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1.1 List of Abbreviations:

- AAID:** Arab Authority for Agricultural Investment and Development - Sudan
- ACIAR:** Australian Centre for International Agricultural Research
- ACSAD:** Arab Center for the Study of Arid Zones and Dry Lands - Syria
- ACT:** Network: Africa Conservation Tillage Network
- ADA:** Agence pour le Développement Agricole – Morocco (Agency for Agricultural Development)
- AFD:** Agence Française de Développement (French Agency for Development)
- AGENDA:** AGriculture, ENvironnement et Développement pour l’Avenir – Morocco (Agriculture, Environment and Development for the Future)
- APAD:** Association Pour l’Agriculture Durable – Tunisia (Association for Sustainable Agriculture)
- ARC:** Agricultural Research Centre – Libya
- ATMAR:** Les Ateliers Marocains (*Moroccan Workshops Company*)
- AusAid:** Australian Government Overseas Aid Program
- AUSTRADE:** Australian Trade Commission
- CA:** Conservation Agriculture
- CFMA:** Centre de Formation en Mechanisation Agricole – IAV II – Morocco (Technical Training Centre in Agricultural Mechanization)
- CGIAR:** Consultative Group on International Agricultural Research
- CIMMYT:** International Maize and Wheat Improvement Centre - Mexico
- CIRAD:** Centre International de Recherche Agronomique pour le Développement - France (International Agricultural Research Centre for International Development)
- COMICOM:** Compagnie Marocaine Industrielle et Commerciale (*Industrial and Commercial Moroccan Company*)
- CRRA:** Centre Régional de la Recherche Agronomique – Morocco (Regional Centre for Agronomic Research)
- CTC:** Centre Technique des Céréales – Tunisia (Technical Centre for Cereals - now INGC)
- DDFP:** Direction du Développement des Filières de Production – Morocco (Directorate for the Development of Commodity Production Chain)
- DERD:** Direction de l’Enseignement de la Reserche et du Développement - Morocco (Directorate of Education, Research and Development)
- DIAEA:** Direction de l’Irrigation et Aménagement de l’Espace Agricole – Morocco (Directorate of Irrigation & Management of the Agricultural Landscape)
- DSS:** Direction de la Stratégie et des Statistiques – Morocco (Directorate of Strategy and Statistics)
- ENA:** Ecole Nationale d’Agriculture (de Meknes) – Morocco (National School of Agriculture of Meknes)
- ESAK:** Ecole Nationale d’Agriculture du Kef – Tunisia (National School of Agriculture of Kef)
- EU:** European Union
- FAO:** Food and Agriculture organisation – Italy (RNE: Regional Office for the Near-East)
- FFEM:** Fonds Français pour l’Environnement Mondial – France (French Funds for World Environment)
- GDP:** Gross National Product
- GMP:** Green Morocco Plan
- IAV:** Institut Agronomique et Vétérinaire (Hassan II) – Morocco (Agronomic and Veterinary Institute Hassan II)
- ICARDA:** International Centre for Agricultural Research in the dry Areas – Syria
- INAT:** Institut Agronomique de Tunisie (Agronomy Institute of Tunisia)
- INGC:** Institut National des Grandes Cultures – Tunisia (Formerly CTC)

INRA: Institut National de la Recherche Agronomique – Morocco (National Institute of Agronomic Research)

INRAA: Institut National de la Recherche Agronomique d’Algérie (National Institute of Agronomic Research of Algeria)

INRAT: Institut National de Recherche Agronomique de Tunisie (National Institute of Agronomic Research of Tunisia)

IRESA: Institution de la Recherche et de l’Enseignement Supérieur Agricoles – Tunisia (Institution for Higher Agricultural Education and Research)

MALR: Ministry for Agriculture and Land Reclamation - Egypt

MAPM: Ministère de l’Agriculture et de la Pêche Maritime – Morocco (Ministry of Agriculture and Fisheries)

MARHP: Ministère de l’Agriculture, des Ressource Hydrauliques et de la Pêche – Tunisia (Ministry of Agriculture, Hydraulic Resources and Fisheries)

MWRI: Ministry for Water Resources and Irrigation - Egypt

NARP: North Africa Regional Programme (ICARDA)

NARS: National Agricultural Research System (Morocco)

NT: no-till / no-tillage

PADAC: Projet d’Appui de Développement de l’Agriculture de Conservation (Support Project for the Development of CA)

PMV: Plan Maroc Vert – Morocco (Green Morocco Plan)

PNTTA: Programme National de Transfer de Technologie en Agriculture (Morocco)

R&E: Research and Extension

SANTFA: South Australian No-Till Farmers Association

ZT: Zero-till / zero-tillage

2 Scoping Mission Summary

2.1 Executive Summary

Mission Overview

A CA Scoping Mission to North Africa was conducted from July 17th to 30th 2010. The Mission was led by Dr Jack Desbiolles, with other team members comprising Dr Jay Cummins, Dr Colin Piggin and Dr Mohamed El Mourid (refer to attachments for contact details). This report; *“Developing a Regional Conservation Agriculture Hub for North Africa: scoping study assessment”*, represents the reported outcomes from the Scoping Mission. The Scoping Mission involved technical visits in Morocco from July 17th to 20th and Tunisia from July 21st to 25th, followed by a two day workshop focussing on CA on July 26th to 27th in Tunisia involving scientists from Morocco, Tunisia, Algeria, Libya, Sudan and Eritrea). At the conclusion of the North Africa Scoping Mission, members of the Scoping Mission Team also met with the Australian Ambassador H.E. Stephanie Schwabsky in Cairo for a debrief session on the 29th July.

Moroccan Visit

The Scoping Mission team visited Morocco from July 17 to 20th 2010. Field visits to the Chaouia-Ouardigha region were undertaken, where the team visited INRA/CRRA in Settat, which have been long involved in CA and visited a farmer cooperative (Khemisset-Chaouia) practicing direct seeding, complemented by discussions with research scientists relating to CA research and adoption. There was a good exchange of information and ideas between participants, and it was evident there was broad engagement taking place between research and extension personnel, farmers and farmer associations on development and adaptation of CA systems, notably the development of no-till seeding systems, but only limited adoption.

A number of meetings was conducted with NARS (National Agricultural Research System of Morocco) including INRA (Institut National de la Recherche Agronomique with input by Professor Mohamed Badraoui), IAV (Institut Agronomique et Vétérinaire Hassan II), ENA (Ecole Nationale d’Agriculture de Meknes), as well as Directors representing Extension and Development Directorates linked to the Green Morocco Plan (ADA, Agence pour le Developpement Agricole), machinery manufacturers and industry. The Scoping Mission team was also joined by the AUSTRADE representative to Morocco, providing him with an appreciation of the scoping mission objectives, and opportunities for enhancing agricultural production systems in this region.

Feedback from Moroccan Ministerial Directors emphasized the high level of commitment that the Moroccan Government has towards the development of CA systems, complemented by ‘in principle’ support for any project which might eventuate as a result of the scoping study, with potential links to initiatives being developed under the ‘Green Morocco Plan’. The commitment of the Moroccan Government is further demonstrated through H. E. The Minister of Agriculture having given his instructions to feature CA as a priority in the collaboration with Australia following his visit to Australia earlier in the year.

Tunisian visit

The Scoping Mission team participated in field visits in Tunisia from July 21st to 25th 2010. During the first two days, field visits focusing on CA development (primarily no-till farming systems) were carried out, targeting the Beja and El Kef agricultural regions of Northern Tunisia. The team had the opportunity to interact with many farmers, farmer associations, and research and extension personnel, providing a practical and realistic overview of the current state of knowledge and development and the challenges and opportunities associated with the development of no-till seeding techniques, and broader issues associated with the development of CA farming systems. The team was received by the Institute of Agricultural Research and Higher Education (IRESA) and

visited the El-Kef Higher School of Agriculture (ESAK) and the National Institute for Field Crops (INGC) which are both involved in research and promotion of CA, as well as the National Agronomy Institute of Tunisia (INAT) - Higher Education. Interaction with a major private machinery importer of Brazilian no-till seeding equipment (Cotugrain) provided an insight into the commercial drivers of no-till development in Tunisia (and the wider Arab world), where adoption has been limited to the larger farms, reflecting the high cost of ownership of imported machinery. Valuable discussions were held with APAD, a farmer based NGO focused on the promotion of sustainable agriculture to Tunisian farmers, who are extremely active in working with and engaging farmers and research specialists.

The group met with Senior Directors of the Agriculture Ministry and Educational sectors, including Professor Mougou Abdelaziz, President of the country's research and higher education umbrella IRESA, the Institution de la Recherche et de l'Enseignement Supérieur Agricoles. H.E. The Minister of Agriculture, Hydraulic Resources and Fishing, Abdessalem Mansour, received the Mission on Saturday 24, 2010 and stressed his support for CA and looked forward to strengthening relationships and future project collaboration with Australia and ICARDA.

The field visits provided an important element of identifying the opportunities and constraints to the development of CA systems across Northern Africa. It was clear that there is great potential for narrowing the yield gap through improving presently low crop water use efficiencies, based on Southern Australian dryland cropping systems experiences and farming system contexts, which notably have very similar agro-ecological environments. Such outcomes will assist in reducing production and farm income variability (thereby contributing to poverty reduction), effectively contribute towards food security across the region, and assist in building the capacity of all stakeholders, including small to medium farmers.

Scoping Mission Workshop, Tunisia

A two day workshop on "Conservation Agriculture: Constraints and Opportunities in the North African region" was conducted in Tunis on July 26th and 27th. The workshop was attended by participants from Morocco, Algeria, Tunisia, Libya, Eritrea, Sudan, and FAO, and Ms. Erny Wah (third secretary to and representing H.E, The Australian Ambassador to Cairo and non-residential representative to Tunisia).

Day one of the workshop provided opportunity for country representatives to present a situational analysis of CA research, development and extension in their respective countries. Key areas covered included current project initiatives, barriers and limitations to the development of appropriate CA systems. Additional presentations were provided by Australian participants, including an overview of the development and adoption of no-till and CA systems in Australia, participatory extension systems, in addition to the achievements of current ACIAR Northern Iraq dryland farming systems / CA project. This provided an excellent forum to discuss and share experiences and ideas, and develop a common understanding of the key elements of conservation agricultural systems in the region.

Day two sought clarification in relation to the constraints and opportunities for the development of improved farming systems across the region, with a focus upon CA systems. Participants reflected and then focused on a range of opportunities and potential for systems improvement and capacity development. Leading on from this, participants developed a framework for a potential future project, centered on the concept of a regional network (hub) for CA in this region. Project aims, objectives, and priority activities were discussed and agreed. The role of ICARDA in providing future coordination inputs associated with a potential project was recognized, given its current role in supporting the development of dryland agriculture across the region, and its relationships with all north African countries and organizations engaged in agricultural research, development and extension. Participants also felt that it was a priority to engage Mauritania in the development of a future project, given their geographical proximity to the region, and engagement in other programs with targeted partner countries of the Maghreb.

It was agreed that a future project should be built around the following key areas of opportunity;

1. Adoption and impact analysis;
2. Participatory extension of integrated CA systems, targeting small, medium and large farmers;
3. Verifying and adapting technology appropriate to the region in order to develop CA systems (including crop water use, yield potential, agronomy, machinery and seeding systems development);
4. Development and access to effective and affordable no-till seeding machinery equipment for all farmers, and in particular the small to medium sized farmers;
5. Information sharing and knowledge exchange as part of a regional network of organisations, farmers and other stakeholders;
6. Training and capacity building for research, extension, farming organisations, farmers and industry.

