



**International Center for Agricultural Research in the Dry Areas
(ICARDA)**

**Center Commissioned External Review of
Integrated Water and Land Management Program of ICARDA**

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EXECUTIVE SUMMARY

The Center Commissioned External Review of the Integrated Water and Land Management Program (IWLMP) of ICARDA was guided by the Terms of Reference (ToR) which is Annex 1 of this report. The Panel received presentations from the IWLMP program staff and visited with other Programs and Units, conducted individual and group discussions, reviewed Program's scientific publications and other outputs, and the Panel members visited three of the regional program sites as described in Annex 4.

The ToR set out the history of IWLMP and specified the questions to be addressed. IWLMP began in 2007 as a merger of the two existing mega-projects on water (MP1) and land desertification (MP3), as recommended in 2006 by ICARDA's 5th External Program and Management Review (EMPR). A Medium-Term Plan 2008-2010 was developed by IWLMP which was in-line with the ICARDA's new Strategies for 2007 – 2016, that has a strong focus on land and water issues, which is consistent with ICARDA's mission as the center for agricultural research in dry areas. Considering these relatively recent and major changes required to initiate the IWLMP, ICARDA requested an assessment and review of this program by the Review Panel with the objective of obtaining advice for future directions and specific recommendations to “address the challenges facing sustainable water and land management within the goals” of IWLMP and ICARDA.

The report is divided into 9 sections: 1. Background, 2. Introduction, 3. Overview of IWLMP research, 4. Overview of main research issues (Background section, ToR, 7 questions), 5. Research (Section I, ToR, 14 topics), 6. Administrative and financial management (Section II, ToR), 7. Personnel (Section III, ToR), 8. Coordination and partnership (Section IV ,ToR), 9. Conclusions and recommendations. Since the outline of this report follows that of the ToR, the major findings are not justified and set out once; rather most of the findings are presented in various sections throughout the report.

Central to the findings of the panel is that the IWLMP is excellent particularly considering its short history and limited staff. It has achieved much of what was recommended by the EMPR and has established a firm start on meeting the expectations set out in ICARDA's new Strategies for 2007 – 2016 for IWLMP. The Program is the most successful in mobilizing restricted funds at ICARDA: the list of research Themes and projects underway, or completed is provided in Annex 3. The number of ISI publications and other publications published by staff since the program was started are commendable, as are the training programs for NARS, linkages to regional and international universities in regard to research and supervision of MS/PhD students, and work done in conjunction with the other programs at ICARDA. Capacity building efforts undertaken by IWLMP -- training courses for NARS, postgraduate students -- are excellent and should be continued.

The NARS partners consider the IWLMP to be an excellent partner. They help identify work that needs to be done and supports IWLMP staff in developing project proposals,

and if funded, also partner with IWLMP to conduct the work. IWLMP's linkage with IWMI is also a major positive factor in the research and training work that is underway.

Water and soil resources are basic to production of food and fiber by farmers and farming communities. Consequently the work done by IWLMP provides key resources for BIGM, DISPS and SEPR. Improved linkages with these programs are the primary source of suggestions for improvement. The aimed integration of MP3 with MP1 recommended by the EPMR Panel is successfully implemented through the IWLM Program. However, dry rangeland agro-ecosystems definitely require the integration with water related research, particularly water harvesting, since the main constraint of rangelands is water. In practice, close collaboration exists between IWLMP and the DSIPS program, but further developments in staff and knowledge in DSIPSP are required to better overcome the current limitations.

Following EPMR Panel's recommendations, integration of socioeconomic issues into water and land management research is being achieved in various ways: collaboration with SEPR through joint research activities, implementation of participatory and community based research projects, partnerships with development projects and organization of training programs in social analyses and participatory research. Systematic integration of socio-economic and policy issues into IWLMP continues however to be faced with a number of constraints: tension between maintaining quality technology-oriented research and promotion of community based and participatory research, insufficient staff and skills with regard to social analyses, funding sources that do not always favor development of joint projects between social scientists and scientists in biophysics and applied techniques. Additional efforts should provide for: (1) further integrating socioeconomic analyses in the different phases of the research process: diagnosis, technology development, including on farm trials, and ex-post evaluation of technological innovations; (2) reinforcing the move from a technology transfer approach to a participatory technological innovation approach; (3) assessing the costs and benefits (of financial and social nature) associated with the adoption of the innovation, and (4) creating base information required to support research on policies. The implications of land tenure systems and of institutional arrangements for technological innovations and adoption of improved systems also constitute areas of further research developments. Thus, relative to socio-economic and policies research studies it is proposed that a joint IWLMP and SEPRP position be opened for better integrating socio-economic studies in water and land management projects, as well as to support participatory research issues.

The reinforcement of interdisciplinary and participatory approaches requires that the Management Board of ICARDA defines further orientations about socio-economic and policy related research and on the relationships and work integration of SEPRP with IWLMP and eventually with other programs. Concrete actions could include: (1) the setting up of a committee in charge of elaborating a strategy to strengthen interdisciplinary work and participatory research, (2) the recruitment of social scientists

trained in interdisciplinary work, farming systems approaches and community-based research, (3) the development and implementation of a training program in participatory approaches and integration of social analysis in agricultural research, targeting both IWLMP and SEPRP scientists, as well as scientists and students of NARS. In addition to encouraging joint interdisciplinary partnerships (for research and training) with international agricultural research agricultural institutions, it would also be advantageous to develop a scholarship program, such as available through funding sources that support post-doc positions, and associate positions to attract young social scientists.

Relative to droughts and climate change, considering the priorities of ICARDA in this domain, with implications in other programs, agronomic trials are needed to assess differential cultivar responses to abiotic stresses, mainly in relation to droughts, salinity and climate change. The panel considers that the existing collaboration of IWLMP with BIGMP is very important and needs to be further developed, which calls for additional time of the IWLMP staff involved. In order to respond to research needs on droughts and climate change it is advisable that a new position be open within IWLMP mostly oriented to the hydrological/meteorological and physics aspects of droughts and climate change.

The EPMR Panel Recommendation 7 on improving rainfed productivity is being well addressed by IWLMP. Recommendation 8 refers to additional investments in the scientific staff of GISU to tackle the challenges of the new Water and Land Program. The CCER Panel could observe that a very good collaboration developed between IWLMP and GISU, which is apparent in various projects, particularly in the Water Benchmarks Project. Developments in GIS through this Project provide conditions for modeling, for analysis and for out-scaling. The success of this and other recent approaches calls for enhancing GIS capabilities within IWLMP that could provide for synergies with GISU.

As described in item 14 of Section 5, various recommendations of technical nature are provided, which are in line with present developments of research by IWLMP. These recommendations include: (1) new approaches for physical and socio-economic modeling of water harvesting issues in rangelands agro-ecosystems, including for assessing related benefits; (2) further assessing the implications of land tenure, institutional arrangements, and policies on technological innovation and adoption in rangelands; (3) improve knowledge and modeling of water and land productivities and economics of supplemental irrigation, particularly considering the water source; (4) improve knowledge on beneficial effects of conservation agriculture, mainly relative to water and nutrient dynamics of cropping systems as well as on soil fertility in dry areas, including modeling to support controlling the risk of resource mismanagement; (5) adoption of appropriately calibrated and validated irrigation scheduling simulation models to be used in supplemental irrigation and irrigated agro-ecosystems; (6) conducting adaptive research on irrigation systems technologies to assess the constraints imposed by these systems on the application of water saving and salinity control practices; (7) continuing and developing research on dominant wind and water erosion processes, mainly using modeling and GIS for out-scaling and for assessing

possible changes in storm water regimes that impact erosion; (8) modeling to address the impacts of conservation on biomass productivity, economics, and ecosystem services under different agro-ecosystems; (9) further develop research on groundwater conservation, both in terms of quantity and quality; (10) continuing research on marginal quality waters, with particular attention to the control of health and salinity hazards.

Other recommendations relative to technical research issues are those referring to (1) developing new research issues on drought risk management, including early warning, aiming at supporting further developments and applications by the NARS; (2) developing climate change scenarios that may be useful for the BIGM program as well as for NARS in terms of predicting the onset of rains, temperature extremes and changes in rainfall regimes; (3) further developing studies on salinity, including assessing models that address salinity management, either for irrigation with saline waters or cultivation of salt-affected soils; (4) initiate studies on canal delivery scheduling and management aimed at solving existing constraints to adopt improved water saving and salinity management irrigation at farm level; (5) develop studies on irrigation water user associations whose mismanagement of irrigation systems may be constraining water use on farm. It is highly desirable that ICARDA continues collaboration with IWMI on the salinity topic and extend this collaboration to those domains as well as groundwater management in dry areas.

With respect to the administration and financial management (Section 6), the panel is convinced that the system of book keeping, evaluation and auditing is in line with the Center regulations, being transparent and up to date. Project Managers/coordinators take most of the decisions in consultation with the project team and the program director including financial management within the budgets, and work plans consistent with the project objectives as specified in the agreement with donors. Decisions on initiating new projects are taken based on the Medium Term plan, and on feedback from (a) scientists who interact with NARS, (b) donors, (c) partner institutions, and (d) invitations by other parties. Interactions within the program are healthy and of team type operations. The Program revisit its priorities periodically, internally with the ICARDA management, and, externally, with its counterparts (NARS). Similar to the other programs of ICARDA, and other CGIAR Centers, the Program is experiencing a decreasing proportion of unrestricted funding versus restricted project funding.

With respect to personnel (Section 7), the panel observed 3 important vacant positions in IWLMP. However, discussions with the staff and the appreciation of their publications, as well as the responsibilities they assume in terms of projects management, confirm that staff are up-to-date and have the required qualifications in terms of research and cooperation with the NARS. They however, are overstretched with activities.

Relative to coordination and partnership (Section 8), the panel concluded that IWLMP is developing very good collaboration/coordination with other Programs and Units of ICARDA, as well as with other CGIAR Institutes. Various recommendations are presented above aimed at reinforcing these Programs in some critical domains.

1. Background

ICARDA's 5th External Program and Management Review (EPMR) in 2006 recommended that the Center's thematic program structure needed further realignment. Specifically it recommended that *"the two currently separate MPs focusing on natural resources; MP3 (on desertification) and MP1 (on water) should merge as a single Water and Land Program"*.

The EPMR also recommended that *"the MP1 (on water) embrace research on water policy, institutions and adoption strategies to further enhance a very good program in water management"*.

ICARDA in 2007 implemented the EPMR's recommendations and created the Integrated Water and Land Management Program (IWLMP) to foster integration and improve research efficiency. The new program developed its Medium-Term Plan (MTP) 2008-2010, and subsequent plans, to specifically embrace these changes, in line with the Center's new Strategy for 2007-2016, which places special emphasis on water and land issues in the dry areas.

