐		
Bovins	☐ Concentré ☐ Foin ☐ Paille Autre……	☐ ☐ ☐		

Caprin	☐ Concentré ☐ Foin ☐ Paille ☐ Autre……	☐ ☐ ☐ ☐		
	☐ Concentré ☐ Foin ☐ Paille ☐ Autre……	☐ ☐ ☐ ☐		

P: Propriété A: Achat L: Location

4.8. Structure du revenu: ☐ agricole (%) ☐ des végétaux (%) ☐ des céréales (%)

Part des légumineuses (%) ☐

5. Topographie et nature du sol:

5.1. Plaine: ……..ha % SAU……

5.2. Pente: ……..ha % SAU……..... Degré: Faible☐ Moye☐ Elevé☐

Part menacée par l'érosion ……ha (%) SAU…….....

5.3. Nature du sol: Léger☐%) …… Lourd☐%) …….. Autre☐%) ……..…

5.4. Hydromorphie: ……..…….ha Part (%)……
Fréquence……..

5.5. Structure foncière: Nombre de parcelles……..
Eloignement……..

6. Parc matériel:

Rubriques	**En propriété**				**De location**				**Prestation de services**			
	Tracteur	**Semoir CV**	**Semoir ZT**	**Pulvérisateur**	**Tracteur**	**Semoir CV**	**Semoir ZT**	**Pulvérisateur**	**Tracteur**	**Semoir CV**	**Semoir ZT**	**Pulvérisateur**
Nombre												
Marque												
Age												
Largeur												
Puissance												
Coût*												
Nb. hrs/Clients												
Surface dans Zone**												

Surface hors Zone**												

Autres matériels:

Désignation	**En propriété**				**De location**		**Prestation de services**	
	Nombre	**Marque**	**Age**	**Coût**	**Nbre. heures**	**Coût**	**Nbre. heures**	**Coût**
Moissonneuse Batteuse								
Epandeur d'engrais								
Véhicule de transport								
Motopompe								

*D'acquisition, si en propriété, et horaire, si location ou prestation de service, ** Si prestation de services

Disposez-vous d'un atelier de maintenance: Oui ☐ Non ☐

Si oui, Type: Petite ☐ rande ☐ Equipement
……..……..

Modification: Oui Non ☐ Nature……☐……

Si non, Lieu de maintenance: Atelier voisin ☐ Prestataire sp☐ialisé Coût annuel
…….

Problèmes de maintenance: Non ☐sponibilité de pièces détachées Main☐'œuvre non spécialisée ☐
Coût élevé

7. Main d'œuvre utilisée:

Genre	**Main d'œuvre familiale**	**Main d'œuvre salariée**	
		Permanente	**Occasionnelle**
Hommes			
Femmes			
Rémunération			

8. Expérience en Agriculture de Conservation:

8.1. Oui ☐ Non ☐

❖ **Si Oui**, depuis quand……..

Evolution:

Campagne / **Culture**	**2010/2011**		**2011/2012**		**2012-2013**	
	Superficie	**Rendement**	**Superficie**	**Rendement**	**Superficie**	**Rendement**

Total						

Par qui étiez-vous informé la première fois?

INGC☐ Voisin impliqué au SD Revendeur machines et produits agricoles ☐
Autres……

Cadre: Expérimentation Journée de formation Séminaire☐

Ecole rurale Commission de suivi Autre☐…….

Si expérimentationsource: INGC (CIRAA, Food Security) ☐
Autre…….

Pratique du semis direct: ☐ Sur chaume ☐ Sur couverture végétale verte ☐
Sol nu

Changement dans la rotation agronomique: Oui ☐ Non ☐ oui
comment……...

Source du semoir: INGC ☐ Propriété ☐ Location ☐ Autre……☐……...

En cas de pratique et de possession:

- Seriez vous intéressé par la modification de votre semoir en vuede :
  - Son utilisation par vous-même Oui ☐ Non ☐
  - Son utilisation pour prestation de services Oui ☐ Non ☐
- Sou quelles conditions:
  - Coût maximal additionnel de modification……
  - Disponibilité de pièces détachées……...
  - Disponibilité de service réparation et entretien…….....
  - Autres……..

Etes-vous satisfait par l'expérience AC ?Non satisfait ☐ Peu satisfait ☐ Satisfait ☐

❖ **Si non: Pourquoi ?**……

- Seriez-vous disposer à en être plus informé Oui ☐ Non ☐
- Seriez-vous disposer à entamer l'expérimentation Oui ☐ Non ☐

- Seriez-vous intéressé par la modification de votre semoir en vuede:
  - Son utilisation par vous-même Oui ☐ Non ☐
  - Son utilisation pour prestation de services Oui Non