2.2 Key Recommendations

The Scoping Mission team, following its field visits, extensive consultation and engagement with stakeholders, and utilizing outcomes arising from the workshop in Tunisia, provides the following recommendations;

1. **The need for a project;** there is the opportunity to develop a CA project focussing on the Maghreb region of Northern Africa, and including Sudan and Eritrea. Whilst the Tunis workshop included Morocco, Tunisia, Algeria, Libya, Sudan and Eritrea, the group of participants collectively considered that Mauritania should be included in a future project, due to its geographical relevance and engagement in other regional agricultural projects.
2. **Project length;** in order to initiate valuable impact through the development and promotion of suitable CA systems in the region, a Phase 1 project needs to have a minimum duration of 5 years.
3. **ICARDA as a lead networker and coordinator;** there is general agreement that a future project should utilise existing networks in the region, particularly those associated with activities linked to ICARDA. A future project on CA is very much about building on current initiatives and activities across the region, rather than setting up new structures and networks. This approach will assist in maximising impact in the short to medium term. Utilising ICARDA as a key networking organisation for the region will help to achieve the following outcomes;
 - a. ensure that efficient project systems are put into place, in terms of securing country cooperation and participation (through formal project agreements) in a timely manner;
 - b. provide a key agency to assist in distribution of 'seed project' funds for specific initiatives that may be linked to a future project, and assist in ensuring accountability and delivery of project investment outcomes for the benefactor countries;
 - c. ensure complementarities in relation to existing project initiatives, and help to provide recommendations on where resources are best allocated, in line with the relative needs of participant countries, and opportunities for maximising project impact;
 - d. assist in 'adding value' to project initiatives, either through integrating complementary projects, or identifying other sources of co-funding to expand the impact of project outcomes;
 - e. provide a degree of 'independence' in relation to securing cooperation amongst all partner countries identified as participants in a future project;
 - f. provide access to regional expertise, for assistance in developmental, training and mentoring roles associated with future project activities.
4. **Regional Network concept;** workshop participants considered that a future project should be described as a 'regional network', as opposed to a 'regional hub' relating to the development of CA. This point of clarification generally reflected particular interpretations of

a 'hub' versus 'network', the most important element being that both achieve the same outcomes from a future project investment. The network would facilitate partner interactions and access to information and training, as well as provide a central focus for CA development in the region.

5. **Integrated linkages**; in developing a future project, it is recommended that:
 - a. The emphasis upon a future project needs to be that of information and knowledge sharing between participant countries;
 - b. The opportunity for specific countries to provide specialised input, or to be recognised as 'centres of excellence' in defined areas associated with CA needs to be explored, in order to avoid duplication of effort, and to provide recognition of expertise and experiences and mechanisms for the pooling of resources and sharing of information and knowledge;
 - c. There is a range of specific targeted areas of training and capacity development where Australian expertise can make a valued contribution to the project, and in turn achieve significant impact in the development of CA across the region. It is the 'Australian system's approach' that provides a real opportunity to develop innovative CA systems, given the agro-ecological similarities between the north African countries and Australia and the demonstrated productivity gains achieved in Australia's low rainfall Mediterranean environments through the development of adapted CA systems;
 - d. There is the need to form dedicated linkages with Australian research and development organisations, to access key expertise and practical experiences as part of a future CA project. These include Rural Solutions SA, the University of South Australia, the University of Adelaide, and the South Australian No-Till Farmers Association (SANTFA).
 - e. There is a real opportunity to boost the role of farmer based NGOs such as APAD (Tunisia) and AGENDA (Morocco) in expanding the adoption and quality of CA in the region, drawing on the no-till farmer association experiences in Australia.
6. **An adaptive research approach**; a future project will require strong elements of adaptive research, in order to ensure that activities are developmental, participatory and integrated in nature to achieve impact as follows:
 - a. Capacity building of scientists engaged in the research, development and adoption of CA, ensuring that sound research principles underpin the development of CA systems;
 - b. Development of open information sharing through agricultural knowledge information systems that engage research, development, extension, agribusiness and farmers (the 'stakeholders') in a manner which assists in the development and adaptation of CA systems;
 - c. Built upon successful initiatives already in place by a number of the participant countries using on-farm research and demonstration approaches;
 - d. As part of developing an adaptive research model, it is critical that a systems approach is adopted, in order to capitalise upon the advantages of integrated agronomic management;
 - e. Assist in developing and promoting a risk management framework, taking into consideration the impacts of environmental and climate change, as well as operational, social and political risks;
 - f. Engagement of 'key farmers' and farmer-based organisations from both the Maghreb region and Australia, in order to provide a practical conduit for CA systems development and information exchange.
7. **Targeted approaches**; a future project requires a clearly targeted approach to identifying where the impact of introducing CA systems can be greatest, both in area of land under management (industry and environmental impacts) and number of farmers (stakeholder impact). This will require:

- a. Working across a range of farm sizes in different regions, to develop and adapt CA systems appropriate to varying agro-ecological zones. Additionally, an understanding of the variations in the socio-economic characteristics of farmers, including management of risk, gender equality, and supporting and targeting farmers considered to be 'at risk', will be essential to the project. Whilst mechanised CA systems have been best demonstrated and adopted by the larger farmers, it is with the small to medium sized farmers where a greater impact on livelihoods and poverty can be achieved, and such a future project needs to focus on these demographics.
 - b. Recognizing the reality of achievable levels of 'conservation' when developing locally adapted CA systems, while lower levels (e.g. direct seeding into harvested/heavily grazed stubble) are mostly being implemented in research and adoption to date, due to the high reliance on the straw market for farm income stability. Realistic pathways to adoption of soil fertility and water use efficiency enhancing livestock/cropping systems need to be developed and promoted.
8. **Socio-economic constraints to adoption;** While studies on the socio-economic aspects of Maghreb agriculture were highlighted during the visit, no significant studies associated with the adoption characteristics of CA amongst farmers from across the region were identified. A future project needs to identify what CA specific studies have been conducted in this area, and if there are specific information gaps, to assist in facilitating local adoption surveys amongst participant countries. A proper situational analysis will be a critical element in developing appropriate systems into the future.
 9. **Development and adaptation of appropriate machinery;** Machinery was identified as a key constraint to the widespread adoption of CA in the North African region. There is a need to develop and adapt an array of machinery solutions appropriate for CA across a wide range of cropping and farm size contexts. Whilst current systems in the Maghreb are mostly based upon the use of expensive imported zero till disc seeders (including development projects funded by AAAID), there is the need to also consider tine seeders, which are widely used in Australia, together with promotion of local manufacture to reduce cost, increase affordability and availability, and encourage easily-accessible modification and maintenance capacity. A key element of a future project will involve the development of simple yet reliable machinery which is affordable and effective for small to medium farmers, who are likely to be encouraged to purchase from savings from eliminating ploughing. Linking future project activities to current machinery development activities associated with the ACIAR Northern Iraq project can provide alternate models of development of self-sustaining industry providing locally suited seeding machinery.
 10. **Machinery syndication and contracting;** there is the need to explore alternate models of machinery ownership/rental such as syndication, farm cooperatives and contract services for crop sowing operations utilising zero till seeding equipment. Some machinery access options (leasing, contracting) are currently promoted within the Green Morocco Plan (1st and 2nd pillars), while farm cooperative are widespread in both Morocco and Tunisia. The influence of government subsidisation of low cost machinery to specifically assist the adoption of CA systems across a wider audience of farmers needs to be explored, and guiding principles developed.
 11. **Integrated agronomic management and capacity building;** it is evident that there is the need to build the research and development capacity associated with the overall agronomic management of a CA system, including water use efficiency, crop sequencing, seeding rates and time of seeding, soil and plant nutrition, integrated pest and weed management, integrated livestock/cropping systems. The development of CA systems for the Maghreb region has tended to focus upon the development of the crop seeding system, and whilst such efforts have technically been successful in varying degrees, there is the need to address emerging systems issues, especially those associated with overall agronomic management.

12. **Specialised training initiatives**; a future project needs to provide specific training and development opportunities for project participants, which assist in addressing a range of the technical and socio-economic constraints to the development, adaptation and adoption of conservation farming systems across the region. This can be achieved through providing the following;
- a. Specialist technical training workshops in the region;
 - b. Study tours within the region, as part of the CA network sharing activities;
 - c. Study tours to Australia, for targeted training addressing specific needs.
 - d. CA information sharing within the region via dedicated literature
- Linked to this is the need to define core competencies, and undertake an audit of current and desirable skills for research, extension and farmer participants that will assist in capacity building of all participants, and achievement of project outcomes.

13. **Tertiary education sector engagement**; there is the need to engage with, and include tertiary education providers from across the Maghreb region to;
- a. Develop awareness and influence attitudes and teaching of academics towards the benefits of CA systems and recognition of the many negative aspects of ploughing;
 - b. Assist in promoting knowledge of CA as part of the academic curriculum, including the development of specific teaching resources and packages in undergraduate courses;
 - c. Include the tertiary sector as part of the information and knowledge sharing network associated with the project;
 - d. Encourage and support applied research activities linked to CA undertaken by the institutions, so they provide opportunities for post-graduate students.
 - e. Encourage postgraduate training in Australia in key areas of CA (e.g. agronomy, farming system, machinery, and extension) as pathways to developing capacity in the region.

14. **Improving crop water use efficiencies (water productivity)**; elements of a future project need to explore specific crop water use efficiency models, to compare current and potential production – noting differences in efficiencies between the Mediterranean environments of the wider Maghreb region and Southern Australia. Information supplied during the scoping mission would suggest that crop water use efficiency values are much below those achieved in southern Australia. Comparable systems of analysis are needed to confirm these observations and identify the reasons for the gaps.

15. **A regional approach to food security**; there is the potential to significantly increase production of grains across the region, providing the opportunity for improved yield stability and increased food security for the region and beyond. In the longer term, a future project needs to identify and establish an understanding of current grain trading and supply demands both within the region and to other African regions (such as sub-Saharan Africa), with future demands likely to be based upon population increases. Supply and demand dynamics, and the need to address regional food security, are key elements that need to be understood, and taken into consideration for longer term planning. An appreciation of such elements and sharing of local intelligence will assist in setting productivity improvements and targets.

3 Introduction and background

3.1 Background to the Scoping Mission Study

Achievement of food security in the marginal dryland agriculture zones of North Africa is considered by many organisations (including Governments) operating throughout this region to be limited by highly variable crop production. Low and variable production is symptomatic of the frequent incidence of drought, poor crop management, inadequate crop and soil nutrition, poor crop water use efficiency, and land degradation. Reflecting this situation is food insecurity and persistent poverty.

Following a Ministerial meeting conducted between Australia and Tunisia earlier in 2010, the development of dryland agriculture in North Africa was identified as an area requiring further investigation by both countries. The Head of Mission to The Australian Embassy in Egypt proposed an AusAID-ACIAR funded project to address this very important need.

The project concept builds on the South and Western Australian technical assistance on dryland agriculture to North African countries conducted during the 1970s and 1980s, focused on improved tillage and cereal-medic rotations; and the successful current AusAID-ACIAR CA activities in Northern Iraq.