ICARDA, in light of the EPMR recommendations and its new Strategic Plan 2007-2016, and to ensure that its research is consistent with the evolving mission of the CGIAR and emerging water and land issues in the dry areas, commissioned an External Review to assess and review the progress made in the research in the IWLMP and to seek advice for future directions. The CCER Panel was therefore asked to state specific recommendations to address the challenges facing sustainable water and land management within the goals of ICARDA's Strategic Plan. The Terms of Reference (ToR) of this external review consist of Annex 1 and the program of the review is given in Annex 2.

2. Introduction

Dry areas in the world are characterized by highly variable and unpredictable rainfall with limited renewable water resources. The three major agro-ecosystems of the non-tropical dry areas - rainfed, fully irrigated and marginal rangelands - have evolved as a result of climatic extremes and a long history of human occupation and management. Agricultural productivity of the natural resources - water, land and biodiversity - is generally low in the dry areas. Besides, its sustainability is threatened by a number of converging trends

including water scarcity, land degradation, droughts, high population growth rates and climate change. Climate change models predict that West Asia and North Africa (WANA) will become hotter and drier with changes in seasonal and spatial distribution of precipitation and increasing incidence and magnitude of extreme events, which will affect both the availability of water resources and the quality of land, mainly through erosion. Countries in the dry areas with predominantly rural economies and high dependence on agriculture will be at most risk as they are highly vulnerable to shifts in seasonal climatic patterns and changes in hydrological cycles.

The dry area's share of the world's fresh water resources is very limited with many of the countries already below the "poverty level" of less than 1000 cubic meters per capita annually. The current allocation of over 75 percent of the available water for agriculture is decreasing with increased population and competition from the expanding domestic and industrial sectors. Deterioration in water quality is of prime concern as pressure to use marginal-quality saline and wastewater is on the rise. However using these waters requires careful management to avoid the loss of land quality through salinization. Use of groundwater for supplemental irrigation is also increasing. The effects of uncontrolled exploitation of groundwater resources is observed throughout the Dry Areas with dropping groundwater tables, dried up springs and qanats, and salt-water intrusion.

Opportunities for expanding cultivated rainfed or irrigated lands are minimal. As little new water is expected to be available, increases in food production must come mainly from increased water productivity of the rainfed, irrigated and rangelands agro-ecosystems. Land fertility is low, mainly due to dryness, lack of organic matter and wind and water erosion. In addition, salinity often threatens the soils in dry areas. All limitations in water and land affect crop production and biodiversity, thus calling for innovative approaches that help the sustainable use of natural resources in the Dry Areas. Research plays therefore an important role when it is followed by appropriate transfer of knowledge and adoption of innovation by the end users. ICARDA has a research mandate to develop and support innovations for the sustainable use of land and water in these areas.

The ICARDA's Integrated Water and Land Management Program (IWLMP), in collaboration with National Agricultural Research Systems (NARS), Advanced Research Institutions (ARI's), other CGIAR Centers and other ICARDA programs, conducts research to develop technologies, methodologies and strategies as well as policy and

institutional options for sustainable and efficient use of water and land resources in the referred rangelands, rainfed and irrigated agroecosystems of dry areas. The fact that research is conducted in collaboration with other ICARDA programs and other institutions is to be understood in further comments developed in this report and is not referred at every occasion. It is also to be understood that such a collaboration occurs in projects or activities implemented under the responsibility of IWLMP as well as in projects or activities implemented by others. It is also clear to the Panel that responsibilities are shared, particularly in accordance with the technical and scientific domains involved.

The program's research focuses on improving those agro-ecosystems and is conducted in close cooperation with various institutions of the countries in the dry areas, i.e., of the NARS. Research is developed mainly through research projects which are listed in Annex 3 with reference to the research themes of IWLMP. The majority of the projects are executed in partnership with the NARS, and a community-based and participatory research (CPR) is generally adopted. The direct- users of the research outputs and training are the researchers, technicians and policy makers of NARS who transfer technologies and knowledge to farmers and support their adoption of innovative technologies.

This review report summarizes first the research being developed by the IWLMP program, which constitutes the Overview of IWLMP Research section. It follows a section on the Overview of Main Research Issues responding to a few central questions well defined in the Background section of ToR. The following sections refer to specific issues defined in the ToR relative to Research, Administrative and Financial Management, Personnel, and Coordination and Partnership. Recommendations are provided in these sections. Since the outline of this report follows that of the ToR, the major findings are not justified and set out once; rather most of the findings are presented in various sections throughout the report since main questions in the ToR are presented more than once. To facilitate the consideration by the Center, a final section on Conclusions and Recommendations is presented at the end of the report. A section on the methodology used is included in Annex 4.

3. Overview of IWLMP Research

IWLMP research aims at combating land degradation, improving water and land productivities and enhancing land and water uses as the logical responses to increasing water scarcity and desertification in the dry areas. Research focuses the main agro-ecosystems of Dry Areas: rangeland, rainfed agriculture and irrigated agriculture. As referred above, the program work should positively impact the livelihoods of the poor communities and in the long run contribute to alleviating poverty. The program research priorities are aligned with ICARDA's new strategy, NARS priorities, CGIAR priorities and, to a large extent, with the global directions in responding to water scarcity and combating desertification.

In the rangelands (*badia*) agro-ecosystem, the program is promoting water harvesting and the integration of micro catchments practices in the system for rehabilitation of the degraded rangelands and for reversing desertification. Research results show that improved rangelands productivity and reduced land degradation are being attained in the benchmarks sites and beyond. The use of indigenous water harvesting knowledge combined with modern technologies has helped promoting and out scaling innovation issues in the WANA countries, which is expected to expand to sub-Saharan Africa. Further work is needed on modeling the *wadi* watersheds of these low rainfall areas both for evaluating the environmental and direct benefits of water harvesting and to develop appropriate guidelines for out-scaling interventions to other areas. The impacts of land tenure systems and searching for institutional setups needed for adoption of improved systems also constitute areas of required research.

In rainfed agro ecosystems, supplemental irrigation was extensively researched where the system was characterized, analyzed and optimized, and water productivity has been improved. The source of water for supplemental irrigation is groundwater, canal water and, in less extend, treated wastewater. Integrated packages on supplemental irrigation have been developed for cereals and legumes in several WANA countries. IWLMP research in this regard has contributed to improved rainfed crops and water productivity in Syria, Tunisia, Morocco, Turkey, Iran and Iraq. Considering that groundwater is mostly a non renewable resource in large part of Dry Areas due to very low natural recharge, packages on supplemental irrigation should include appropriate management issues for the conservative use of this resource. Relative to wastewater and marginal quality water,

the package should also include management practices aimed at avoiding the health and salinity hazards. More work is needed on the economics of supplemental irrigation and very much needed enabling environments for increased investment in this practice. Further developments are required to also analyze land productivities since the economic return of farmers mainly depends upon these. Research aimed at finding the optimal allocation of water to supplemental (and full irrigation) requires further modeling work. The adoption of appropriately calibrated and validated irrigation scheduling simulation models is also desirable to base the development of alternative supplemental irrigation schedules that NARS may propose to end users.

In irrigated areas the program focused on increasing irrigation water productivity and combating land salinization. The program researchers participated in advancing the concept of water productivity and promoting its improvement at the global level. The tradeoffs between water and land productivities were analyzed and clarified by the program research on various levels of water and land scarcity. Deficit irrigation was researched for cereals and legumes with irrigation production functions published and used in many areas. Responses of cereals and legumes to salinity and drought stresses were evaluated. More work is needed on modeling the soil-water-plant dynamics, either using water balance simulation models or more demanding dynamic models when salts transport need to be considered. Adaptive research on irrigation systems technologies is required because the performance of irrigation systems constrains the appropriate application of water saving and salinity control practices. Adaptive research is also required relative to delivery scheduling in canal systems since it conditions the adoption of irrigation schedules. Also work on the environmental consequences of irrigated agriculture is needed.

The program developed, in collaboration with the GISU, methodologies for assessing water and land resources and potential areas for implementing water harvesting and supplemental irrigation practices, which are applied in Syria, Tunisia, Libya and Iran. The assessment of impacts of supplemental irrigation was developed in Karkheh river basin of Iran. Assessments of groundwater and marginal quality water were also conducted in key areas. However, further developments are required in these domains because groundwater sustainability is very important in the region and technologies for health and environmental impacts of using wastewater have to be controlled to support the expansion of this marginal resource.

A considerable component of the work of IWLMP refers to the soil & water laboratory, which provides analytical services for all programs at ICARDA as well as third-party institutes. Supervision of these activities, upgrading the technical infrastructure (new equipment) and the chemical skills (new analytical methods), as well as the consolidation of the lab-facilities (unifying separate labs of the old Land and Water programs) has been achieved during the past year.

Traditional soil fertility research (impact of chemical fertilizer application and crop rotation) has been expanded to cover various aspects related to Conservation Agriculture. Experiments have been initiated to study the impact of minimum-tillage and residue management on soil fertility (enhancement of soil microbial activity) and soil physical properties (enhanced soil structure), and on soil water dynamics (possible increase of infiltration and reduction in soil evaporation). These experiments are carried out in partnership with the DSIPS program and should impact both land conservation and water and land productivity.

The program developed, implemented and disseminated a benchmarking research site approach in CWANA taking into consideration the different agro-ecologies and levels of water scarcity in the region. Three benchmark sites have been developed with NARS partners for the development, testing and adaptation of improved water and land management options at the farm, irrigation scheme, and watershed levels. The benchmark sites have been established in Jordan, Morocco, and Egypt to represent respectively the marginal dry rangelands agro-ecosystem, the rainfed agro-ecosystems, and the irrigated agro-ecosystems. The benchmark sites are associated with satellite sites in other WANA countries. The program developed and used important methodology for selecting and characterizing the benchmark sites, as well as GIS databases, e.g., with the Jordan NARS, that shall provide for further modeling to be used in out-scaling. The benchmark approach is very successful and receives continuous support and participation from other programs at ICARDA. Likewise, collaboration with GISU has resulted in GIS based similarity and suitability analysis of the benchmark sites that will be very useful for out-scaling improved practices such as water harvesting and supplemental irrigation. More work is needed to further refine the processes, to improve out-scaling methods and to modeling that makes full use of the GIS databases.