9. Avantages et contraintes à l'AC:

9.1. Avantages par rapport au conventionnel [7]

Economie d'énergie	**1**	**2**	**3**
Economie en temps de travail	**1**	**2**	**3**
Atténuation de l'érosion hydrique	**1**	**2**	**3**
Amélioration du rendement économique de la parcelle	**1**	**2**	**3**
Stabilisation du rendement économique de la parcelle	**1**	**2**	**3**
Cultures plus résistantes en période de déficit	**1**	**2**	**3**
Amélioration de la qualité du sol	**1**	**2**	**3**
Diversification des productions	**1**	**2**	**3**
……..	**1**	**2**	**3**
……..	**1**	**2**	**3**
…….....	**1**	**2**	**3**

9.2. **9.3.** **9.4.** **9.5.**
Pourriez-vous hiérarchiser les trois principaux avantages ? **9.6.** **9.7.** **9.8.**

9.2. Contraintes à l'adoption de l'AC

Aversion aux changements	**1**	**2**	**3**
Disponibilité du semoir sur le marché	**1**	**2**	**3**
Prix excessif du semoir	**1**	**2**	**3**
Prix excessif de la location du semoir	**1**	**2**	**3**
Disponibilité du service de location du semoir	**1**	**2**	**3**
Nécessité d'acquisition d'un tracteur puissant	**1**	**2**	**3**
Manque de vulgarisation spécifique	**1**	**2**	**3**
Impact immédiat négatif sur le rendement	**1**	**2**	**3**
Compétition avec l'élevage ovin	**1**	**2**	**3**
Problèmes liés à la manipulation du semoir	**1**	**2**	**3**
Inadéquation taille d'exploitation/semoir	**1**	**2**	**3**
Manque de travail associatif	**1**	**2**	**3**
Pâturage illicite	**1**	**2**	**3**
Problème de compactage du sol	**1**	**2**	**3**
Augmentation des charges de traitement	**1**	**2**	**3**

[2] *Par ordre croissant d'importance*

……	**1**	**2**	**3**
……	**1**	**2**	**3**

Pourriez-vous hiérarchiser les trois principales contraintes ?

9.3. Selon vous, comment peut-on induire une meilleure adoption?

Meilleure information à travers des journées d'information	**1**	**2**	**3**
Meilleur contact avec des voisins expérimentés	**1**	**2**	**3**
D'avantage d'expérience propre (combien……ans)	**1**	**2**	**3**
Travail associatif	**1**	**2**	**3**
Vulgarisation adaptée	**1**	**2**	**3**
Création des prestataires de services	**1**	**2**	**3**
Mesures incitatives spécifiques (subventions, primes, ….)	**1**	**2**	**3**
……	**1**	**2**	**3**

Pourriez-vous hiérarchiser les trois principales mesures ?

Appendix 4: Comparative platform indicators

Platforms / Indicators	Setif (Algeria)	Chaouia-Ouardigha (Morocco)	Fernana (Tunisia)
Climate	**Arid**	**Semi Arid**	**Sub Humid**
Rainfall (mm/year)	**300-400**	**250-350**	**600-700**
Soils			**Silty-clay**
Dominant landscape	**Moderately sloped**	**Sloped**	**Hilly**
Dominant soils	**Light and heavy**	**Light**	**Heavy**
Erosion	**Moderate**	**Moderate**	**Severe**
Organic matter	**Low**	**Low**	**1.5 – 3.5**
Farmers			
Average age (years)	**54**	**56**	**51**
Secondary education (%)	**47**	**44.8**	**32**
Active in agriculture (%)	**63**	**73**	**72**
Male gender (%)	**97**	**100**	**90**
Average household size (number)	**13**	**(0-10 ha) 5.6** **(10-30 ha) 6.9** **>30 ha 8.6**	
Off-farm activities (%)	**4.55**	**3**	**28**
Farms (Based on survey)			
Sample size	**100**	**100**	**150**
Average farm size (Ha)	**< 5 (87 %)** **5-109 %)** **15-30 (3 %)** **>200 (1 %)**	**(0-10 ha) 43%** **(10-30 ha) 33%** **>30 ha 24%**	**< 5 (17,3 %)** **5-10 (30,7 %)** **10-20 (32,7 %)** **>20 (19,3 %)**
Spread of farm size (Ha)			**1-75**
Equipment (% owned)	**89.2**		
Tractors	**55**	**(0-10 ha) 13%** **(10-30 ha) 31%** **>30 ha 81%**	**30 %**
Seeders	**29**	**(0-10 ha) 00%** **(10-30 ha) 07%** **>30 ha 38%**	**6 %**
Direct seeders	**2**	**0**	**0**
Combine Harvesters	**22**	**(0-10 ha) 00%** **(10-30 ha) 09%** **>30 ha 21%**	**6 %**