The Scoping study has very closely interacted with ICARDA (International Center for Agricultural Research in the Dry Areas – Aleppo, Syria and Tunis, Tunisia), associated in particular with AusAID-ACIAR funded project CIM/2008/027 “Development of conservation cropping systems in the drylands of Northern Iraq” through Dr Colin Piggin (Project Leader) and with an EU funded project (7th Framework programme) *CA2Africa* -“Conservation Agriculture in Africa: Analysing and Foreseeing its Impact – Comprehending its adoption”.

Other regional centres affiliated with the Consultative Group on International Agricultural Research (CGIAR), such as CIMMYT – were also consulted. Under its Conservation Agriculture Programme, (Leader: Dr Pat Wall), CIMMYT is associated with ACIAR project CSE/2009/024 “Sustainable Intensification of maize-legume cropping systems for food security in Eastern and Southern Africa – SIMLESA”).

3.2 Terms of Reference

The scoping mission’s terms of reference were as follows:

1. Assess CA research, education/training and extension capacity (e.g. key institutions and staff, current programmes, recent achievements) in both Morocco and Tunisia and in four other countries of the region;
2. Assess opportunities for relevant linkages to Australian and regional (e.g. CIMMYT, ICARDA, CIRAD, FAO-RNE, ACT network) institutions;
3. Identify research challenges for successful conservation farming systems in the region;
4. Identify extension challenges for improved adoption of conservation farming systems in the region;

5. Analyse the situation of the CA machinery industry in the region;
6. Develop a general road map for the implementation of a regional hub on CA, likely based in Tunisia, delivering mentored adaptive research and advanced training to scientists/extension staff in the region, with outreach activities to areas of poverty in the region and active support from, and linkages with, Australian and regional institutions;
7. Collect and synthesise key literature and contacts assisting with the above.

3.3 Outputs

The Scoping Mission aimed to identify opportunities for a long term partnership with North African regional and Australian Institutions. The intended outputs of this scoping mission project were to:

1. Identify and propose a strategic approach to the development of a regional CA research and training hub; potentially to be centred in Tunisia. The hub potentially would;
 - develop regional adaptive research and extension capacity associated with CA, with the view of achieving increased impact in terms of CA adoption and extension outreach to agricultural regions of higher poverty incidence,
 - facilitate information exchange on CA between partner countries,
 - form linkages with Australian institutions as well as other regional based organisations such as ICARDA and CIMMYT.
2. To identify, and provide an improved understanding of;
 - the challenges and opportunities for enhancing the adoption of CA in the region, including equity and participation issues,
 - the level of capacity of research and extension personnel relating to CA, participatory extension (and areas of required skill development)
 - the applicability and adaptability of Australian CA practices, system's approach and technologies to the region, including areas of high poverty rates and gender considerations.
3. Assess the feasibility and provide recommendations for a future project (Phase 1) centred upon the establishment of a regional CA hub, that may address the following characteristics and outcomes;
 - form a regional network of countries from across the region, who as a part of a regional hub would collectively identify, develop and implement a range of programs related to building the capacity of CA research and extension amongst scientists and extension specialists
 - contribute to an improved programme of adaptive field research and evaluation of innovative technologies for the development of CA in the region
 - identify strategies to enhance the adoption of CA systems across the region, targeting those farming communities where there is a higher incidence of poverty, and / or the need for improved access to such technologies and farming systems improvement
 - clearly define key targets for enhancing CA through implementation of improved practices that would aim to achieve a range of targeted outcomes (e.g. increased adoption of CA practices, positive contributions to poverty reduction and gender inequality, up-skilling of research and extension personnel, and farmer skills), that will be largely implemented by the countries of the region (with an impact over a 10 year period).

3.4 Scoping Mission Team Members

The scoping mission team members selected provided the combined expertise to cover the key areas linked to addressing the project's terms of reference, encapsulating agronomy and farming systems development, CA and machinery design (including seeding systems), rural development, and participatory extension. The collective international experience of the team members is representative of the major cropping zones globally. The team selected for the scoping mission comprised:

- Dr Jack Desbiolles, Agricultural Research Engineer, Institute for Sustainable Systems and Technologies, University of South Australia, Adelaide (Scoping Mission Leader).
- Dr Jay Cummins, Principal Consultant, Global Food and Agri-Systems Development, Rural Solutions South Australia, Adelaide (Project Leader).
- Dr Colin Piggin, ICARDA, Aleppo – Syria. Leader of ACIAR Project CIM/2008/027 “Development of conservation cropping systems in the drylands of Northern Iraq”
- Dr Mohammed El-Mourid, ICARDA, Tunis - Tunisia. Regional Coordinator, North Africa Regional Programme (NARP).

3.5 Scoping Mission Approaches

A scoping mission to the North African region was conducted from July 17th to 29th 2010. The mission utilised a range of approaches and methodologies that aimed to address the terms of reference for this project. These included:

- undertaking site visits to significant institutions and stakeholder organisations from across the region, observing field research sites, zero-till fields, seeder technologies,
- engaging with, and acquiring information from industry representatives involved in CA research, development and extension programmes;
- meeting with senior officials from a range of Government departments and supported research and education institutions, and discuss existing initiatives;
- conducting a two day discussion workshop in Tunisia, attended by key specialists engaged in research and extension activities linked to CA from countries of the Maghreb region (Morocco, Tunisia, Algeria and Libya) and the broader North African region such as Sudan and Eritrea.

4 Scoping Mission Discoveries (related to TOR)

4.1 Agriculture and CA context for Morocco and Tunisia

Morocco

Agricultural context

Agriculture generates 14-25% of GDP depending on the nature of the growing season. The arable land area is only 13% of the total land area and represents 9.2 million hectares (1.7M ha irrigated) with an estimated 1.66M farm holdings.

Some 50% of Morocco's population lives in rural areas, 80% of whom are employed in agriculture. Around 45% of farmers are more than 55 years old. Morocco's population currently exceeds 30 million, and is projected to grow to in excess of 39 million by 2025.

Most farmers operate small areas, with 73% of farms having less than 5 ha (representing 25% of total arable area), whilst only 0.7% have more than 50 ha (representing 16.8% of total arable area). Cereal cropping represents 5.3 M ha, or 60% of the total arable area. Of this, around 500,000 ha are irrigated. Wheat is mainly grown under wheat-fallow or mainly continuous cereal cropping systems, with only a small proportion of arable area (6.5%) producing food legumes or forage crops, used in rotations.

The major challenges facing the development of Moroccan agriculture include soil degradation (erosion with associated downstream sedimentation, low and decreasing soil organic matter and soil compaction), drought and rainfall scarcity, rising food and energy demand and cost.

As the majority of farmers have livestock (mainly sheep, but also goats and cattle), a major feature of Morocco's agriculture (also valid for the Maghreb region) is the livestock/cropping integration and the associated market for both grain and straw. Cereal yields of grain and straw are equally important. Price of straw can provide much higher returns in poor years, and shift from grain to hay crops often occur in less favourable seasons. Weeds also are considered as an important source of forage by farmers. A major issue is lack of residue cover where livestock are so important.

Under the Moroccan Mediterranean climate, rainfall is typically concentrated in winter months (October-March), while summers are hot and dry. The effects of climate change seem to be a reduction in both the amount of rainfall and the period of its occurrence. Soils in the semi-arid areas (70% of Moroccan agriculture is in semi-arid and arid zones with 250 – 450mm annual rainfall) are often erosion sensitive with low/medium natural fertility and low organic matter. Cropping issues include poor soil structure (compaction), surface crusting, stoniness, shallow depth and low water holding capacity. Average cereal yields vary from 0.4t/ha (unfavourable arid areas) to 1.7t/ha (favourable semi-arid areas), and 2.5t/ha (irrigated areas).

Mechanised drill seeding is estimated to be used on up to 30% of the cereal cropped area by farmer-contractors who commonly provide tractor-based plough/harrow services. The balance in cropped area is managed by seed broadcasting and incorporation. High seeding rates (180-200kg/ha) are common practice when broadcast establishment. There is a farmer perception that high yield is linked to thick crops. Conventional tillage practice involves deep working with heavy duty harrows ('Stubble plow') followed by disc harrowing (2 passes) and machine sowing or seed broadcasting between harrow passes. Disc ploughs are not used so much anymore except in irrigated cropping. Chisels are recommended by the Ministry of Agriculture for soil conservation.

Overview of conservation agriculture technologies and adoption characteristics

Adoption of CA in Morocco has been minimal with an estimated 6,000 ha currently under no-tillage, out of 5.3 M ha under cereal cropping. Two adoption pathways occurred, namely i) large farms buying imported zero-till drills such as Kuhn (imported by Comecom) with five seeding units

currently serving an estimated 5000ha and ii) INRA CRRA-Settat's efforts with on-farm projects with 32 direct seeders made to date (12 and 15 rows at 20cm spacing, based on the prototype developed in 2003, and with 15 still in operation). There is a general industry reluctance to support this emerging no-till machinery market due to the reduced mechanisation requirements, lower sale potential associated with a no-tillage system, and an understandable lack of farmer enquiry and demand.

Large farms include that of Mr Zine El Abidin Aziz; 800 ha near Meknès now fully under CA. Mr Zine Abidin is a self-made enthusiast who started experimenting with 20 ha under direct seeding in 2006, quickly achieving great success under drought conditions of 160mm rainfall (normally >450mm zone). The strongest benefits to date have been robust soil erosion control during large downpours (e.g. 180mm in 1 week). Overall experience to date highlights at least similar cereal yields in normal years with much improved yields in poor years as well as in bean crops overall, and much less weed germination (use of glyphosate knock-down and manual labour – 20-25 man days/ha - in wide row spacing crops as main control methods). Mr Aziz maintained a conventional control area for comparison and produced documented results, published in a newsletter article (*Monthly Bulletin No 163 from PNTTA – Special issue on Direct seeding – MAPM/DERD April 2008*). Early sowing is deemed essential. A main cited drawback included the requirements for chemicals, with Roundup herbicide being very expensive at dh120/L or AUD18/L (NB: 2L/ha rate used - 1 harrowing pass = dh 150/ha). Crop rotation includes typically wheat-wheat-Garbanzo beans. Wheat is sown at 17cm spacing (beans at 71cm) with a double disc machine (Kuhn SDE direct drills) at rates between 120-160kg/ha, and into wheat residue levels of up to 10t/ha (NB: limited grazing is conducted on the property).

Another related experience was the Cooperative of Talouaite in the Settat region, with a membership of 409 farmers over a 2740ha area (80% farms <8ha). The cooperative started with direct seeding 1.5ha in 2006, currently undertakes 421ha over 73 farms, and plans for 674 ha over 98 farms next season. The cooperative records yield and cost savings (seed, fuel) associated with no-till, and cites dh230-560 /ha savings over the last 3 years, at least 7% productivity/ha increase and 78% increase in income per ha.

Successful weed management is crucial in no-till. The Moroccan experience cites broadleaf weed dominance, with 2,4D herbicide regularly used on-farm, and pre-sowing knockdown spray required only 2-3 years in 10. Grazing is a key tool in managing (grass) weeds. Moroccan farmer's perceptions of no-till acknowledges lower costs, a more robust and productive system, simplified management, but with a key requirement being a performing no-till drill. The research direction taken in Morocco has pushed tine openers with residue cutting coulters since its inception, mainly due to penetration and furrow seedbed limitations encountered with disc openers in many soil types. Significant no-till benefits still arise (demonstrated by yield results to date) from low soil disturbance combined with the limited residue remaining (mostly underground) after grazing. There is a belief that broad scale adoption of no-till will gradually reduce the pressure on residue.