The joint initiative of ICARDA and the International Water Management Institute (IWMI) has made significant progress in the field of marginal-quality water resources and salt-affected soils through joint projects (e.g. Salinity Bright Spot project in Central Asia, and SWUP-MED project in Mediterranean countries), knowledge sharing and capacity building (e.g. Bridging Workshops, Borlaug and Fulbright fellowships, and supervision of postgraduate students and interns), and collaboration with partners from developing countries and advanced research institutions. This is an excellent and successful example of inter-center collaboration. There is a need for long-term continuation of this initiative. ICARDA may consider extending collaboration with IWMI in having joint initiatives and staff appointments in other fields of mutual interest such as groundwater management in dry areas and canal delivery scheduling and management.

The ICARDA-IWMI joint initiative has made significant progress in regard to the management and productivity enhancement of salt-affected soils and saline water resources, e.g., conjunctive use of saline water, and amelioration and productivity enhancement of magnesium-affected soils through the use of phosphogypsum in Central Asia. These studies have demonstrated that productivity enhancement of such water and soil resources can play a major role in improving livelihoods and alleviating poverty of poor rural communities. There is a need to follow-up in terms of facilitating technology transfer and the adaptability of these water and land practices by the concerned farming communities.

Considering water scarcity and water quality deterioration, ICARDA has moved forward to collaborate with advanced research institutions to assess models that address salinity management, either for irrigation with saline waters or cultivation of salt-affected soils. This important move should continue and expand as there is a need for ICARDA to also transfer such technologies to NARS through ongoing and future projects.

Based on the recommendation of the CCER of ICARDA's Natural Resource Management Program to continue and intensify its research to better utilize wastewater for irrigation, ICARDA has also initiated work on use of greywater, which is an important resource under extremely water-limited conditions. Considering health and environmental implications of using wastewater in crop production systems, it is important to do comprehensive health and environmental impact assessment of wastewater irrigation to assure its safe and sustainable use. Further developments in

monitoring, crop restrictions and other measures aimed at health safety need to be developed and disseminated in the region.

Models that simulate optimal water management strategies under scarcity were calibrated, verified and used for major crops. Crop-yield-water-soil simulation modeling (e.g., CropSyst) has been initiated. Further modeling activities address the impact of climate change (rising temperatures and CO₂ and reduced and more variable rainfall) on wheat productivity. Possible mitigation strategies, such as early planting, supplemental irrigation, short(er)-season varieties, are also to be covered by simulation scenario analyses.

In the light of progressing pollution of ecosystems by intensified, industrialized agricultural production, and dwindling resources (fertilizer, water, fuel), the Program is initiating the study of 'smarter' cropping systems. These systems must be environmental friendly, resource efficient (fuel, water and fertilizer), while at the same time sustain the food production basis. To achieve such goals, the existing known beneficial effects of conservation cultivation (minimum tillage and crop residue management), integration of legumes, and the rational application of chemical and organic fertilizer must be united. It is furthermore important to understand the nutrient dynamics of enhanced smart cropping systems, e.g. by means of cropping system modeling. The same is true for fully irrigated systems, which, given their high intensive production environment (high input systems), pose a greater risk of resource mismanagement and related damage to the environment.

The program is devising better practices for rainfed areas that are expected to alleviate poverty, protect the land and make better use of the limited water resources. Many practical and cost-effective soil and water conservation technologies were developed, including for hilly areas, with participation of farmers, e.g., inter-cropping (grapes and vetch), stone bunds, non vegetative contour strips, reduced tillage. However, the social and economic aspects regarding the adaptability of these technologies need to be further investigated to provide solid package that could be out-scaled.

There has been great deal of research on participatory technology development to test and fine-tune suitable soil and water conservation and water harvesting technologies (agronomic and structural packages). This was also going side by side with developing modified enabling environment (micro credit system and community-watershed planning

tools) - conducted by the SEPRP, NARS or other cooperating institutions – to facilitate and optimize the implementation of these technologies by the farming communities.

The program realizes the impact of severe rainfall events on soil erosion. An integrated watershed-community planning tools are being developed to adapt for heavy rainfall events and severe erosion, especially in mountainous areas. Also the program undertook various research activities to study the impact of water harvesting and soil conservation technologies on soil erosion but mostly at field level and localized research sites. Further work is needed on adopting and implementing various models to verify the impact of soil conservation and water harvesting technologies on both water and wind erosion. Modeling should address the impact on biomass productivity, economics, and ecosystem services at watershed level and under different agro-ecosystems.

The program leads together with the International Center for Advanced Mediterranean Agronomic Studies (CIHEAM) and FAO the Near East, Mediterranean and Central Asia (NEMEDCA) drought network and hosts its secretariat. The network helped in the dissemination of findings produced by the EU project MEDROPLAN. However, new and upgraded lines of research on droughts need to be developed aimed at risk management, e.g. data handling for quality and trend analysis, and time series analysis of drought indices for developing early warning tools. The program cooperates with the GISU on drought characterization, and with BIGM on drought mitigation. BIGM works on the identification of molecular markers for drought tolerance and NUE, and the selection of more adapted varieties/lines to be tested and released in collaboration with NARS. This includes the characterization of cultivars and identification of agro-physiological traits associated with drought tolerance and nitrogen use efficiency (NUE).

Climate change (CC) is another research subject of the program. Work is being done to assess the impact of CC on crop production in relation to the increase of CO₂ level in the atmosphere and to temperature and rainfall variation. CropSyst model has been calibrated and may be used to simulate the effect of supplemental irrigation on wheat yields under different scenarios of predicted CC to base further research on adaptation measures. The program studies the interactions among zero tillage, water regime and genotypes of bread wheat to assess the impact on the improved use of rainwater. Work on temporal trends in climatic weather data series needs to be further strengthened particularly relative to the on-set of rainfall, temperature extremes and rainfall (and

runoff) extremes to assess strategies that take into account risk management and adaptation.

The socio-economic and policy research of the program is conducted through the SEPRP staff and it is integrated in several projects, e.g., the benchmarks project, the Karkheh basin project, and the land management projects in Syria. Often, the shortage of human resources at ICARDA leads to hiring consultants. However, given the importance of the socio-economic and policy research in context of ICARDA projects, and considering the responsibilities assigned to IWLMP in terms of integrating issues related to policy, institutions and adoption strategies to further enhance a very good program in water management (EPMR5 recommendation 6), it is advisable to strengthen the capabilities of ICARDA through a joint appointment of staff by IWLMP and SEPRP (the analysis hereafter, mainly under items 1 of Section 4 and item 2 of Section 5, give appropriate justification for this proposal).

Capacity building efforts undertaken by IWLMP are oriented towards the enhancement of the NARS human capacity to manage water and land resources efficiently and properly. IWLMP conducted high-skill targeted training on all water management issues, including water use efficiency and water productivity, drought management, supplemental irrigation, water harvesting techniques and efficient irrigation water use. The scope is to improve human capabilities of NARS to conduct research with relevance to their national needs, with emphasis on the deficiencies associated with the implementation of the collaborative research projects, lead by ICARDA. The improvement of human capacities was also supported through the enrollment of M. Sc. and Ph. D. students in the laboratories of IWLMP, by organizing and supporting workshops and conferences at ICARDA and in the countries, and by conducting awareness building campaigns at different stakeholder levels.

4. Overview on main research issues

The Center Commissioned External Review (CCER) was asked to address the following questions:

1. Has the new program implemented the EPMR recommendations satisfactorily?

Recommendation 3 states that the formerly “separate MPs focusing, on natural resources, MP3 (on desertification) and MP1 (on water) should merge as a single Water and Land Program, while the MP3 activities on land tenure, rangelands and policy options should be integrated with work on diversification (currently MP4) and other work on socio-economics and policy be integrated in MP5”.

The following themes of the Integrated Land and Water Management Program (IWLMP) evidence that the new program is implementing the EPMR recommendation 3 satisfactorily:

Theme 1 - Assessment of Water and Land Resources for Agriculture – addresses the integrated assessment of the potential and availability of water and land resources for agriculture, as well as the identification of the constraints limiting the improved resource use in agriculture. As per projects developed, the IWLMP assesses water and land resources' potential productivity and degradation under present and future scenarios at the farm-, ecosystem- and basin-levels, as well as relative to the diverse climate and agro-ecosystems occurring in the Dry Areas.

Theme 2 - Increasing Agricultural Water and Land Productivity in Dry Areas - refers to improving agricultural water and land productivity at the field, farm and basin scales. The principal management options that can improve water and land productivity include: improved crop varieties and cropping patterns, and adoption of precision agriculture, improved water management technologies and modern irrigation. IWLMP is developing appropriate technologies and integrated management options that assess these management options. Approaches include the improvement of water and land productivities in: (a) dryland farming systems through improved agro-management, conjunctive use of rainwater and supplemental irrigation; (b) crop-range-livestock systems of marginal arid environments through water harvesting techniques; and (c) irrigated agro-systems through improving irrigation management, water use efficient germplasm, and cropping patterns. Approaches take into consideration the effects of physical, economic, environmental and energy requirements on water and land productivity.

Theme 3: Combating Land Degradation. The principal topics of degradation of concern to IWLMP are wind and water erosion of soils, soil salinity and, at a wider scale, desertification. IWLMP develops and disseminates practical, low-cost options to protect soil and water resources in dry areas, mainly in rangeland and rainfed agro-ecosystems, but also includes irrigated agriculture in regard to soil salinity. It also includes the development of multi-scale tools and methods to assess land degradation and vulnerability to desertification in dry areas. The integration of land and water in this theme is better viewed when desertification is understood as a process embracing soil, water, vegetation, biodiversity, fertility and human resources of a given area. In the perspective of integration, this Theme 3 could better be entitled “Combating Land Desertification” or “Combating Land and Water Degradation”.

The CCER panel does not fully understand why the EPMR Panel recommended (recommendation 3) that MP3 (land) activities on rangelands and policy options should be integrated with work on diversification. In fact, research on land (not soil only) relative to rangeland agro-ecosystems definitely requires the integration with water related research, particularly water harvesting, since the main constraint of rangelands is very likely water. The condition of rangeland agro-ecosystems in dry areas, with annual rainfall averaging 100 to 250 mm, is very different from rangelands in sub-humid climates, where the integration with diversification would be much more rational. The CCER panel had the occasion to discuss with staff of the DSIPSP program and could observe that water issues are the main constraint for this research group and that improving water availability is essential to improve the productivity of rangeland agro-ecosystems. Consequently, the collaboration between IWLMP and DSIPSP needs to continue and to be strengthened.

The CCER panel also does not understand why the EPMR Panel recommended (recommendation 3) that work of former MP3 (land) on socio-economics and policy be integrated in MP5 (policies). In fact, the problems for adopting and implementing innovation in rangelands management requires that socio-economic and policy work be developed jointly by DSIPSP, IWLMP and SEPRP in a manner similar to other water management issues focused in the recommendation 6 analyzed below. For instance, results of the recently concluded project on Water Benchmarks include a socio-

economic study of the *badia*, i.e., the arid rangelands of Jordan. This study, among other findings, shows that water harvesting (in its diverse forms) is the main tool for improving these ecosystems. These results support the idea that rangeland agro-ecosystems should be considered in a similar form to rainfed and irrigated agro-ecosystems. However, as for all agro-ecosystems, a close cooperation and work integration is required between IWLMP and SEPRP, which is developing quite well as the panel heard during discussions with both groups.