Spraying equipment	**30**	**(0-10 ha) 00%** **(10-30 ha) 6.25%** **>30 ha 12.5%**	**12 %**
Other equipment	**Fertilizer spreader** **28**	**(0-10 ha) 13%** **(10-30 ha) 29%** **>30 ha 75%**	**Fertilizer spreader** **(6 %)**
Farm activities			
Crops		**(0-10 ha) 3%** **(10-30 ha) 0%** **>30 ha 8%**	
Share of cereals in farm land occupation (%)	**59.3**	**(0-10 ha) 76%** **(10-30 ha) 72%** **>30 ha 73%**	**60 %**
Share of forage crop in farm land occupation (%)	**17.5**	**(0-10 ha) 47%** **(10-30 ha) 57%** **>30 ha 58%**	**6,1%**
Share of feed legume in farm land occupation (%)	**2.6**	**(0-10 ha) 10%** **(10-30 ha) 10%** **>30 ha 05%**	**19 %**
Livestock			
Average cattle herd size (Heads)	**5.52**	**05.67**	**5**
Average sheep herd size (Heads)	**23.2**	**30.40**	**9**
Other animals (Heads)	**1.24 (goats)**	**3.00**	
Natural graze land (Ha)	**8-9 months/year**	**(0-10 ha) 13%** **(10-30 ha) 16%** **>30 ha 20%**	
Other farm assets			
Barns (%)		**(0-10 ha) 80%** **(10-30 ha) 100%** **>30 ha 100%**	
Crop storage facilities (%)		**(0-10 ha) 20%** **(10-30 ha) 80%** **>30 ha 100%**	
Feed storage facilities (Indicate)		**(0-10 ha) 0%** **(10-30 ha) 20%** **>30 ha 40%**	
Attitudes towards CA			

Heard of it prior to CANA project (%)	**14**	**5**	**45 %**
Think advantageous (%)	**77**	**100**	**90 %**
Adopt if conditions are met (%)	**100**	**100**	**90 %**
Major perceived constraint(indicate)	**Price of seeder**	**Seeders, Information**	**High price of seeder**

11.5 Appendix 5: Log frame of project planned activities

Project logic	Verifiable indicators	Means of verification	Key assumptions/risks
Aim: Promote adoption of CA practices to reduce natural resource degradation, and to increase productivity, profitability and sustainability of the crop/livestock systems in North Africa	Natural resources degradation, production, profitability and sustainability of crop/livestock systems	Adoption/impact reports Follow-up case studies of randomly-selected farmers and households Cost-benefit analysis reports	Governments invest in CA and enact favourable policies
Outcomes			
1: wider adoption of CA among small and medium-scale farmers in North Africa	# farmers and contractors using ZT Area under CA	Adoption/impact reports Follow-up case studies of randomly-selected households Cost-benefit analysis reports	Enabling institutional and policy environment; effective research-extension-farmers-private sector linkages
2. Affordable ZT seeding machinery available through local manufacturing	# seeder manufacturers # ZT seeders sold # ZT seeding machinery service providers	Adoption/impact reports Follow-up case studies of randomly-selected manufacturers Cost-benefit analysis	Private sector collaborate Enabling policies
3: improved productivity, profitability and sustainability of cereal crop-livestock systems in North Africa	- improved household income -improved soil quality and moisture conservation -# alternative feed resources included in the feeding calendar	- Social, economic and environmental impact reports - project technical reports and publications	Small and medium-scale farmers adopt CA practices. Small –scale farmers have access to new feed resources
4. improved capacity of NARES, farmers, NGOs, machinery manufacturers, and agricultural institutions to plan and implement natural resources conserving practices in Tunisia, Algeria, and Morocco and 3 neighbouring countries (Libya, Mauritania and Sudan)	# staff trained # farmers and other stakeholders trained -Institutionalization of CA programs in R&D projects	-Training reports -Impact study reports - National R&D reports	Governments invest in CA institutionalization and training, and enact favourable policies
Objectives			
1. To identify constraints to adoption of CA by small holder farmers and ways of enhancing adoption, most importantly identifying and testing socio-economic options	- Farmer baseline and adoption surveys - 100 household surveys - Typology of production systems -Type and # of constraints -Type and # of recommended options - Environmental similarity analyses	-Survey reports - Databases -Adoption reports - Similarity maps	Availability of secondary data Farmers collaborate

Project logic	Verifiable indicators	Means of verification	Key assumptions/risks
2. To identify and test improvements in seeding machinery, and in weed and biomass management of CA systems : 2.1. Develop and test affordable ZT seeding machinery and crop establishment systems for small to medium-sized farms; 2.2 Fine-tune weed management and crop sequences for sustainable land and water management; 2.3. Optimize crop residue management and test alternative livestock feeding systems under CA	2.1. -Inventory of available ZT seeders and selection of appropriate type(s) -# ZT drill prototype(s) developed # of ZT drills manufactured 2.2. Best integrated crop and weed management developed & validated -APSIM model calibrated & validated 2.3 -Optimization of crop residue management - # alternative feed resources - Calibration & validation of decision-making model	Annual workplans and technical reports 2.1.- Reports - ZT drill prototype - Business register of manufacturers 2.2. Reports -APSIM documentation 2.3. Reports - Decision making model documentation	- Farmers collaborate - Manufacturers invest in low-cost ZT -
3. To enhance the capacity of NARES staff and other stakeholders to practice and promote CA	# training events/modules # Farmers field schools #NARES, farmers, & other stakeholders trained	-Annual workplans and technical reports - Training manuals and extension brochures - ICARDA capacity development database	-NARES select suitable candidates