Plan Maroc Vert:

The Green Morocco Plan (GMP) launched in April 2008 aims to develop and intensify national agricultural production while conserving natural resources under an investment programme set to reach dh150billion by 2020 (with an estimated 1.4M farmers targeted). The GMP targets both the modernisation of high value intensive/productive agriculture (1st pillar of investments) and the development and improvement of small farmer based operations, especially in unfavourable areas (2nd pillar). The 2nd pillar of investments comprise socially oriented projects under 3 programmes: i) reconversion from high risk rainfed cereal cropping to higher value irrigated horticultural crops, ii) diversification with complementary income from quality label produce and iii) targeted training to enable improved productivity and value-adding to current cropping systems. By 2020, while the GMP will very significantly increase horticulture production levels, cereal production will also be increased by 45% despite a 22% planned surface area reduction. A key concept central to the GMP strategy lies in the implementation of farm groupings ('aggregations') led by a central operator

('Aggregateur', typically a well organised farm or professional business) working with a well-defined set of neighbouring farmers and organising / gathering the production by defined plant/animal commodities as well as ensuring its market. Preferential incentives are provided to aggregations relative to individual farmers. This aggregation concept is key to developing Morocco's agricultural production in the context of increasing fragmentation of farm size. In a 3rd phase this year (21,240ha – 290 projects), public land is further being released to attract private investments and develop public-private partnerships into aggregation projects supported by the GMP on a competitive basis.

One such project proposal (currently under assessment by ADA) was submitted by AGENDA in partnership with the ATMAR agricultural machinery company. This project #063822 would take place in the cereal producing region of Chaouia (Settat region) and targets no-tillage cropping system demonstration and implementation on a 30ha pilot farm to produce durum wheat/food legume with aggregated neighbouring farmers. The pilot farm (owned by Atmar) would act as a platform for training and technology transfer to gradually develop an aggregation of 2000ha (200 farmers) under no-tillage over a 6 year period. The technology transfer will rely on the establishment of field operation units ("*unités de service*") conducting soil sampling, cover crop rolling, crop sowing and spraying, as well as one machinery maintenance unit.

The Agricultural Development Agency (ADA) was created as the implementation arm for the GMP. The GMP, as well as the Environment Charter adopted in 2010, represent very important opportunities for the development and adoption of CA in Morocco. Opportunities also exist for multilateral international collaboration in such programmes. The Director of Aggregation at ADA, met by the scoping mission team, has also undertaken training at a seven day no-till workshop Spain.

Tunisia

Agricultural context

There are approximately 5 M ha of arable land in Tunisia (= 30% of land area), with 66% falling under less than 400mm annual rainfall. Cereals are grown on 1.5 M ha, with wide fluctuations in annual production from 250,000 to nearly 3 million tonnes over the period from 1980-2009. There was an average increase in production of 3% (30,000 tonnes) per year, with six seasons where production was ≤500,000 tonnes, during this 30 year period. Similarly to Morocco, only a small proportion (9%) of land is cropped to legumes and forage crops.

Total farm households number close to 390,000 (1993 data), while the typical farm size is small with 45% of farms having less than 5 Ha and representing 7.7% of the total farming area. More importantly for mechanisation, a significant number of farms (16,200 or 4.2% of the total number) have more than 50 Ha and represent a large proportion (40.5%) of the farming area.

The country needs more cereal production. Over the last 15 years, imports of bread wheat have fluctuated around 800,000 tonnes or about 40% of requirements in some years with a value of 150-400 million DT (Tunisian Dinar). Durum wheat imports are highly variable, fluctuating typically between 200-600,000 tonnes and valued at 200-600 million DT. Barley is also a significant import. The Tunisian cereal strategy targets self-sufficiency for durum wheat by 2040 and an assured minimum cereal production of 1 million tonnes. Maximizing the production and percentage of domestic bread wheat is a priority.

Cropping and grazing enterprises are well integrated in Tunisian farming systems. Crop stubbles are grazed or cut for hay. In many locations, there is little stubble left on fields before the next cropping season. This need not be a major constraint to the adoption of ZT. Whilst more residue cover provides more protection and more moisture conservation (less evaporation) in the soil, ZT works well and better than CC even where little stubble is retained. However, the concept that all stubble must be retained remains strong and can be a constraint to adoption. More research and farm experience on the needs and benefits of residue retention is required.

Conventional cultivation consists of 1 ploughing and 2-3 harrowing followed by drill seeding. Seeding rate for wheat is typically 200kg/ha in the semi-arid areas – 450-600mm annual rainfall (INGC recommendations are 150kg/ha to achieve 250-300 gr/m² with expected up to 25% crop establishment losses). Seeds are typically broadcast in the arid areas (300-450mm rainfall zone or 20% of arable areas).

Overview of CA adoption and practice

There was no zero till cropping before 1999-2000. Adoption has grown modestly over 10 years to a total of 12,000ha in 2009-10. A target has been established recently to expand this to 100,000ha in wheat by 2014, especially in areas of high erosion risk. To date, the main adoption incentives have been: i) erosion control (on slopes), ii) improved trafficability for cropping (higher rainfall and clay soil areas) and iii) economics (in the plains).

The Minister of Agriculture, Hydraulic Resources and Fishing is very supportive of the development and promotion of CA/ZT to increase grain production and water use efficiency and increase sustainability and conservation without the need for major infrastructure development. He is very keen to form stronger linkages and collaboration with Australia, as discussed in July with the Australian Ambassador to Egypt and Tunisia. He will ensure resources and commitment to any collaborative project developed from the scoping mission.

Various institutions including the Institute for Agricultural Research and Higher Education (IRESA) and the National Institute for Field Crops (INGC) have been involved in CA development and promotion. There have been collaborative projects and linkages on CA with France (AFD, FFEM), US projects, Brazil specialist visits, ACSAD, and ICARDA/CIMMYT seminars. All institutions visited were enthusiastic and committed about ZT and its promotion to provide a higher and more certain level of production, profitability, sustainability and resource conservation than the current cultivation-heavy and exploitative system which has prevailed for centuries.

Work on ZT started with an experimental program set up in 2000-01 involving CTC, ESAK and INRAT and funded by AFD, with a main objective of developing and promoting CA technology options to control serious erosion being experienced which was feared to be irreversible. The program now promotes ZT for production, cost saving and sustainability benefits. Together with farmers, it runs demonstrations, identifies problems, and develops technology options. ZT areas in Tunisia have increased slowly since then, constrained by availability of effective and affordable ZT drills: there were 3 drills used to sow 312ha of ZT crops in 2001-02; 15 drills sowed 1799ha in 2004-05; and 90 drills sowed 12,000ha in 2009-10. These drills are disc seeders, based on European and South American concepts, and are imported at costs in the range of €25,000 - 50,000.

Field research by INGC indicates the ownership of an 85HP tractor + 2.2m ZT drill becomes profitable beyond 105ha/year compared to a full rental option. Comparatively, 222ha/year would be the profitability threshold for a larger capacity machinery set (115HP tractor + 4.4m ZT drill).

The CA program is implemented as part of the *PADAC* project (Projet d'Appui au Développement de l'Agriculture de Conservation – support project for the development of CA), funded by FFEM over the 2007-11 period. It undertakes research and extension in a participatory manner, and has accumulated extensive scientific and technical data and experience. Extension clusters have been established in 11 locations across the north of Tunisia, now involving 28 small, 32 medium and 5 large farmers. Some of the farmers have been members for 10 years and others for 3 years. Extension has included establishing zero till versus conventional till demonstrations on small and medium farms, and providing technical advice and information exchange to large farmers with zero till drills. A training and dissemination program is conducted with national field days, annual results discussion days, technical guides and on-farm field schools.

Measurements are taken on: crop production (biomass, yield components); crop management (fertilizers, pests, diseases and weeds); soils (water infiltration, moisture, organic matter, bulk density, and compaction). Experience has been that yields are increased and erosion, fossil energy consumption and working time are reduced with ZT. Issues requiring more investigation are residue

management, traditional grazing practices, weed control in legumes (Lack of post-emergent dicot herbicides), build-up of weeds (especially *Bromus diandrus* and *Lolium perenne*), potential for resistance to glyphosate, snail pests and poor drill performance (residue cutting, uneven seed cover, soil sticking, tine openers). Only very expensive ZT disc drills from Europe and Brazil (Gasparado, Baldan, Semeato, and John Deere) have been used and there is a clear opportunity to evaluate and develop low-cost, locally-made tine seeders.

There does not seem to have been any focus on alternative seeding systems such as tine seeders, widely used in other countries such as Australia, where some 90% of ZT seeders are tine machines. While these create more soil disturbance and residue burial, they can be simpler and cheaper to use, maintain and modify, and overall quite an effective option to stimulate early adoption of direct seeding practices, especially in initial conditions of poor soil structure and compaction. CA development to date seems to have followed mostly European or Brazilian systems. There is no doubt that Australian experience - with participatory development of no-till cropping systems and tine seeder technologies - is very relevant to the north African environment, and provides a strong foundation for any Australian assistance which could encourage more flexible approaches, broader applicability and quicker adoption of farmer-ready solutions.

ZT farmers are linked in extension clusters as part of the PADAC project, with some visited in the Governorate of Beja, west of Tunis, in Oued Zarga district. In this region, ZT is adopted on larger farms mostly, and is well mechanised. One farmer, Moez El Bahi, an agricultural graduate, farms 150ha with 40ha of zero till. Another, Wael El Behi (also former Professor at INAT) farms 180ha with around half devoted to no-till. In the next season, a 1000ha is expected to be under ZT in the 2 Beja clusters (currently 400Ha with 8 farmers). This ZT clusters are served by servicing companies (Societes de Service) which are critical in enabling adoption among smaller farmers. Crop rotations include bread wheat, durum wheat, barley, fenugreek, and peas. Lucerne is grown for erosion control and production - especially for lot-fed Holstein Friesian dairy cows. Major issues in the cropping programs are rye grass competition, Dicotyledonous weed control in legumes, incorporation of trifluralin/simazine, soil compaction in clay soils, traditional grazing of stubbles and low efficacy of glyphosate (resistance not recorded). Some of the above issues represent potential ZT disadoption threats. They have Semeato ZT seeders from Brazil, which cost US\$40,000 - 50,000.

The 10 year anniversary of CA adoption in Tunisia is marked by a national conference supported by the Ministry of Agriculture and Hydraulic Resources, organized by APAD in collaboration with ESAK/INGC, held on 28 October 2010, and focusing on achievements of CA to date and perspectives for the future.