The EPMR Panel identified the need to specifically “strengthen collaboration between research on water management per se and research on water policy and institutional constraints to the adoption of water conservation technologies, so as to develop strategies for improving rates of adoption”. This led to Recommendation 6 stating “that MP1 embraces research on water policy, institutions and adoption strategies to further enhance a very good program in water management”.

Following this recommendation, the IWLMP group includes the research *Theme 5 - Integration of policies and institutional options* -, which fully responds to this recommendation. IWLMP develops frameworks for conservation and sustainable management of ecosystems with emphasis on their multi-functionality and involves a local multi-stakeholder process that links land users with policy- and decision-makers. Thus, the IWLMP program links research to policy in terms of water and land management to broaden the partnership-base to include civil society and local research institutes. This activity is mainly developed in collaboration with the SEPR Program. It includes: (a) developing methodologies for scarce water resource valuation for major dry environments and socio-economic conditions; (b) studying current policies on water allocation, valuation and use; and (c) reviewing existing water management institutions and developing appropriate alternative institutional issues to improve irrigation management. However, the panel considers that this recommendation on integration of research on water policy and institutional issues needs to be strengthened: it should embrace socio-economic research that would provide for (a) generating technological innovation based on a thorough assessment of farmers’ needs and socioeconomic environment; (b) evaluating the costs and benefits (of financial and social nature) associated with the adoption of the innovation taking into consideration the situation of end-users; and (c) creating base information required to formulate policies that could

favor the adoption of the methodology. While recognizing the tension between maintaining quality technology-oriented research and promotion of community based and participatory research, the Panel considers that integration of ILWMP work with SEPRP requires a shift from a technology transfer approach to a participatory technology generation approach. A more global view of socioeconomic issues, including greater attention to land tenure systems and institutional arrangements for technological innovations needs to be promoted. This paradigm shift involves alleviating existing constraints: insufficient staff and skills with regard to sociological analyses, funding sources that do not always favor development of joint projects between social scientists and scientists in biophysics and engineering. Thus, relative to the integration of socio-economic and policy research, it is proposed that a joint IWLMP and SEPRP position be opened for better integrating socio-economic studies in water and land management projects, as well as to support participatory research issues.

The CCER panel observed that activities relative to Theme 5, in addition to studies aimed at formulating policies, included economic appraisals and analysis, done in collaboration with the SEPRP. The panel also observed that collaboration with SEPRP includes water and land studies and that community-based and participatory research is adopted in land and water management research projects, which is considered a positive contribution to integration. Considering EPMR Recommendation 6 stating “that MP1 embraces research on water policy, institutions and adoption strategies to further enhance a very good program in water management”, and given the need for socio-economic and policy studies to integrate technological projects, it is advisable to consider strengthening the existing staff through the joint appointment (IWLMP and SEPRP) of a social scientist devoted to water and land studies.

The EPMR Panel also identified the need for “research to meet the pressing future food production requirements of the CWANA regions, thus the need to focus on productivity improvements, and more specifically on bridging the yield gap between actual and attainable production, mainly relative to the current realities of dry land agriculture”. Consequently that Panel proposed Recommendation 7 on the need for “increased efforts in agronomy to assist countries in bridging the yield gap between actual and attainable yields, including researching the agronomy, crop management and economic incentives required to generate the needed synergies with the breeding efforts”.

As referred above, the IWLMP group is developing the research Theme 2 on Increasing Agricultural Water and Land Productivity in Dry Areas, referring to improving agricultural water and land productivity at the farm level, which is achieved by using improved crop varieties, precision agriculture, modern irrigation, improved cropping patterns, and improved water management. It may therefore be concluded that Recommendation 7 is being successfully implemented. Moreover, water productivity refers not only to crop yields, but also to the economic, nutritional, energetic and environmental yield values, which are of great importance. Studies on land productivity should also develop similarly since land productivity is a key factor in the income of farm communities.

The EPMR Panel considered “additionally to such an effort, supporting both research on yield gaps and to conduct additional research in the areas of agroecological characterization, spatial analyses, remote sensing and related fields in natural resources management”. Panel recommended (Recommendation 8) that “additional investments are made in the GISU unit by providing it with sufficient scientific staff to tackle the challenges of the new Water and Land Program (Recommendation 3)”. It was further recommended that “ICARDA should map, with the help of modeling and available data on actual yields over several years, the difference between actual yields of crops and the yields expected if the crops were limited only by water and not by disease or management”. This recommendation may also be understood as demanding an increased collaboration between the GISU and the IWLPM on the referred domains.

The CCER panel could observe that a very good collaboration developed between IWLMP and GISU, which is apparent in various projects, particularly in the Water Benchmarks Project, where agro-ecological zoning is the base to define the benchmark sites and to develop out-scaling of Project results. Collaboration in terms of analysis and databases of climate variables and droughts are other themes evident from this collaboration. The recommendation on mapping the yield gaps and the yield gains due to water management are expected to result from the continuation of the Water Benchmarks Project. However, more important than just mapping, it could be of interest to develop or implement a dynamic management tool operating with GIS that could help in decision making.

The CCER panel could observe that the Water Benchmarks Project developed new skills in GIS. In case of the *badia* site in Jordan, the GIS is being operated as a true

database system, where all interventions are recorded and mapped. This constitutes an essential tool for modeling, analysis and out-scaling. Moreover, this GIS tool is now totally operated by the NARS partner, thus demonstrating successful collaboration and transfer of technologies. The success of this and other recent approaches calls for enhancing GIS capabilities within IWLMP that could provide for synergies with GISU.

Recommendation 9 refers to developing “a strategy for research in horticulture by identifying the subject matter where the return on research investments would be highest in the various agro-ecologies of the Dry Areas”. This requires that horticultural water management be considered. The EPMR Panel identified “tree crops such as olive, almond and pistachio, as one of the most promising areas for horticultural research in the dry areas”, and expressed the belief “that networking and partnering would be the most appropriate instruments for knowledge dissemination and problem solving, with ICARDA linking the NARS with advanced institutions” on this domain.

IWLMP is presently operating in hilly rainfed areas where the main crop is olives for which IWLMP developed appropriate water harvesting and soil conservation technologies. Water harvesting in the *badia* is also being used by farmers to provide for planting medicinal plants and almond trees. IWLMP is also collaborating in a project of the DSIPS Program relative to protected horticulture in Saudi Arabia where the IWLMP is providing support on irrigation. Although this is only a small response to the various aspects dealt related to Recommendation 9, the fact is that IWLMP is already performing research along these lines. Further developments and implementations can be expected once ICARDA better defines priorities relative to horticultural crops, which is expected soon.

The CCER panel therefore concludes that the EPMR recommendations are being successfully implemented by IWLMP.

2. Does the research program address the new directions in water and land as adopted in the Center’s Strategic Plan 2007-2016, especially within the context of climate change?

Global challenges identified in the Center’s Strategic Plan 2007-2016 include:

- Population growth and food deficits
- Water poverty or water scarcity, and

- Land degradation and desertification

The consequent new dimensions in the strategy of ICARDA refer to:

- a) Increased emphasis on risk management, drought mitigation and the adaptive capacity of agriculture to climate change
- b) Greater emphasis on water and land management for sustainable agricultural development within diverse production systems
- c) Increased emphasis on improving water productivity in terms of the biophysical, economic, social and environmental returns per unit of water
- d) Increased emphasis on socio-economic research [...] develop policy options for the successful implementation and adoption of new technologies, and
- e) Broadening the geographic coverage to non-tropical dry areas [...] with increased attention to Sub-Saharan Africa, South Asia, China and Latin America.

The analysis of activities of IWLMP show that research *Theme 4 - Drought and Climate Change Preparedness and Mitigation* – focuses on subject (a) above. Research efforts include: developing methodologies for characterizing drought, developing tools for drought risk management including preparedness and mitigation, assessing community strategies to cope with drought, evaluating germplasm for adaptation to drought and other climatic risks, assessing potential impacts of climate change, and developing adaptation measures relative to water and land management. Nevertheless, due to the complexity of the problems referring to climate variability and climate variation, further developments are required to better deal with these themes and to support coherent developments in the countries of the region. This includes weather data handling to include, for example, early warning of drought intensity, the on-set of seasonal rainfall, extreme temperatures and extreme rainfall (and runoff) events.

The strategic subject (b) refers specifically to IWLMP since it asks for a greater emphasis on water and land management for sustainable agricultural development within diverse production systems. IWLMP is responding positively in two ways: maintaining and developing a good portfolio of research projects, and adopting a research strategy focused on agro-ecosystems – rangeland, rainfed and irrigated. The first approach allows the group to expand and improve impacts and interactions with

NARS counterparts and the international community. The second approach supports research and development projects in a variety of production systems and at various scales of those agro-ecosystems.

The IWLMP activities are responding well to strategic subject (c) as described above in the discussion about Theme 2 (item 1 of Section 4). It is important to notice that the group's research responds not only to the strategic improvements in water productivity but also on improvements in land productivity, a core feature of IWLMP.

As noted previously, IWLMP is actively cooperating with the SEPRP in socio-economic and policy studies aimed at assessing the feasibility and acceptability of research findings aimed at the successful implementation and adoption of new technologies. This responds to the strategic subject (d) on increased emphasis on socio-economic research. This topic has also been addressed relative to the Recommendation 6. Again, these studies address the research activities related to both water and land management.

The strategic subject (e) calls for broadening the geographic coverage out of the traditional CWANA countries to other non-tropical dry areas, mainly Sub-Saharan Africa, South Asia, China and Latin America. The CCER panel could observe that IWLMP initiated research in Ethiopia and is part of a consortium that submitted a proposal to EC focusing on Sub-Saharan Africa. IWLMP activities are being prepared to extend to Latin-America – with a water productivity project already initiated in South America, a consortium project on climate change funded by Fontagro. A project proposal on livestock water productivity was developed with Embrapa for the semi-arid lands of northeastern Brazil but was not funded. Project proposals relative to dry areas in China and ICAR of India are waiting decisions for funding.

The CCER panel is definitely convinced that IWLMP is successfully addressing the new directions in water and land as adopted in the ICARDA Strategic Plan 2007-2016, including the context of climate change.

3. Does the program address the CGIAR system and NARS' priorities and the emerging global issues associated with water and land?