4.2 Assessment of conservation agriculture research, education, training and extension capacity for Morocco, Tunisia and other countries

Assess CA research, education/training and extension capacity (e.g. key institutions and staff, current programmes, recent achievements) in both Morocco and Tunisia and in four other countries of the region

Morocco:

The National Institute for Agronomic Research (INRA) is Morocco's predominant agricultural research agency and currently includes 10 regional centres (CRRA) while 16 are planned in total by 2012 to cover all regions. The CRRA of Settât (60km South of Casablanca) which was visited was created in 1980 with a mandate to develop research on dryland agriculture and is a key centre working on CA. It has 27 researchers, 17 technicians and 120 support staff, with facilities including 1 gene bank, 24 greenhouses, 17 disciplinary laboratories and 3 experimental estates. The CRRA of Settât has 4 research units, including an agricultural mechanisation section which developed small and medium scale machinery (e.g. precision planter, animal drawn weeder, push sprayer, deep ripper and harvester windrower). INRA-Settât's research directions 2009-2012 include:

- Investigate climate change impact in arid & semi-arid zones
- Develop drought mitigation strategies
- Diversify production systems & integrated crop management technologies
- Improve crop and natural resources conservation
- Enhance capacity building of rural communities

Morocco's CA research started in 1983 with Dr A. Bouzza at INRA-Settat under a water use efficiency focus aiming to stabilise crop yields (soil erosion and degradation considerations occurred later). CA was effectively taken to the farmer's fields in continuing programs from 1996, undertaking various phases of introduction (1996-98), extension (98-2005), development and adoption (2006-2010). The latest phase co-funded by AAAID directly aimed for a broad adoption of CA in Morocco, and involved farmer participation, developed CA farmer groupings around the use of tractor and drill service units managed via the CRRA of Settat, as well as planned to set up private no-till service companies. 50% of the area affected by the latest project phase (e.g. district of Chaouia – Ouardigha) currently practice minimum tillage.

Despite these significant efforts and convincing field research results accumulated over more than 25 years now, less than 0.2% of Morocco's cereal cropping area is currently under CA. These efforts have recently culminated in the creation of the AGENDA association ("Agriculture, Environment and Development for the Future" Association, www.acagenda.com). Its mission includes: contributing to no-till system development, mobilising the private sector, developing incentive policies, and seeking out international linkages. Its current research emphasis includes:

- Machinery performance and models for better crop stand and establishment as well as improved soil and water conservation.
- Evaluation of impacts of no till in erosion sensitive watersheds.
- Crops diversity and seed availability.
- Monitoring of soil changes.
- Economic evaluation of no till on water conservation, fertilizer, seeds and the impact on national crop production, food security, poverty alleviation and global economy.

Morocco's research and development activities in CA since 1983 have recently been compiled in a book by Dr Rachid Mrabet (2009) "No-tillage systems for sustainable dry land agriculture in Morocco", published by INRA and which received the 2009 Hassan II 2nd prize in the category of scientific publications. Dr Mrabet's book was held as a significant reference of CA results conducted to date. INRA's support for CA development in Morocco was well articulated by its current Director, Professor Mohamed Badraoui.

The Agronomic and Veterinary Institute Hassan II (IAV Hassan II) is the 2nd largest agricultural R&D agency and was created in 1996 to undertake a combined mission of Education/Training-Research-Development. It currently employs 250 lecturer-researchers serving a current student base of 1800 over 2 campuses (Rabat and Agadir), set to grow to 2500 by 2012. IAV Hassan II staff are government funded. While much of the research activities are directly associated with the Green Morocco Plan, research projects are funded through a variety of mechanisms including national and international competitive funding schemes, contract research with public and private sectors. One domain of education produces agronomy graduates destined as qualified producers, advisers, researchers and other professionals for the related agro-industries.

Of particular relevance was the Technical Training Centre in Agricultural Mechanization (CFMA) created in 2000 within the IAV Hassan II. Its objectives are to promote all aspects of agricultural mechanisation, and it engages in national and international training activities of capacity training and extension, as well as offers a related source of technical information. This was seen as an obvious facility which could deliver targeted training for the region within a CA regional hub concept.

The National School of Agriculture ENA-Meknès was the first School of Agriculture established on dry land agriculture with now 460 students and 50 permanent staff. Its areas of expertise include plant production and the environment and rural development engineering (with its Centre for Experimentation in Agricultural Machinery).

The Directorate of Education, Training and Research (DERD) is under the Ministry of Agriculture and Fisheries (MAPM). DERD includes a division dedicated to research and technology extension, involving agricultural advisors and in charge of the planning and implementation of extension programmes and development of extension materials. Activities on the ground are coordinated via local centres ('Centres de Travaux' and 'Centres de Mise en Valeur Agricole'), managed under a provincial then regional hierarchy. An example of extension material was the PNTTA technology transfer newsletter with an early direct seeding issue in collaboration with INRA (#76, Jan 2001, Dr Rachid Mrabet).

Other DERD divisions include: i) 'Higher Education and Research and Development' whose role are to define and implement reforms and orientations in education and R&D in agriculture as well as ensure its performance review, and ii) 'Technical Education and Professional Training', whose role is to develop capacity in line with agricultural development policies and contribute to the implementation of national policies on education and professional training.

The existing degree of active collaboration between the above four institutions, who have since April 2009 formed a Consortium of partnerships, was noted. The Consortium wants to develop more outside collaboration (particularly with ICARDA and Australian organisations), with the view of strengthening its CA capacity.

Under the Ministry of Agriculture and Fisheries (MAPM) also lie the Directorate for the Development of Commodity Production Chains (DDFP - 'Filières de Production') and the Directorate of Irrigation and Management of the Agricultural Landscape (IAEA). The DDFP supports the development of production chains for plant/animal commodities, develops and promotes quality labels and local produce initiatives as well as coordinates a development program for related Agropoles and agri-food businesses. For plant commodities (including cereals), its mission is to coordinate and implement related development programs, including diversification, value-adding and commercialisation components. In meetings, its Director Mr Ahmed Ben Touhami expressed personal interest in no-tillage for his own 500ha farm, and recognised the importance of CA to guarantee a minimum production level and stability for Morocco. Mr Touhami also considered that the tone was right for an Australian collaborative project to add value to the Moroccan efforts achieved to date.

The Directorate of Irrigation and Space Management was represented (on behalf of the Director who was not available) by, Mr Mohamed Belghiti, who also recognised the role of CA (as a general concept affecting all crops whether annual or perennial) in saving green (rainfall) or blue (irrigation) water. While the Directorate focuses on irrigation efficiency, better use of existing resources is a key principle underlying the improvement of water productivity and water use efficiency, and the Directorate is conscious of the urgency of the CA approach for Morocco.

Tunisia:

There are many research, extension and education institutions which have been involved in CA development and promotion since 2000. Those listed below were visited during the project scoping mission. All were keen to be involved in appropriate ways in an Australian-supported project to develop and promote ZT more widely.

The Institute for Agricultural Research and Higher Education (IRESA) was established in 1991 with the mandate to promote agricultural research through the coordination of research, higher education

and extension. IRESA encompasses in particular 10 research institutes and regional research centres, as well as 11 institutes of higher education who delivered 379 doctorates and 697 masters in 2009. IRESA promotes the key government priorities of food security and preservation of natural resources and works on 10 priority domains (set-up by a scientific committee) including field crops (grain and fodder), water management and agricultural mechanisation. It establishes and monitors integrated national research programmes (42 federative projects), and operates under bilateral and international cooperation (inc. France, other EU and Maghreb countries), and international organisations such as ACSAD, ICARDA, CIMMYT, CIHEAM, FIDA and FAO. Its research support reaches Euros18M annually - 93% of which originates from national funding.

The National Institute for Field Crops (Institute National des Grandes Cultures – INGC, Formerly Centre Technique des Céréales, CTC) was established in 2008-09 after the "wheat crisis" to ensure supply of 1 MT and self-sufficiency. INGC undertakes applied field research and demonstrations with the aim of developing technical extension material on field crops such as cereals, legumes, forage crops and industrial crops, as well as dissemination of technical information to farmers and advisers mainly.. INGC is located in Bousalem, 130km west of Tunis. It has 15 engineers (6 dedicated to CA activities) in the Technical Division and 54 technicians in the Regional Action Division. They receive funding from a levy/collection of 2.8DT/t on production. Main technical activities are germplasm evaluation, improving the efficiency of fertilizer and irrigation water use, developing improved crop protection technologies, evaluating farm machinery, improving forage systems, and evaluation of different cropping systems (farm structure, work organisation, profitability). Technology dissemination activities include meetings, training, field days, farmer field schools, a cereal expert system and technical guides for farmers, technicians. They have a network of 45 on-farm trials and early warning fields.

INGC has international projects on durum wheat landraces, IPM of Septoria, wheat production forecasting, and contributes to the PADAC project on CA, to increase productivity and improve soil fertility and structure. The 5 year PADAC project started in 2007 is worth €1.4M funded by the French Funds for World Environment (Fonds Français pour l'Environnement Mondial - FFEM) , and is conducted as a collaboration between INGC, ESAK, and APAD. It aims to support a strategy of applied and practice-based research, demonstration and promotion via the 3 actors, and currently includes on-farm trials (comparing conventional and zero till, effects on C-sequestration, soil fertility and erosion, crop productivity, energy use, and farm-level socio-economics) and 11 extension clusters (involving 65 farms).

The National Office of Extension has not worked on CA because there was no policy/national strategy to develop CA.

The Ecole Supérieure d'Agriculture du Kef (ESAK Le Kef) is also very willing to collaborate on CA. ESAK commenced CA research in 1999, in collaboration with development agencies and farmers, reportedly undertaking the first Tunisian research in farmer fields. ESAK prides itself on their integrated CA programme approach involving inter-agency collaboration (esp. INGC, on the PADAC scientific project), long term CA research commitment and farmer involvement. ESAK has 14 specialists (including economists, agricultural engineers, agronomists) working on the project, often integrated at the same sites. ESAK has a field site on-farm in Guern-Halfaya, near El-Kef, where an Australian project which ended in 1982 promoted barley/medic for sheep. They have demonstrations on-farm and research trials on-station of ZT vs. CC with various rotations (durum wheat, barley, faba bean) and residue levels (0, 1, 2, 3, 4 t/ha of crop residues). Collaboration with local farmers, include some cluster members who have been using ZT for 3 years over relatively large areas (200-400ha). Many of these farmers have olives and livestock (sheep, cattle). ESAK is interested to work more on issues such as livestock/stubble integration, affordable drills, policy aspects, weed control, snails, and integration with olives. The ESAK team was very open to collaborate on innovative adaptive/validating field research.

The Institute Agronomique de Tunisie (INAT) is very interested to collaborate in CA. INAT is under the Ministry of Agriculture and Ministry for Higher Education, working on education of engineer and doctoral agronomists, research and extension, and continuing education. It has seven specialities including plant production; animal production; fisheries; rural engineering, water and forestry; rural economics; phytopathology. There are about 600 undergraduate, 600 MSc, 200 PhD, and 100 continuing education students. It has no specialist CA course but has a sustainable CA theme integrated in some courses aiming to highlight principles, present concepts and describe options. In 2011, a course on CA is being planned. There are also some MSc students on CA in plant production/engineering and students may interact with CA in field visits or in on-farm traineeships. INAT has strong agreements and collaboration with many overseas research institutes and universities. Its objectives are to improve production, farmer incomes, food safety, product quality, trade liberalization, resource preservation and sustainability. They have a large agricultural machinery school engaged in fabrication and R&D and they have produced small manual ZT seeders.

The Soil and Water Research and Study Department (under MARHP) has a strong interest in water saving technologies and water efficiency concepts. A lot of work has been conducted in developing large watersheds (water collecting dams – 50% of potential achieved across Tunisia), with a current focus on small watersheds especially for the arid regions (e.g. on-farm soil and water conservation structures, 22 types of structures are being promoted, with an associated subsidy scheme ending in 2016). CA based water harvesting techniques (e.g. furrow sowing, sub-seed disturbance, residue retention etc.) are of high interest to the department, with an opportunity to integrate into existing strategies.

The Association for Sustainable Agriculture (Association Pour l'Agriculture Durable - APAD) is a farmer based organization created in 2006. Its aim is to reconcile the requirements for economic performance and crop productivity with those of biological efficiency and soil conservation. APAD's objectives are to promote ZT practices and more broadly CA concepts, facilitate exchange of information, develop good agronomy practices, and move from top-down to participatory approaches. The context of APAD initiation is as a professional NGO organisation able to promote and speak out about CA. CTC (Centre Technique des Céréales, replaced by INGC in 2009) gave a ZT drill for testing on 5ha of farm areas. The Association commenced with 5 and now has 50 farmer members. Its focus is looking at the yield ceiling under CC and ZT. APAD activities (aimed to open minds rather than be categorical about what is best) include visits to other regions/users; field days on new varieties; national field days on ZT; field day with a *GDA de Céréalières* (Grain Grower Groups for Agricultural Development) of Bizerte, Beja, Jendlou Bai regions; complementing and not duplicating government agencies; influencing neighbours/friends; linking with and recognising companies (SEMEATO, John Deere) which have moved from marketing conventional ploughs to ZT machinery. They demonstrate new herbicides, multiply forage seeds (berseem, sorghum, fescue), and promote interest in *Medicago africana* in dry areas. APAD uses clusters, with one farmer growing 3-10ha of ZT to influence neighbours. They have a focus beyond Tunisia and are interacting in international conferences/meetings. APAD understands linkages with Europe and summer cropping are inappropriate and is very keen to link into collaborative CA projects with Australia and California.

4.3 Linkage Assessment

The Scoping Mission identified a range of opportunities for developing linkages with the wide range of organisations whom the team met with, in addition to a significant number of others who are also undertaking work across the Maghreb region.

The common opportunity across the region is to work with an organisation such as ICARDA, who can provide the conduit to access the wide range of organisations and professionals who work in the area of CA.

The important consideration is not to duplicate existing efforts or networks that operate, but instead add value to such networks and facilities. This is primarily in the areas of sharing unique Australian expertise and experience, notably in the development and adaptation of no-till conservation farming systems, as suited to Mediterranean farming environments.

It is evident that, in all the organisations which met with the Scoping Mission team, there is a strong willingness and feeling of cooperation to work collectively, to access Australian experience and knowledge. There were many local comments that CA would likely be more developed and adopted in the region if strong linkages had been maintained with Australia over the last 20-30 years, rather than the somewhat exclusive focus on systems and institutions in Europe, where the climate and farming systems are very different and zero till has been little adopted. The opportunity to further develop and extend adaptive research approaches linked to CA from a systems perspective is a key benefit.

It is also recognised that there is significant local capacity present; however there is the need to examine how such capacity can be further enhanced, and taken to an effective step of adaption and impact at the farmer level.

The workshop activities highlighted areas of country specific expertise that can be shared amongst other countries in a participative framework. The opportunities for specific countries to foster 'areas of excellence' as opposed to each country being an expert on all areas of CA is an approach that needs to be considered in the development of a future project across this region.

Participants from the workshop recognised the opportunity to work together, develop stronger communication networks, and build relationships between countries. The sharing and pooling of information and ideas, and providing areas of focus were clearly opportunities identified as being a key outcome from the workshop activities.

It is recognised that ICARDA can provide an ideal conduit to bring together the Maghreb region and surrounding countries into a collective project; furthering the utilisation of a valuable and strong sense of cooperation present in the region. This will allow the further identification and sharing of information and experiences linked to other project initiatives in the region.

Australian expertise has much to contribute in support of the regional development of CA, particularly in identifying and influencing opportunities for enhancement of adaptive research processes, specific skills and capacity improvement, and development of CA systems. Collectively, the countries across this region have not had direct access to this level of expertise and intellectual property, and it is in this respect that significant impact through a directed project offers great potential to increase adoption of sustainable crop production practices and in turn influence food security across this region.

Also noted is the value of linking to other CA related projects, such as those being undertaken through the ICARDA network, CIMMYT initiatives, and country specific projects, some of which also involving other international organisations and including Australia.

4.4 Analysis of the CA machinery industry across Morocco and Tunisia

Morocco

- The machinery manufacturing capacity in Morocco is divided between i) a small number of large companies (including the 2 visited ATMAR & COMICOM) who operate within a subsidy scheme on machinery purchase and, ii) a large number of small rural workshops who do not engage with

subsidy schemes, and thus supply mainly the non-subsidised market (e.g. disc harrows, trailers).

- A scheme designed to boost mechanisation provides large subsidies (40-50% - with fixed ceiling values) on the purchase price of many implements including tractors, tillage and seeding implements. Exceptions include the very widespread market of secondary tillage disk harrows and trailers. All agricultural implements are additionally exempt from the common 20% VAT tax. The subsidy scheme is credited for a large increase in tractor sales over the last few years.
- Despite the 50% (dh67k ceiling) current subsidy scheme, conventional seeders (3m typically) are not manufactured in Morocco, but are imported from Southern Europe, Turkey and newly from China, and are retailed over a price bracket of dh50-120k.
- Conversely, imported direct seeding drills retail in a much higher dh250-450k price bracket and can benefit from the same subsidies, however constrained by the low ceiling values. In comparison, the prototype direct seeding drills developed by IAV II (Ag Eng) and INRA Settat cost dh60-75k using simple cut/weld technology and purchased metering and seeding system components. These prices are significantly more than the simpler and more basic, Syrian made zero-till seeders (e.g. 2.4m at US\$1,800 ex-factory). Generally, machinery purchase by farmers is significantly influenced by the immediate farm neighbourhood.
- ATMAR (Les Ateliers Marocains – www.atmar.ma - D.G. Mr Mohamed Idrissi is a major manufacturer supplying a line of more than 30 mostly agricultural products (80% of sales are done via dealerships), including a broad line of conventional primary and secondary tillage equipment, sprayers, cistern and bulk trailers. It operates 2 plants with a peak staff team of 140. Labour wages are said to be above SMIC levels = dh2000/month (e.g. dh3200-3500/month - function with length of service - at 85-90 hrs/fortnight), and are complemented by various cultural and social allowances. Working hours are 7.30am-12noon and 2-6.30pm, with up to 6 days per week for some workers. Overtime rate applies beyond a 85-90hr fortnight. The company's production diversification outside agriculture (e.g. into concrete mixers) now accounts for 25% of its turnover. ATMAR is the main Moroccan manufacturer of concave disk blades used on harrows and ploughs (capacity is 1000 disks/day in peak season, Boron steel, HRc 48-50, no flat blades made) as well as common coil and heavy duty spring loaded (chisel) tines. Its manufacturing capabilities include cut and weld assemblies, sheet-metal work, casting, heat treatments and basic machining. It operates on the national market at maximum capacity and does not supply for export. However the direction of ATMAR recognises the rising profile of CA and its likely impact on their current line of tillage related products, and for this reason is keen in getting into a cost-competitive direct seeding machinery market, either imported or partially manufactured under licence.
- COMICOM (Compagnie Marocaine Industrielle et Commerciale, since 1974, www.comicom.ma) started off in 1902 as a French company, La Compagnie Marocaine. Now certified ISO9001, it comprises several subsidiaries, either manufacturing (small line of soil tillage implements) or importing farming machinery, particularly Massey Ferguson and Landini. Its Morocco tractor market share was 45% in 2007, with up to 6000 tractors sold by the company alone in 2009. The tractor market expansion was largely influenced by significant subsidies introduced to develop Morocco's mechanisation, currently as much as 40% for farmer groupings ('aggregations'). COMICOM's strategy in CA includes the promotion of innovative technologies for the larger farms that can operate in a business-like fashion. Marketing strategies include open days, demonstration days, free implement set with the purchase of a new tractor for a value of up to dh60k in the form of conventional tillage implements and free annual maintenance on their tractor fleet. Price is however a major psychological barrier for most farmers.

Tunisia

- COTUGRAIN (www.cotugrain.com) was created in 1985 and is a company marketing seed, pesticides, agricultural materials and ZT seeders (SEMEATO zero-till disc machines). They are passionate about CA, a keen supporter of the Semeato technologies, and keen to collaborate in any way. The company has been promoting CA (ZT) for 11 years in Tunisia and employs a full time Agronomist/Engineer who leads the ZT programme. It started its ZT activities in sub-humid

regions of Suma and El Kef in the west, with interested/financial farmers. AFD (French Agency for Development) funded a SEMEATO ZT seeder for demonstration purpose. In 1999, 10 fields were seeded (on the basis of 5 ha free per farm) in Beja and El Kef, with many farmers sceptical and many open minded and interested. To date, 55 Semeato ZT seeders have been sold in Tunisia out of an estimated fleet of 90 units. Estimated minimum CA cost savings are US\$100/ha. Interest in ZT seeders is now decreasing in Tunisia due to economic slowdown (influenced by grain price, climate/drought, less income, and less investment). For the last 2 years, the company has shifted its CA focus to the wider Arab region, in countries such as Jordan, Syria, Iraq, Lebanon and Algeria where 7 machines are sold already. The SEMEATO ZT technology marketing is conducted in partnership with Agrimatco Ltd, a large international agricultural distribution company operating in 35 countries, incl. North Africa and Middle East. Cotugrain will use the same approach of lending seeder to farmers for awareness and experience. Its current focus is on improving efficiency and reliability of equipment, in collaboration with partners who don't market tillage/cultivation equipment. Cotugrain is also interested in local fabrication to provide more affordable and effective seeders.

- Field research and demonstration work by INGC was conducted on imported machinery (Baldan, Gaspardo, Semeato and John Deere) highlighted the following ZT machinery limitations under Tunisian conditions:
 - poor residue cutting,
 - poor furrow closing (cast iron closing wheels),
 - limitation and blockage in sticky soils
 - missing suitable ground openers for light soil conditions
 - poor residue cutting,
 - poor furrow closing (cast iron closing wheels),
 - limitation and blockage in sticky soils
 - missing suitable ground openers for light soil conditions
- INGC recommends for the development of sustainable CA systems in Tunisia that:
 - service companies are the focus to provide machinery and technical inputs to small farms,
 - specialised machinery manufacturers be involved in adapting and developing suitable, low-cost ZT drills for Tunisian farmers.

4.5 Opportunities identified in Egypt

While not central to this scoping mission, discussions were also held with the Deputy Minister for Water Resources and Irrigation (MWRI) and H.E. Eng. Amen Abaza, Minister for Agriculture and Land Reclamation (MALR), while in Egypt.

Egypt is characterized by a very different farming context, being an arid country with 51mm average annual rainfall (up to 200mm/year in the northern coastal areas where a small amount of rainfed agriculture exists); close to the entirety of its cultivated area is under irrigation. 95% of Egypt's freshwater resources are supplied from the river Nile, managed under the Nile Basin Initiative aiming to 'develop the river in a cooperative manner, share substantial socioeconomic benefits, and promote regional peace and security'.