It is recognized that CGIAR priorities relative to natural resources are being addressed by the group. In fact, the strategic priorities defined by ICARDA result from those established at the CGIAR level. Collaborations with other CGIAR centers such as IWMI and ICRISAT, and the involvement of IWLMP in the CGIAR Challenge Program on Water & Food, as well as the Comprehensive Assessment of Water Management in Agriculture, also corroborate that assumption.

Relative to NARS, priorities are compatible with those of ICARDA when analyzed at a wide scale, and correspond to the project themes when priorities are focused at national or regional level. IWLMP always has projects with partners from NARS, and there is a good collaboration between NARS and IWLMP for preparing project proposals, which means that projects always satisfy the priorities of the cooperating NARS including when donors open calls for focused projects. The large number of projects in charge of IWLMP, with various sizes and a large variety of partners of NARS, allows formulating the assumption that NARS priorities are addressed. In addition, the panel had contacts with various NARS partners in Syria, Jordan and Egypt and it was confirmed that IWLMP is responding well to their priorities: in fact cooperation with IWLMP is highly desired. Moreover, the NARS consider that joining in projects with ICARDA increases the chances for funding their research and for improving the human capacity of their research institutions.

The emerging global issues associated with water and land may be summarized as the following:

- Sustainable use of water and land that responds to future needs of a growing population and overcomes present food deficits and population poverty
- Developing technological, managerial and socio-economic tools to cope with water scarcity, including projects that address the increased competition for water from the various user sectors and the associated need to increase safe use of marginal quality waters.
- Prioritizing the preservation of the water resource, with particular emphasis on groundwater, both in terms of quantity and quality

- Developing technological, managerial and socio-economic tools to prevent and combat land degradation and desertification
- Broadening the sustainability concepts on natural resources use to give consideration to health impacts of water use and reuse
- Developing adaptation measures that may contribute to minimize the impacts of climate change and climate variability

A research program cannot respond to all global and local issues. Global issues are relevant driving forces for local issues related to the various environments in dry areas as is the case of arid rangeland agro-ecosystems, semiarid to sub-humid rainfed agro-ecosystems, and irrigated agro-ecosystems. The foci of the research conducted by IWLMP are definitely in line with the referred emerging global issues associated with water and land. Moreover, increasing knowledge, developing consequent application tools and transferring research results to the national and local institutions helps to address the emerging global and local issues associated with water and land.

It is appropriate to underline the great effort of IWLMP in strengthening the human capacities of the NARS partner institutions. The activities under *Theme 6 – “Enhancing NARS human capacity to improve water and land management”* is definitely relevant to help responding to NARS priorities and to support NARS preparation to face the referred emerging challenges. Activities under Theme 6 conduct targeted training on a variety of water management issues including water productivity, drought management, supplemental irrigation, water harvesting and efficient irrigation systems. The purpose is to enhance NARS capacity to conduct research that is relevant to their national needs and in response to emerging challenges. To be also noted, that projects are also serving to support post-graduates research in the NARS, e.g., the Water Benchmarks project recently provided for two PhD students in Jordan (Ms. Samia Akroush, NCARE and the University of Jordan; ICARDA supervisor - Dr. Kamel Shideed; and Ms. Nesreen Shawahneh, NCARE and University of Jordan, ICARDA supervisor – Dr. Theib Oweis)

Following the statements above, the CCER panel considers that IWLMP appropriately addresses the CGIAR system and NARS’ priorities and the emerging global issues associated with water and land.

4. Does the research program address the strategic aspects of sustainable use of limited water resources, especially in the context of livelihoods and poverty alleviation, in non-tropical dry areas?

IWLMP focuses on three main agro-ecosystems of the dry areas: rangeland, rainfed, and irrigated agro-ecosystems. The first are characterized by water poverty, i.e., water is definitely the main factor limiting development. Research on these agro-ecosystems has focused and continues to focus on water harvesting, which has various forms and is the only way to mobilize water. The second is characterized by the variability of rainfall and therefore the need for a conjunctive use of rainfall and irrigation water when this is available. This approach is being developed through the study of deficit supplemental irrigation, i.e., considering that water is again the limiting factor and should be used not to cover the full crop water requirements but aiming at economic viability. In irrigated agro-ecosystems a variety of aspects are under consideration: on the one hand, the use of marginal, non-conventional water resources, including irrigation with treated wastewater generated by cities and drainage water generated by irrigated agriculture; on the other hand, the efficient and sustainable use of irrigation water is a priority.

The research by ICARDA address the farmers and rural populations together with the NARS partners. These apply the research findings in the local contexts and assume the responsibilities for training of non-research personnel and the farmers. However, IWLMP contributes to the ultimate transfer of knowledge through supporting training at the NARS level. This transfer of knowledge, particularly the actions that provide for the progressive implementation and adoption of innovation by farmers, certainly contributes to improved rural livelihoods and poverty alleviation. The case of the Water Benchmarks Project is a good example: technology transfer to other basins in South and East Jordan is already initiated, and the rehabilitation of the rangelands following the degradation caused by the Gulf War is going to apply the project technologies and tools developed in that project.

Although not all situations are under consideration, and the fact that the responsibility for addressing the solutions at the local rural level are with the NARS partners, the CCER panel considers that the research program of IWLMP appropriately addresses the strategic aspects of sustainable use of limited water resources, in the context of livelihoods and poverty alleviation in non-tropical dry areas.

5. Does the program cover effectively the use of various types of water resources in agriculture?

Current research and development studies include: (a) water harvesting, e.g., collection of rain water and runoff water for use by humans, crops, and animals; (b) developing on-farm and technological assessments of the suitability of marginal quality waters - agricultural drainage water, treated wastewater and grey water - to alleviate water shortages and strategies that foster long-term sustainable use of such waters; (c) additional projects dealing with good to medium quality canal water and groundwater. Studies refer to the characteristics of the resource and to the measures required to make uses appropriate and sustainable, e.g. the grey water project in Jordan is considering a good monitoring program, covering plant, soil and human health impacts, as well as strict guidelines for use. However, more work is needed particularly referring to groundwater and marginal quality waters.

The Panel considers that the program covers effectively the use of various types of water resources in agriculture and should prioritize further developing research on this domain.

6. To what extent the outputs, outcomes and impact generated by the program are relevant to rural poverty alleviation and sustainable natural resource management and achieved in an effective and efficient manner?

This question clearly relates to the above response to Question 4. Developing technological and managerial tools for an improved use of limited water resources, to prevent soil and water degradation, and to cope with droughts and climate variability in rangeland, rainfed and irrigated agro-ecosystems certainly contributes to a sustainable natural resource management. Developing these activities jointly with NARS country teams, contributing to strengthen their human resources, and collaborating and supporting them in technology transfer to the end users, also contribute to rural poverty alleviation of rural populations.

The Panel considers that the outputs, outcomes and impact generated by the program are relevant to rural poverty alleviation and sustainable natural resource management and are achieved in an effective and efficient manner.

7. What is the quality of science in the program?

The quality of science may be assessed by analyzing the research outcomes and outreach activities, particularly concerning how they respond to the policies of CGIAR and ICARDA, how they contribute to solving problems in the targeted regions, including those referring to improving the livelihood of populations and poverty alleviation, and how they benefit the NARS and the respective target end users. The analysis performed above clearly shows that IWLMP fully responds to the referred policies and objectives, thus assuming a level of excellence in this regard.

The quality of science may be measured through various indicators referring to the various types of publications with emphasis on ISI journal papers, patents, invited speeches, organized scientific and technical events, collaborations with other scientific institutions - of the NARS, the CGIAR system or international -, research and technology transfer projects, training activities through focused short courses, training MSc and PhD students, and outreach activities of various nature. Particularly noteworthy are invitations to submit review papers such as the paper published in *Advances in Agronomy* by Qadir et al.

The number of ISI journal papers is high, 33 for the IWLMP and 36 for the former MP1 and MP3, which corresponds to an average of 2.64 and 2.04 papers per staff of IWLMP and MP1&3 respectively. In addition, the IWLMP staff produced 6 books, 6 book chapters, 29 conference papers published in proceedings and 8 conference abstract papers; the MP1&3 staff produced 4 books, 8 book chapters, 49 conference papers and 10 conference abstract papers. Research reports by IWLMP and former MP1&3 staff are respectively 20 and 13. Brochures and caravan papers produced by IWLMP and MP1&3 staff are respectively 6 and 20. This number of publications is very high and reflects both the orientations for research and for development.

IWLMP is currently implementing 31 research, training and knowledge sharing projects, which is a high number when considering that there are only 6 senior staff (3 positions vacant), 4 national professionals, 1 post-doc, 1 senior consultant and 1 research assistant. IWLMP carries out 4 training courses per year, with duration from 1 to 5 weeks. During the last decade 52 post-graduate students were trained within the program, out of which 20 got a PhD degree. In addition, also 32 interns were trained at

IWLMP laboratories. These activities demonstrate a very dynamic attitude of the program and of its leader.

To develop its research and outreach activities, IWLMP collaborated over the last few years with staff of other CGIAR institutions – IWMI, IRRI, CIAT, ICRISAT and IFPRI -, with UN institutions – UNU, UNESCO, FAO, ESCWA, WMO -, with various advance research institutions and/or universities (14) in various continents, and with NARS institutions in 33 countries. This situation shows an excellent internationalization of the research and development activities of IWLMP.

Based on the above comments, the Panel considers that the orientations for research and for development are well balanced and that the scientific quality of research is excellent.

5. Research

1. Establishment of a coherent and integrated multidisciplinary program of research on water and land, with a clear balance between both, and a clear strategy and research work-plans that address the critical issues of water scarcity and land degradation in the dry areas.

Land productivity is directly linked to the characteristics of crops, climate, soils and to the management by farming communities that put land in use. Aridity, water scarcity and variable soil characteristics pose limitations on the crops that can be grown, and the available management options available to grow them. The projects underway in the IWLMP program are relevant to these options: water harvesting, supplemental irrigation, safe use of marginal quality waters, characterization of potential land productivity using satellite imagery, assessment of groundwater resources, land degradation and climate change, policies, and capacity building (see the overviews on activities performed and research issues in Sections 3 and 4 respectively).

The IWLMP does have a ‘balanced’ approach in the research program consistent with the strategic plan of ICARDA for 2007 -2016 (see items 1 and 2 of Section 4). The word ‘balanced’ does not totally capture what is involved in program development and management. Program goals continually require adjustment because the source of funding is linked closely to a competitive grant process. Stated simply, the management team must adjust its goals based on the projects that are funded. However, the diversity

of the climates, crops, topography, water resources and soils within CWANA provide many opportunities to continually pose projects to funding agencies that target the basic objective – to increase land and water productivity and improve the health and welfare of people within CWANA, and other locations in the world with similar climates.