With its rate of water use at 100% of its sustainable capacity, water issues are becoming a top priority for Egypt, and fall under the responsibilities of MALR and MWRI, for on-farm and off-farm contexts, respectively. Large challenges facing Egyptian agriculture were discussed, such as:

- improving water quality (e.g. pesticide and industrial pollution, salinity of aquifers),
- improving water productivity and use efficiency (e.g. cropping management, reticulation efficiency, re-use of drainage/treated water),

- reclaiming land for agriculture (1997-2017- e.g. Toshka project in South of western desert, Sinai valley).

Collaboration on water issues with the 9 other partner countries sharing the Nile resources takes place among 12 research institutes in the region, including the Agriculture Research Centre (under MALR). Opportunities to collaborate and share experiences with Australia on water issues and CA cropping efficiency under irrigation are of great interest, with the Australian context perceived as a modern, innovative and science-based irrigated agriculture. Previous FAO project investigated direct seeding into rice mulch and alternative uses of straw for energy/feed/material, as means to significantly reduce straw-burning, and improve water productivity.

5 Tunis Conservation Agriculture Workshop; Country Analysis and Regional Situation

The two day workshop was well attended by Morocco, Algeria, Tunisia, Libya, Eritrea, Sudan, FAO, and Ms. Erny Wah (third secretary to, and representing H.E, The Australian Ambassador to Cairo and non-residential representative to Tunisia).

Day 1 of the workshop provided the opportunity for country representatives to present a situational analysis of CA research, development and extension in their respective countries. Key areas covered included current project initiatives, barriers and limitations to the development of appropriate CA systems. Additional presentations were provided by Australian participants, including an overview of the development and adoption of no-till and CA systems in Australia, participatory extension systems, and an overview of the strategies and achievements of current ACIAR Northern Iraq dryland farming systems / CA project. A presentation by the Tunisian farmer based CA organisation (APAD) was also given.

Day 2 sought clarification in relation to the constraints and opportunities to the development of improved farming systems across this region, with a focus upon CA systems. This provided the opportunity for participants to reflect and then focus on a range of opportunities and potential for systems improvement and capacity development. Leading on from this, the participants developed a framework for a potential project, centered on the concept of a regional network for CA in this region. Project aims, objectives, and priority activities were discussed and agreed. The role of ICARDA providing a valued role in future coordination work associated with a potential project was recognized. Participants also felt that it was a priority to engage Mauritania in the development of a future project.

As part of the Tunis workshop approaches, a situational analysis was conducted in order to identify the specific constraints and opportunities for each of the countries. Countries having comparable agro-ecological environments and parallel experiences to date in CA were pooled together in the analysis of constraints, opportunities and priority areas for new project development. These were:

1. Morocco and Tunisia
2. Algeria and Libya
3. Sudan and Eritrea

In addressing the specific constraints and opportunities, key areas such as research, extension and capacity and skill development were highlighted. Following on from this, specific areas for new project development were then identified by the workshop participants, with the view of addressing the constraints, and capitalising upon the opportunities identified. The key findings from the workshop are summarised in the following text.

5.1 Morocco and Tunisia

The specific constraints and opportunities associated with the development of CA systems for Morocco and Tunisia were identified by country representatives. These were grouped according to whether or not they were aligned to research, extension or skills development.

Constraints

Research

- Soil residue management
- Crop management
- Machinery development
- Availability of low cost machinery for the small farmer
- Crop/livestock integration

Extension

- Drills availability and cost
- Weed control management
- Service companies = farmers, contractors
- Consulting groups or experts
- Integrated livestock cropping systems for small farm households
- Integrated crop management;
 - Seed rate and row spacing
 - Weed management
 - Crop fertilisation
 - Disease management
 - Pest management (incl. snails)

Skill Capacity

- Communication strategies: newsletter, website, media TV radio
- Introduce CA principles in education (technicians, engineers, researchers, farmers)
- Human capacity building

Opportunities

Research

- Farmer's knowledge
- Bank of research solutions already available
- Seed drill prototype in Morocco
- Technical team

Extension

- Farmer's organisations and associations
- Farmer's experts and actors for NT services
- Technical team

Skill Capacity

- Introduction of CA course in Tunisia
- Existing linkages through regional organisations (ICARDA)

5.2 Algeria and Libya

The specific constraints and opportunities associated with the development of CA systems for Algeria and Libya were identified by country representatives.

Constraints

- Machinery availability (no developed network, delays) and cost
- Untrained staff
- CA machinery industry not well established
- Dominance of small farmers (low income)
- Limited institution expertise in CA
- Farmer know-how in CA missing

Opportunities

- Research extension framework available
- Machinery conversion precedent (local farm in Setif),
- Conventional drills available for possible conversion
- Ministry promoting CA (Institute)

- Strong farmer interest with many farmers ready to join (NGO)
- Young Scientists available to work on CA
- Collaboration Framework → Exchange of expertise within North Africa esp. Morocco/Tunisia
- ARC ICARDA project already in place (Libya)
- Libyan Ministry support natural resource conservation
- Collaboration Framework → Exchange of expertise within North Africa esp. Morocco/Tunisia

5.3 Sudan and Eritrea

The specific constraints and opportunities associated with the development of CA systems for Sudan and Eritrea were identified by country representatives. These were grouped according to whether or not they were aligned to research, extension or skills development.

Constraints

Research

- Shortage of proper lab equipment and other research inputs
- Sustainability of funds for research
- Shortage of high skills of manpower in some areas (soils, machinery)
- Lack of appropriate machinery and equipment for CA and CT
- Lack of training and awareness for researchers

Extension

- Lack of skilled manpower
- Lack of technology: Machines and equipment
- Lack of media awareness programs
- Shortage of funds for extension work
- Lack of posters/leaflets on CA to create awareness
- Limitation of adequate demonstration programs
- Traditional removal of crop residue from crop fields
- Shortage of inputs (fertiliser, chemicals)
- Shortage of animal feed or integration of livestock and CA

Capacity/skill development

- No CA project developed for small scale farms
- Lack of extension programs
- Lack of training programs

Opportunities

Research

- AAAID precedent as example model to start with (Sudan), with a number of farmers already involved in CA programs
- Many institutes and organisations have experience on CA programs
- For Eritrea, some work has been conducted at Hamelmalo Agricultural College, opportunity to provide a future focus for research in Eritrea in conjunction with the National Agricultural Research Institute (NARI)
- CA can be included in student learning and curriculum in Eritrea

Extension

- Work with district administration and other stakeholders in popularizing or demonstrating CA/ZT
- Test animal drawn equipment for hilly topography
- Prepare leaflet/posters for extension workers, policy makers on CA/ZT

5.4 Priority Areas for new Project Development

Representative countries were asked to identify priority areas for developing a new project relating to CA. This was a follow up to firstly identifying the particular constraints to the development of CA systems, and then secondly identifying what opportunities there were to develop such systems. Specific responses by country are presented as follows;

Morocco, Tunisia

- Morocco: up-scaling to the medium + farmers, setting targets (e.g. Tunisia 100,000 ha by 2014)
- Tunisia: develop suitable CA systems with medium and small farmers, need new machinery, then weed/crop management

Algeria, Libya

- Improve and develop capacity building in i) machinery, ii) crop management and iii) socio-economics, through on the job training specialised courses, experts visits
- Strengthen R&E programs in machinery, crop management and socio-economics
- Acquisition of suitable CA equipment and support local industry
- Exchange of visit and travelling workshops within and across countries
- Dissemination of the results (decision makers, farmers, extension services, machinery manufacturers)

Eritrea/Sudan

- Pilot farms for research
- Acquire, test and compare appropriate equipment/machinery
- Address weed and crop management issues in no-till
- Integrate no-till and animal feed
- Demonstrations, field days, (farmers, policy makers)
- training of the trainers (R&E) and farmers/extension workers
- Travelling workshops (field research programmes)
- Postgraduate training
- Dissemination of results and technology to beneficiaries
- Link between the project and universities
- Develop a new vision: University and farmers linkages
- Lack of recognition of no-till staff in institution – need to motivate staff
- Private sector: implementation within public sector institution unrealistic, private sector to ensure sustainability, not tied to institutions – e.g. University unable to recruit top students in their project – Engage with public sector for efficiency

It is evident that countries are at differing levels of CA development and capacity. In the case of Morocco and Tunisia, where research into and promotion of CA has been undertaken for a significant number of years, they are collectively at a stage where there is the need to examine how

best significant expansion and outreach of CA practices can be achieved. Developing such systems particularly for the small to medium farmer is an important priority. Already within these countries there is a high level of technical competence in the development of CA research. However, there is the need to build further opportunities, particularly from an adaptive research perspective.

Whilst Algeria and Libya have research infrastructure and facilities available, these two countries have had little involvement in undertaking research into CA. There is an immediate need to develop research and extension capacity in this area, including development and access to suitable CA seeding technologies. It is also evident that there is the need to develop CA in an integrated manner, and ensuring that there is not only capacity in the research sector, but also in terms of adaptive research, and extension outreach. There is the need to also influence the political decision makers, about the widespread benefits of CA for the region. It is important that this element is addressed across all countries, in order to build appropriate momentum and Government policy in relation to investing into CA. Support at the senior government level will assist in the development and adaptation of such CA systems, and where possible, provide market signals in the form of possible machinery subsidization being a clear indicator and benefit to the small farmer, particularly where suitable low cost CA machinery can be developed.

In the case of Sudan and Eritrea, they too have experienced similar constraints to Algeria and Libya. Sudan and Eritrea differ somewhat from other countries, in terms of availability of Government resources for research and development being significantly constrained (reflective of the relative wealth of the countries concerned), in addition to their farming systems being based more on a semi-arid tropical / temperate environment, with summer crop dominant systems such as sorghum, maize and millet. There is great value however of such countries being engaged in a project, due to the geographical proximity, and ability to access and share knowledge relating to the development of CA systems for the wider region, including Mauritania.

5.5 Development of a Regional Network approach

Workshop participants favored the concept of developing a regional network, as opposed to using the term 'regional hub', whose meaning was not clear to the participants.

It was considered that a central body with responsibility of coordinating activities and having input into the project would be an ideal approach, in order to achieve strong local ownership of such a project. It was also considered important to encourage a two way flow of information. It was also felt that a project committee, comprising 'project leaders' was an important element of ensuring cross country participation and engagement.

Such a regional network would serve to act as an 'advocate' for the development and promotion of CA, providing degrees of facilitation and support. Building upon current successes and project initiatives, in an effort to create synergy and complementarity were considered to be important characteristics to follow.

The need to have regular communication was considered to be critical to the success of a future network and associated project. Initiatives such as;

- Regular meetings amongst project leaders, in order to share and exchange project ideas and activities, and act as a platform to focus on key project activities was considered a priority.
- Having a regional database of human resources (expertise) was considered a useful element to foster support and build networks across participant countries, and would assist in identifying competencies of each particular country
- The emphasis should be on the capacity building, mentoring and technical exchange of information, as opposed to concentrating on structural requirements

It was considered an important priority to develop a network in such a manner that it would be self-sustaining into the future, and one that would evolve and modify into the future along with the experiences of the participants. A flexible approach was also considered important.

It was also recognised that Morocco and Tunisia had developed a high degree of research expertise relating to CA, and these experiences and skills could be shared with other participant countries. It was considered that such countries need not be experts in every 'field of CA', but could develop specialised expertise that could be shared across the region, in order to avoid duplication of efforts, and maximise efficient use of project resources.