The IWLMP approach is balanced also because its goals extend from research to adoption of improved management practices. The linkages with NARS (see item 3 of Section 4), made more robust because of work done at benchmark sites within WANA, are key to mobilizing efforts to pass the findings to the farming communities and to governmental agencies with responsibilities to set regional and national policies that foster adoption.

2. Extent to which the social and economic dimensions of water and land research are adequately addressed in the research program.

ICARDA's strategy, which is mainly oriented towards developing research and technologies to achieve the Millennium Development Goals relative to the sustainable use of natural resources and alleviate poverty in rural areas, strongly affirms the necessity to integrate socioeconomic and policy analysis into its main research programs. The IWLM research program stresses the need to develop an integrated approach, taking into account the complexity of factors that intervene in the sustainable management of water and land resources (including socioeconomic, institutional and policy related factors). This integrative approach includes stakeholder participation, as a main instrument to include beneficiaries' needs in research design and to encourage farmers' adoption of new technologies. The development of community based research projects, in addition to station-based research, has created a new need for socioeconomic analyses, as well as training in participatory approaches. It also has created a growing need for collaboration between social scientists and water and land management specialists.

As referred before (item 1 of Section 4), following EPMR5 recommendations, the IWLM program gives an increased attention to policy and institutional issues, with the aim to assess the impact of existing policies on water and land use practices and to identify policy options and an enabling institutional environment for technology adoption.

The main strategy adopted to ensure the integration of socioeconomic and policy dimensions of water and land management rests on the implementation of community-

based and development oriented research projects carried out at regional or local level. The integrative approach concerns all phases of the research process: proposal development, identification and planning of activities, characterization of the socio-ecological systems, technology development, and assessment of socioeconomic impacts. Concrete examples of the attempt to implement this integrated water and land management approach are provided by projects such as the Khanasser Valley (Syria), the Machreq and Maghreb project, the Vallerani water harvesting systems, the water challenge program, the community based soil erosion reduction project (Syria), the Rainfed systems in Ethiopia, the Jaboul agro-system (Syria), and the Water and Livelihoods Initiative.

ICARDA's IWLMP has implemented the Water Benchmarks Project, which includes a strong socio-economic component. This project constitutes the best illustration of the integration of the different dimensions of water and land management. The project has main research sites in three countries of CWANA: Morocco, Egypt and Jordan. The selected sites in each country are representative of different agroecosystems: rainfed in Morocco, irrigated in Egypt, and the steppe rangelands in Jordan. Research activities carried out on these main benchmark sites are further elaborated in satellite sites in other countries. They involve importantly the NARS in each of the countries. Other partnerships include the CIHEAM and several ARIs. Benchmark sites and satellite sites projects are applying an integrated approach which combines technical, socio-economical, and institutional and policy related analyses.

In order to reinforce the capacity of research teams to effectively implement community based and participatory research, IWLMP has made an important effort in terms of capacity building and training. Training courses in community based participatory research have been organized in relation to the implementation of action-oriented research projects (Egypt 2005, Participatory L&WM for livelihood resilience, Karkheh River basin in Iran, Water Management for Improved Water Use Efficiency in the Dry Areas, 2006, which integrates the role of gender in agriculture and water management). As referred further in recommendations (item 14 and Section 9), this strategy aimed at integrating socioeconomic and gender issues in IWLMP training activities needs to be reinforced and systemized (for example the water harvesting course organized in 2009 did not include socioeconomic issues).

Despite efforts made by the IWLMP to develop new research approaches and practices, which give greater consideration to socioeconomic issues, important constraints continue to hinder an effective implementation of interdisciplinary work associating social sciences and technical sciences. The constraints are of different types:

- A tendency to focus on a technology transfer approach, rather than on participatory based technology generation. This reveals a restrictive conception of social and policy related issues, which are viewed primarily in terms of constraints impeding the development process. Although farmers, faced with the immediate need to make living in a competitive environment while maintaining working relationships within their farming communities, can be reluctant to adopt new land and water management techniques, they also need to be seen as key partners in the research and development process. For example, the efforts made by the IWLMP to integrate local knowledge need to be reinforced and a greater consideration should be given to women's knowledge and contribution to water and land management. Similarly, the restrictive understanding of policy issues contributes to giving priority to impacts assessment and policy conditions for technology adoption. They need to be better balanced in considering the macro economic level and the farm/community level, as well as at the social level. Also institutional aspects of water and land management (local arrangements, water users' associations) should be given systematic consideration.
- An increasing tension between the need, on the one side to maintain the technology development oriented research and the quality of science and, on the other side, to promote community based and participatory research. This type of research is very time consuming, divert the scientists from research activities that they have been trained for and require new skills.
- The available staff is insufficient: 6 scientists in the socioeconomic program (SEPRP), who have their own projects, and who do not have the necessary time and the skills (particularly with regard to sociological analyses) to meet the important needs of the IWLMP in terms of the integration of socioeconomic issues.
- Lack of expertise: Interdisciplinary work and community-based research require specific skills and methodological tools that IWLMP scientists are not familiar with.

- The funding systems of research projects do not always favor the development of joint projects between social scientists and scientists in biophysics, agronomy and engineering. Pressure of deadlines sometimes does not allow IWLMP to consult with socio-economists before developing a research proposal.

3. Congruence of the Program's research activities with ICARDA's Strategic Plan.

The ICARDA's Strategic Plan refers to the following challenges: population growth and food deficits, water poverty or water scarcity, and land degradation and desertification. It also specifies new research goals; how IWLMP is responding to them follows (see also item 2 of Section 4, where this subject is also analyzed):

a) Increased emphasis on risk management, drought mitigation and the adaptive capacity of agriculture to climate change

IWLMP Theme 4 - Drought and Climate Change Preparedness and Mitigation, addresses this goal. Research topics include development of methodologies to characterize drought, development of tools for drought risk management, assessing community strategies to cope with drought, conducting trials to evaluate germplasm for adaptation to drought and other climatic risks, assessing potential impacts of climate change, and progressively developing adaptation measures relative to water and land management. Due to the complexity of the problems referring to climate variability and climate variation as well as the varied characteristics of the agro-ecosystems in the region, as well as the differences in institutional arrangements within WANA countries, further developments are required, particularly to support coherent developments in the countries of the region. These expected developments include: (a) weather data handling, including data quality and trends analysis, (b) use of drought indices and time series analysis to develop early warning and information systems, (c) predicting/warning the on-set of rainfall, (d) analysis of extreme temperatures and extreme rainfall (and runoff) events. These developments are expected to support improvements in adaptation to climate change.

b) Greater emphasis on water and land management for sustainable agricultural development within diverse production systems

This strategic subject is being currently addressed by IWLMP through its Themes 1, 2, and 3 (respectively Assessment of Water and Land Resources for Agriculture,

Increasing Agricultural Water and Land Productivity in Dry Areas, and Combating Land Degradation). IWLMP maintains a good portfolio of research projects that allows the group to expand research and create better influence on the NARS counterparts and the international community. Research is performed considering the integration of water and land resources, which is essential in agricultural use of water, and refers to various types of water resources, including non conventional ones. In addition, research foci include rangeland, rainfed and irrigated agro-ecosystems, which provides for the research to support developments in a variety of production systems and at various production scales.

c) Increased emphasis on improving water productivity in terms of the biophysical, economic, social and environmental returns per unit of water

IWLMP Theme 2 (water and land productivity) is a robust response to this goal. Research projects address the use of improved crop varieties, precision agriculture, modern irrigation, improved cropping patterns and improved water management. It concerns rangeland, rainfed and irrigated agro-ecosystems and applies to the field, farm and basin scales. These projects focus on the assessment of water productivity in terms of physical, economic, nutritional, environmental and energetic productivities of water. In addition, the group's research responds not only to the strategic improvements in water productivity but also in land productivity.

d) Increased emphasis on socio-economic research [...] develop policy options for the successful implementation and adoption of new technologies,

The IWLMP group is actively cooperating with the SEPRP in socio-economic and policy studies aimed at assessing the feasibility and acceptability of research findings, and the successful generation, implementation and adoption of new technologies. These studies tend to be part of every new project being prepared and submitted by IWLMP referring to rangeland, rainfed or irrigated agro-ecosystems. Moreover, these studies refer not only to water technologies and management tools but also embrace research on land management (See detailed comments in item 2 of this Section, above).

e) Broadening the geographic coverage to non-tropical dry areas [...] with increased attention to Sub-Saharan Africa, South Asia, China and Latin America.

The CCER panel could observe that IWLMP activities are being prepared to extend beyond CWANA to Latin-America, with projects on water productivity and climate change and collaborations with Embrapa, Brazil, China Academy of Agricultural Science (CAAS), and Indian NARS. In addition, IWLMP initiated research in Ethiopia and is part of a consortium that submitted a proposal to EC focusing on Sub-Saharan Africa.

The CCER panel is definitely convinced that IWLMP's research activities are congruent with the ICARDA's Strategic Plan.

4. The recommendations of the 5th EPMR related to water and land and the progress made in implementing those recommendations.

This subject is analyzed in item 1 of Section 4. The essential of that analysis follows.

Recommendation 3 states that the former MP3 (on desertification) and MP1 (on water) should merge as a single Water and Land Program, while the MP3 activities on land tenure, rangelands and policy options should be integrated with work on diversification (currently MP4) and other work on socio-economics and policy be integrated in MP5”.

The research themes of IWLMP evidence that the new program is implementing the EPMR recommendation 3 satisfactorily (see item 1 of Section 4). Theme 1 - Assessment of Water and Land Resources for Agriculture - refers to the integrated assessment of the potential and availability of water and land resources for agriculture, as well as to the constraints and issues to improve resources use in agriculture. Theme 2 - Increasing Agricultural Water and Land Productivity in Dry Areas - refers to improving agricultural water and land productivity at the farm level and IWLMP is developing appropriate technologies and integrated management options to maximize water and land productivity at the field, farm and basin scales. Approaches include the improvement of water and land productivities in dryland farming systems, rangeland ecosystems, and irrigated agro-systems. Theme 3: Combating Land Degradation refers to controlling wind and water erosion of soils, salinity and desertification. It includes the development of multi-scale tools and methods to assess land degradation and vulnerability to desertification in dry areas.

The EPMR Panel recommendation 3 also stated that MP3 (land) activities on rangelands and policy options should be integrated with work on diversification. However, this CCER panel considers that rangeland agro-ecosystems definitely require the integration with water related research, particularly water harvesting, since the main constraint of

rangelands is water. In practice, close collaboration exists between IWLMP and the diversification program (DSIPSP) but further developments in staff and knowledge in DSIPSP are required to better overcome the current limitations.

The EPMR Panel recommendation 3 states that work of former MP3 (land) on socio-economics and policy be integrated in MP5 (policies). However, this CCER Panel considers that the problems for adopting and implementing innovation in rangelands requires that socio-economic and policy work be developed jointly by IWLMP and SEPRP in a manner similar to other water management issues.

Results of the recently concluded project on Water Benchmarks fully support this assessment. Thus, the Panel considers that, as for all agro-ecosystems, a close cooperation and work integration is required between IWLMP and SEPRP. However, further developments are required in line with comments under item 2 above: The panel considers that these dimensions be better addressed by SEPRP along with improvements in the integration between IWLMP and SEPRP. Consideration should be given to increase staffing to facilitate accomplishing these needs.

The EPMR Panel recommendation 6 states “that MP1 embraces research on water policy, institutions and adoption strategies to further enhance a very good program in water management”. Following this recommendation, IWLMP includes the research Theme 5 - Integration of policies and institutional options -, which fully responds to this recommendation. IWLMP develops frameworks for conservation and sustainable management of ecosystems with emphasis on their multi-functionality and involves a local multi-stakeholder process that links land users with policy- and decision-makers. Thus, the IWLMP program links research to policy in terms of water and land management to broaden the partnership-base to include civil society and local research institutes. However, the panel considers that this recommendation on integration of research on water policy and institutional constraints to the adoption of water conservation technologies has been well addressed by IWLMP in terms of collaborating with SEPRP for various WLM projects, with IWLMP also embracing socio-economic research through the collaboration of both programs. However, further developments are required in terms of strengthening the capabilities to effectively implement and systematize interdisciplinary work (see comments under item 2 above). Additional efforts should provide for implementing participatory based generation of new technologies,

assessing the costs and benefits (of financial and social nature) associated with the adoption of technological innovation, and creating base information required to support research on policies. The panel also observed that collaboration with the SEPRP, due to the desired integration of water and land research studies, is also embracing land, which shall be considered a very positive issue.

The EPMR Panel also proposed the Recommendation 7 on the need for “increased efforts in agronomy to assist countries in bridging the yield gap between actual and attainable yields, including researching the agronomy, crop management and economic incentives required to generate the needed synergies with the breeding efforts”. As referred above, the IWLMP group is developing the research Theme 2 on Increasing Agricultural Water and Land Productivity in Dry Areas, which justifies a statement that Recommendation 7 is being successfully implemented. Moreover, water productivity refers not only to crop yields but to the economic, nutritional, energetic and environmental yield values, which is of great importance. Studies on land productivity shall also develop similarly because land productivity is fundamental resource that affects farmer returns.

The EPMR Panel Recommendation 8 refers to additional investments in the scientific staff of GISU to tackle the challenges of the new Water and Land Program (Recommendation 3). The CCER panel could observe that a very good collaboration developed between IWLMP and GISU, which is apparent in various projects, particularly in the Water Benchmarks Project. Moreover, it could be observed that the IWLMP through the Water Benchmarks Project had developed in collaboration with the university of Jordan and NCARE new skills in GIS and that the GIS is being operated as a true database system, thus providing conditions for modeling, for analysis and for out-scaling. The success of this and other recent approaches calls for enhancing GIS capabilities within IWLMP that could provide for synergies with GISU.

Recommendation 9 calls for a research strategy in horticulture that is likely to require that horticultural water management be considered. IWLMP is presently operating in hilly rainfed areas where the main crop is olives and developed appropriate water harvesting and soil conservation technologies for olive trees. Water harvesting in the *badia* is also being used by farmers to support medicinal shrubs and almond and olive trees. IWLMP is also supporting the DSIPSP program in a project on protected horticulture in the

Arabian Peninsula. It can be concluded that IWLMP is already performing research in agreement with Recommendation 9. Further developments and implementations can be expected once ICARDA better defines priorities relative to horticultural crops.

The CCER panel therefore concludes that the EPMR5 recommendations related to water and land are being successfully implemented by IWLMP. However the integration work with DSIPSP and SEPRP relative to water and land management projects should be further improved.

5. The response of the research in IWLMP to the priorities of national agricultural research systems (NARS) in dry areas and the emerging regional and global issues, and the relevance of strategic research issues for meeting the research needs of the NARS in the medium- and long-term.

There are a number of mechanisms for the coordination of collaborative activities with NARS. The national and regional planning and coordination meetings are the more formal ones. But, for the day to day research activities, more important are the multiple direct contacts between researchers, through visits, training, workshops, correspondence, etc.

The national planning/coordination meetings have the advantage of bringing national leaders and researchers together. They constitute a forum to assess national agricultural research and development needs and to determine research priorities. The meetings also offer the opportunity for NARS researchers from different departments or institutes within the country to meet, to share and review results and ideas on national research and research-related issues, to interact with IWLMP scientists participating in the meetings, and to develop joint work plans for the following season.

Sub-regional annual coordination and planning meetings are held within sub-regions where two or more countries, often geographically contiguous, share common issues, interests, and projects (e.g. Mashreq and Maghreb project; dry-land agro-biodiversity project for West Asia; Sunn pest project for Syria, Turkey and Iran, cereal rusts project in the Nile Valley etc.). These meetings allow the IWLMP scientists to interact with scientists from different countries. Results of inter-country experiments and activities are jointly reviewed and work plans prepared for the following season. These meetings also offer the opportunity for contacts with policy makers or senior research managers.

National and regional meetings are generally held annually, however, the option of holding national meetings every two years might be considered.

Coordination of special projects is either by a Regional Coordinator or by a scientist at headquarters, depending on the nature and scope of the project. Special projects are implemented by scientists, based at headquarters and in the field, as well as by Regional Coordinators and partners: West Asia Regional Program (WARP), Nile Valley and Red Sea Regional Program (NVRSRP), North Africa Regional Program (NARP), Arabian Peninsula Regional Program (APRP), Highlands Regional Program (HRP), Latin America Regional Program (LARP), and Central Asia and the Caucasus Regional Program (CACRP).

The different arrangements put in place have ensured that over the years of working in the dry regions the research priorities for the Centre have evolved based on the specific needs of this particular agro-ecological zone. There have been inputs from a wide range of stakeholders into the development of the overall strategic plan and the current research projects, and in their updating. This has been achieved mainly through the above-mentioned national and regional coordination/planning meetings, but also in various other ways such as workshops, direct contact among NARS and the Program leaders and scientists and research managers, visits of NARS scientists and leaders to ICARDA headquarters, and regular feedback from NARS, either directly or through staff in the regions.

In conclusion: the mechanism followed by the IWLMP in identifying priorities is made based on NARS requirements. However, some of the priorities of the different NARS may be focused on very specific country priorities and results may not be possible to interpret in other countries and/or regions; and the funding of research programs may not always be insured which can redirect or adjust IWLMP priorities. Other comments on these aspects are presented in item 3 of Section 4.

6. The extent to which the program covers the most critical forms of water and soil degradation in the dry areas addressed by research work.

Deterioration in water quality is of prime concern as pressure to use marginal-quality saline and wastewater is increasing; sustainable use of limited groundwater for supplemental irrigation is another. Research aimed at finding the optimal allocation of

water for supplemental irrigation has been conducted. Land productivity is low due to low rainfall, lack of organic matter, wind and water erosion; and salinity can reduce productivity in both rainfed and irrigated areas. Experiments have been initiated to study the impact of minimum-tillage, residue management, and legume-grain crop rotations on soil fertility, soil structure, water infiltration and reduction in soil evaporation. Water harvesting techniques have been developed and used to reduce land degradation, and improve water and land productivities. In irrigated areas, the program is focusing on increasing water productivity and combating land salinization; field research projects have been conducted to evaluate the effectiveness of irrigated cropping systems to remediate saline, and saline-sodic soils, and use of phosphogypsum has been demonstrated to be effective to remediate high Magnesium (Mg) soils.

The program has developed and tested jointly with GISU methods to assess water and land resources in many countries of the dry areas. These include assessments of potential areas for supplemental irrigation and water harvesting in Syria, Tunisia, and Libya. The program also studied the upstream-downstream impacts of supplemental irrigation in the Karkheh river basin of Iran, and groundwater and marginal quality water was conducted in key areas.

The research work of IWLMP is well documented in peer reviewed publication, books, research reports, brochures and caravans. The following list of topics, for specific research topics, was developed from the list of peer-reviewed publications:

- Water harvesting: impact on soil water storage and shrub establishment; growth of young olive trees in degraded Syrian dryland; options in drylands at different spatial scales; GIS-based approach for assessing water harvesting suitability; water harvesting and supplemental irrigation for improved water productivity of dry farming systems; microcatchment techniques in combating desertification, water and soil losses, modeling water-harvesting systems using SWAT.
- Supplemental irrigation: optimizing supplemental irrigation; assessing the tradeoffs between profitability and sustainability; pathways for increasing agricultural water productivity; limited irrigation of maize and cotton, wheat, faba bean, chickpea and lentil.
- Soil erosion and soil degradation: contour strip cropping; alternative cropping systems to control soil erosion; GPS/GIS integrated approach to the assessment

of current soil erosion by water; major causes for gully erosion in sloping olive orchards; long-term impact of cultivation on soil properties in hilly olive orchards; monitoring accumulation of salts and heavy metals in soils and vegetables irrigated with city effluent.

- Land/crop management – dryland and rainfed: Assessment of tillage and residue management practices on land productivity for dryland crop rotation systems; economic and sustainable land management benefits of the forage legume: vetch.
- Land/crop management – irrigated agriculture: Remediation of sodic and saline-sodic soils; enhancing the productivity of high Mg soil and water resources in Central Asia using phosphogypsum; use of low quality water and soil amendments in conjunction with rice-wheat cropping systems, characterization of salt-affected soils and strategies for their amelioration and management; productivity enhancement through crop diversification; salt-induced land and water degradation in the Aral Sea basin; managing salinity and waterlogging in the Indus basin of Pakistan; irrigation and soil management strategies for using saline-sodic water in a cotton-wheat rotation; sodicity induced land degradation and its sustainable management; crop diversification through halophyte production on salt-prone land resources; amelioration and nutrient management strategies for sodic and alkali soils.
- Climate change: opportunities to reduce the vulnerability of dryland farmers to climate change.
- Improved germplasm: introduction of salt-tolerant wheat, barley and sorghum varieties in saline areas of the Karkheh River Basin.
- Poverty alleviation: impacts of biodiversity and land degradation.
- Modeling: use of water balance simulation models (e.g. ISAREG) to assess and develop appropriate irrigation schedules for supplemental irrigation of wheat; use of crop-water-yield models (e.g. CROPSYST and AQUACROP) to assess the water and land productivity of cereals under different deficit irrigation regimes; use of flux models for simulating the dynamics of salinity under irrigation (e.g. SaltMed, SWAP, UNSATCHM, Hydrous 1D, ENVIRO-GRO).