Any future project as initiated through Australian funding sources would be of a set time frame. Such a project it was considered would be useful in providing a 'kick start' to regional cooperation and initiatives. Countries working together in a cooperative manner, realising their strengths and weaknesses and setting high (but realistically achievable) targets for CA were considered to be important strategies to incorporate into a future project.

6 Opportunity proposition for a future project

There is a range of opportunities for providing support to encourage and facilitate the development and adoption of CA across the North African region.

In the development of a potential project, it is important to recognise that the team strongly considered that there is a need to engage for a reasonable time (say 5 years) to allow technical options addressing constraints to be evaluated and promoted. Adoption of CA is low in the region, partly because of a focus on European systems, information and seeders. Australia has a lot to offer in understanding, expertise and experience with successfully developing and promoting conservation cropping widely in very similar dryland regions. Due to the low rates of adoption of CA practices, there is a necessity to develop adaptive research frameworks, build the capacity of stakeholders, and engage all in a supportive and facilitative network.

There is a great deal of commitment and enthusiasm towards the building of a sound project framework. The opportunity to develop a peer network, and provide opportunities for all stakeholders to look beyond the borders of their respective countries presents an extremely valuable opportunity to make significant inroads into developing CA systems that are adaptable and suitable for this region of North Africa.

Following the field visits, and the workshop involving key stakeholders, the following objectives were agreed to;

1. Developing and evaluating participatory based extension systems for conservation agriculture

Core Activities:

- Evaluate a range of extension approaches and models linked to CA systems
- Evaluate and demonstrate a range of crop monitoring tools and resources, and other approaches to developing and extending information, knowledge and experience associated with CA
- Investigate needs and opportunities associated with engaging agribusiness (service companies, consultants, farm contractors) to achieve significant outreach amongst the small to medium farmers
- Utilise, share and exchange Australian experiences and approaches directly linked to CA systems development

2. Developing affordable and effective no-till seeding equipment options for small to medium sized farmers (in conjunction with all stakeholders)

Core Activities

- Identify farmer constraints to the adoption of low cost no-till seeding equipment, and develop a range of options and strategies for consideration by agencies.
- Evaluate and promote alternative machinery solutions: access and evaluate low-cost options from other countries (vs. existing) – Develop adaptive research capacity in the area of seeding system technology
- Interact and engage with local seeding equipment manufacturers and farmers who are or have the potential to engage in the manufacture of low cost no-till seeding equipment (including modification kits for existing machinery base)
- Explore alternative models for developing the adoption of no-till seeding equipment by small to medium farmers e.g. contractors, farmer group cooperatives etc.)

3. Development of a regional network (Hub) for the development, sharing and exchange of information, knowledge and experiences related to conservation agriculture systems development

Core Activities

- Formation of a Regional Network (or hub) amongst partner countries
- Development of a range of manuals and handbooks on CA systems for use by farmers, and those that work with farmers
- Develop a regional database of CA resources, references, and encourage the sharing and interaction of such materials and resources
- Explore the opportunity for facilitating a dedicated website and periodic newsletter associated with CA, and other associated project outputs
- Coordinate a range of project related activities, such as periodic technical and mentoring meetings (on a rotating basis amongst participating countries)
- Identify training and development needs of project stakeholders, and develop opportunities for targeted training and capacity building activities, and specialised exchange visits.

4. Verify and adapt technology options for integrated conservation agriculture systems

Core Activities:

- develop understanding of the technology options for weed/pest/crop/residue and crop/livestock integration, and where appropriate, undertake a range of demonstrations and research projects (with the option of various countries providing a specialised focus, (in order to avoid duplication of effort)
- evaluate and understand current CA systems (including the benchmarking of traditional and improved CA systems)
- Identify opportunities for significantly improving crop production level and stability and in particular optimising water use efficiency through enhanced agronomic management systems, as a complete package linked to CA

5. Training and capacity building

Core Activities:

Undertake targeted training activities in Australia and North Africa in a range of areas including (but not limited to) the following;

- participatory extension approaches, farmer adoption characteristics
- CA machinery training (seeding system principles and interactions with crop-weed-residue management, etc.)
- CA technology awareness, training and experience for scientists/farmers
- facilitating/enhancing (existing) farmer organisations (e.g. enhance with links to Australian NT farmers Associations, assist with technology and training)
- encourage CA training in undergraduate / post-graduate University courses, through the development of specialised training modules, undertaking 'train the trainer' workshops amongst key academic staff
- explore opportunities for identifying specific local personnel for undertaking CA focussed scholarship training in Australia (through existing AusAID Scholarship program)

6. Adoption and impact analysis through adaptive research

Core Activities:

- baseline survey (socio-economics, technical, farm, community linked to the adoption of CA)

- monitoring of the adoption and impacts of systems improvement through CA
- modelling out-scaling impacts (plot to farm to watershed to district to country)
- agro-ecological characterisation – identify recommendation domains to promote out-scaling
- provide input information/advice to policy development and decision makers on enhancing uptake of CA

7 Phase 1 Project Design Recommendations

7.1 Methodology

This may be presented as part of the new project submission.

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7.3 Itinerary and visits

MOROCCO: (INRA/ICARDA coordinated programme)

Sat 17 July: Scoping Mission team arrived in Casablanca (overnight in Casablanca – Ajiad Hotel)

Sun 18 July: Visits to INRA-CRRA of Settat (Chaouia-Ouardigha region), and its partners (inc. Conservation Agriculture Association *AGENDA*, Farmer Cooperative *Talouiate*)

Activities: Topical presentations (Maghreb agriculture, CRRA activities, Moroccan CA experiences) and group discussions, tour of facilities, field visits.

Overnight in Rabat (Oum Lil Hotel)

Mon 19 July: Meetings and visits in Rabat:

National system of agricultural research: INRA HQ, Agronomy and Veterinary Institute IAV Hassan II inc. Training Centre in Agricultural Mechanisation (CFMA)/ National School of Agriculture (ENA-Meknes), Directorate of Education, Training and Research (DERD, under MAPM)

Activities: Group and mission introduction, institution presentations and group discussion on CA research, education and extension activities

Directorate of Strategy and Statistics (DSS - Ministry of Agriculture and Fisheries MAPM) – Service for Multi-lateral Cooperation

Activities: Group and mission introduction and discussion on CA interest

Directorate for the Development of Commodity Production chains (DDFP) and of irrigation & Management of Agricultural Landscape (DIAEA)

Activities: Group and mission introduction and discussion on possible CA areas of interaction

Agency for Agricultural Development (ADA)

Activities: Group and mission introduction, discussion on CA areas of interaction with the Morocco Green Plan (PMV).

Overnight in Rabat (Oum Lil Hotel) – Group dinner in Rabat

Tues 20 July: Visits to Machinery Industry

Les Ateliers Marocain (ATMAR, - Rabat),

Activities: Mission introduction, tour of facilities, discussion of Moroccan machinery issues relevant to CA

COMPagnie Marocaine Industrielle et COMmerciale (COMICOM – Casablanca)

Activities: Mission introduction, Company and no-till farmer presentation, group discussion and Kuhn direct drill inspection

Overnight in Casablanca (Ajiad Hotel)

Wed 21 July: Transfer to Tunis - Tunisia (am flight) and report development (pm)

(Accommodation in Le-Consul Hotel, Tunis, for the period)

TUNISIA: (IRESA/ICARDA coordinated programme)

Thur 22 July:

IRESA introduction meeting

Activities: Group introduction and discussion on CA interest

Transfer to Beja region and visit to Field Crops National Institute (INGC- Bousalem)

Activities: presentations of INGC activities and PADAC project results (Support project for the development of CA, 2007-2011), farm and field visits, experimental site visit

Return to Tunis

Fri 23 July:

Transfer to Western Tunisia and visit to ESAK (le Kef Higher School of Agriculture)

Activities: presentations of ESAK activities in CA (PADAC project), farm and field visits, and experimental site visit

Return to Tunis

Sat 24 July:

am:

Meeting with COTUGRAIN (Ag. input & machinery supplier), APAD (Association for Sust. Ag.), and National Agronomy Inst. of Tunisia (INAT)

Activities: Mission introduction and presentations by Cotugrain and APAD, group discussion of machinery market, CA practice and adoption issues, presentation on INAT activities and visit of INAT's Farm mechanisation Department

Meeting with H.E. Abdesslem Mansour, Minister of Agriculture, Hydraulic Resources and Fishing

Activities: Australian mission introduction and discussion of CA strategy/interest with Tunisia

pm:

Mission report development, workshop Planning

Visit of ICARDA Office

Meeting with Soil and Water Research and Study Department (Ministry of Agriculture, Hydraulic Resources and Fisheries – MARHP)

Activities: Mission introduction and discussion on CA/water use efficiency interest

Sun 25 July:

Workshop planning and scoping mission report drafting

Mon 26 – Tue 27 July: Interactive 2 day workshop:

“Conservation Agriculture (CA) Challenges and Opportunities in the North African region”

Day 1: Country presentation and CA scene setting

Group dinner

Day 2: Identification of opportunities and challenges, strategies for CA project development

EGYPT:

Wed 28 July: Transfers to Cairo – Egypt via Rome

Thurs 29 July:

Meeting with H.E. Stephanie Shwabsky, Australian Ambassador to Cairo

Activities: Scoping mission debrief, opportunities and strategies

Meeting with Dr Hussein El-Atfy, Deputy Minister for Water resources and Irrigation

Activities: Australian mission introduction and discussion on CA strategy/interest within Ministry

Meeting with H.E. Eng. Amen Abaza, Minister for Agriculture and Land Reclamation

Activities: Australian mission introduction and discussion of CA strategy/interest with Egypt, including Agriculture Research Centre activities

Fri 30 July: Team leaves and returns to Australia

7.4 Acknowledgements

The Scoping Mission Team gratefully acknowledges the following organisations and people who made the Scoping Mission such a success;

- ICARDA North Africa Regional Offices, for arrangements for the Scoping Mission Itinerary and coordination of logistics associated with the workshop,
- INRA (Morocco) and IRESA (Tunisia) institutions for hosting and organising the in-country visits,
- the many people and organisations visited by the Scoping Mission, for time provided, along with valuable information, ideas and knowledge,
- assistance with local arrangements in Cairo provided by the dedicated staff of the Australian Embassy
- support provided by AusAID and ACIAR in making this Scoping Mission and associated project possible
- workshop participants who gave their time freely and shared their knowledge, ideas and enthusiasm

8 Appendix 1

Map of region of interest and participation in Scoping Study



Appendix 2

List of people met during visits with email contacts

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Appendix 3: Photographs



Plate 1: Conventional practices (ploughing and disc harrowing) in the region of El-Kef, NW Tunisia. Key incentives to no-till adoption in Tunisia and elsewhere have been erosion control on slopes, improved trafficability in higher rainfall and clay soil areas, and improved economics in the plains



Plate 2 INRA designed (CRRRA Settat) ZT drill unit manufactured in collaboration with Atmar. 32 units have been made to date (An equivalent unit was separately developed by the Agro-equipment and Energy Department at IAV II)



Plate 3: Kuhn Zero-till Seeder imported by Comicom (Morocco)



Plate 4: Straw is a very significant market for livestock feed and realistic pathways for adoption of conservation agriculture practices must be integrated into livestock-cropping system.



Plate 5: Group photo during visit with CA project staff at ESAK, Tunisia