Studies reported above may be considered in many cases cutting edge activities in the international context. This is typically the case for water harvesting and land management in very dry rangeland agroecosystems, the use of GIS to assess

opportunities for water harvesting and/or supplemental irrigation, methods being developed to assess water productivities and related concepts on efficient water use, approaches to adopt conservation agriculture in rainfed or supplemental irrigation agroecosystems of dry areas. Studies relative to rangelands, rainfed and irrigated agroecosystems are being developed following the site benchmarking approach, which is a key and robust way to facilitate appropriate out-scaling. Field data collected relative to experimental work in all referred domains (see Section 3 and Annex 3) constitute a good potential for further simulation modeling, which should be used to support out-scaling and, when transferred to NARS, may be used to support farm advising.

7. The quality of the science in IWLMP, and the extent that the Program uses the latest cutting-edge developments in water and land sciences.

As referred above under item 7 of Section 4 (Overview of research issues) the quality of science in IWLMP is considered excellent. This judgment resulted from (a) assessing the research outcomes and outreach activities, particularly concerning the response to the policies of CGIAR and ICARDA; (b) developing and verifying solutions to land and water management problems in the targeted regions, including for contributing to the improvement of the livelihood of populations and poverty alleviation, and providing assistance to NARS and the respective target end users; and (c) the unique and robust cooperation between ICARDA and other institutions, mainly IWMI, particularly on assessing water and land management options for the sustainable use of marginal quality water for irrigation.

The judgment resulted also from analyzing various indicators relative to ISI journal papers and other publications, organized scientific and technical events, collaborations with other scientific institutions - of the NARS, the CGIAR system or international -, research projects, training activities, and outreach activities of various nature. Finally, as the result of interactions with the IWLMP team of researcher, the Panel came to appreciate the high caliber of the research work and management skills of the individual members of the team, and their abilities to combine their insights into the critical issues related to water and soil degradation into developing an outstanding program that continually adjusts to the opportunities posed by various funding agencies to obtain the needed funding to advance and improve the Program.

Research papers, journal and conference papers or research reports and brochures, show an updated knowledge on subjects treated which are on the latest cutting-edge developments in water and land sciences relative to dry areas. Subjects as *badia* range management, water harvesting, supplemental irrigation, evaluation of the utility of computer models to predict effects of alternative land and water management options and to predict the effects of transient changes in soil dryness and soil salinity on crop productivity, farm water quality management, water productivity improvements, dryland agronomic research and exploring water use efficiency from plant breeding programs into field assessment are definitely on the latest cutting-edge developments.

8. The appropriateness of the position of the Program on the research-for-development pathway, i.e. strategic/applied/adaptive research, and the international public good (IPG) or location-specific nature of the Program's research activities

The characteristics of the Dry Areas, the focus of the whole ICARDA, can be summarized as follows:

- Unpredictable spatial and temporal variability of rainfall, which causes uncertainty in the availability of water resources, thus creating inherent variations and uncertainties in food security. CWANA, where most activities develop, is one of the most water-scarce regions of the world.
- Most of the arable land is rainfed, and only a small proportion is irrigated. This creates a challenge for the region to find means and ways to increase water and land productivity.
- Food imports are increasing due to population growth, growth in per capita income and consumer preferences. Cereals are the major imported item.
- There is an expanding demand for animal feeds (including poultry).
- CWANA countries have to rely on the international markets to satisfy a proportion of their food needs. Choices have to be made between locally produced and imported food items.
- The competition between humans and animals for cereals requires alternative policies to avoid having adverse impacts.
- Poverty is a common feature in CWANA countries, especially in rural areas. The number of the poor in the region may be estimated from those with below US\$ 1 per day (132 millions); below US\$ 2 per day (442 millions) and below the national

poverty line (380 millions). The spread of poverty in the CWANA region is caused by many factors including the poor natural resource base, especially water, dependence on very insecure rainfall, low investment in rural areas, discriminatory policies against rural areas, population pressure, soil degradation, unemployment, etc.

- Since 1980, agricultural production has been increasing, as exemplified by increasing yields per hectare e.g. of wheat in Egypt, Morocco, and Tunisia. The increases in land productivity were due to technology transfer, particularly improved varieties in an economic reform environment, which ensured better incentives to farmers.

The challenges faced by the Region are enormous and ICARDA with its partners have a unique role in contributing to meeting these challenges. These summarize the global and regional strategic issues and challenges facing the region and similar regions of the world, and provide the overall context for the research, development and extension/participatory roles for ICARDA, as a whole, and the IWLMP, in particular.

Since the 1990's, the CGIAR has emphasized the need to give more attention to production and the socioeconomic contexts and to interdisciplinary approaches. As the same time the international nature of its research (defined "as activities that address significant global, continental or transnational problems") was reasserted. In this context, i.e. the specific challenges facing the dry areas, and the orientations defined by CGIAR, IWLMP research activities should be oriented towards:

- a) the development of technologies that can be used in several countries and that are aimed at improving production systems, while taking into their account social and environmental impacts;
- b) the development of action oriented research methods and tools that also can be used in several countries.

The IWLMP has made significant progress towards achieving these objectives. However, it is desirable that interdisciplinary work and incorporation of socioeconomic issues is reinforced and systematized (see item 2 above). Technology development strategies are well set but could gain when based on an increased understanding of socio-ecological system problems and their interactions with both productivity and poverty. It is also desirable that present efforts to formalize and disseminate research

methods and tools for development, that could be used across countries (publications, training programs), be reinforced. This implies a reinforcement of the program staff since improving participatory research and capacity building are very demanding and are often contradictory with high quality research standards.

9. The research approaches used, especially benchmark sites, working at the community level

Development oriented research requires interdisciplinary approaches and the participation of farmers and other stakeholders in the design and implementation of research projects. Interdisciplinary, multi stakeholder and participatory research is conceived as a pathway to the development of more adapted and more efficient technologies, likely to be more easily adopted by farmers and to be supported by policy makers. Outputs of the Water Benchmarks project indicate that socioeconomic issues and participatory methods are well integrated in IWLMP research projects, although improvements are required. As an example, methodological approaches applied in the first phase of the Moroccan and Egyptian Benchmark projects involved the organization of participatory workshops to explain to local communities the objectives of the project, to establish a network of participants and foster the interaction of researchers with the community members and other partners (Chamber of agriculture, local authorities, associations, etc.) and to identify in a participatory way the community resources and potentialities. Participatory tools used (Venn's and fluxes diagrams, exchange of information and discussions) allowed for the identification of main constraints and potentialities.

Other projects, such as the *Badia* benchmark project, use different methods, such as the rapid rural appraisal tools, which are less participatory. The expertise available at the level of NARS' teams appears to be crucial in the implementation of participatory research methods.

Methodological approaches used to implement community-based research appear to be very diverse, according to the projects, and are lacking homogeneity.

Also, while at the diagnosis phase, multidisciplinary and participatory methods seem to be applied, it is not clear whether they continue to be applied in the next phases, especially in the technology development phase, and in which ways. However, it is

advisable and expected that participatory research be effectively applied in the second phase of the Water Benchmarks project.

10. The extent, intensity and integration of policy research in collaboration with ICARDA's Social, Economic and Policy Research Program (SEPRP)

EPMR5 recommended that the IWLMP embraces research on water policy and that it reinforces its collaboration with SEPRP researchers so as to strengthen research on water policy and institutional constraints to the adoption of water conservation technologies and hence allow for a better program in water management.

Policy research developed in relationship to water and land management include the following: a review of agriculture policies related to water in Iran, Egypt and Morocco, a review of available knowledge on dry land degradation; technology, policy and institutions in Jordan, Morocco, Yemen and Pakistan, and a review and assessment of drought mitigation strategies in 3 countries.

In the framework of the Water Benchmarks project, policy analyses have allowed for the identification of major policy and institutional issues likely to represent constraints for technology adoption and water use efficiency improvement.

In relationship to IWLMP research Theme 3 on "Combating land degradation", priorities defined for policy research aim at understanding and overcoming key policy, market, land tenure and institutional dynamics that aggravate land degradation. These two latter initiatives indicate a growing integration of policy issues related to water and land management based on collaboration between IWLMP and SEPRP.

However, areas of further improvements can be identified:

- In addition to investigating policy related issues at macro level (review of water and land public policies), collaboration between SEPRP and IWLMP could also aim at further understanding the extent to which farmer's choices and strategies are influenced by policies and the ways in which they respond, react or by pass policy measures related to water and land management. This is likely to contribute to better integrate the different levels at which policy issues are to be investigated (national, local and farm level).
- Similarly, in the perspective of increased integration of SERP and IWLMP work, research dealing with the impacts of economic policies (pricing, subsidies mainly),

which is well developed, should also be further expanded and **linked** to the analysis of the diverse dimensions of policy and institutional issues (land tenure, institutional arrangements, collective action, credit system and financing strategies, extension systems, etc) likely to determine farmers' choices and practices.

- Also, when social and policy analyses are related to the implementation of a specific project they should be more systematically carried out at the experimental phase, in addition to being conducted at the diagnosis phase and at the evaluation phase.

Related recommendations are provided in Part 2 of item 14 of this Section.

11. The extent and intensity of linkages to the other ICARDA Programs (BIGM and DSIPS).

IWLMP has very good linkage with BIGMP, particularly through the activities developed under Theme 4 on developing appropriate trials for evaluating germplasm/cultivars for adaptation to abiotic stresses and their response to water management alternatives. IWLMP includes an agronomist in its staff, who is playing a determinant role in trials for adaptation to drought and salinity, including adopting various deficit irrigation strategies. Apparently this activity should be enlarged to better cover the plant material resulting from the breeding program.

Similarly, IWLMP has also good links with DSIPSP mainly relative to: (a) rangeland management due to the main role of water harvesting in the *badia* systems; (b) soil fertility and crop management in rainfed agriculture, including supplemental irrigation, with particular focus on conservation agriculture practices; (c) horticultural crops in protected agriculture, specially in searching for the respective water and irrigation requirements. Integration of IWLMP and DSIPSP activities should be strengthened.

12. The capacity of the program in providing effective training to NARS on major water and land management issues.

The goal of training conducted by the staff of IWLMP is to improve the capabilities of NARS, advanced degree students, and Fellowship awardees to manage water and land resources efficiently and properly. IWLMP conducted high-skill targeted training on all water management issues, including water use efficiency and water productivity, drought management, supplemental irrigation, water harvesting techniques and efficient irrigation

water use. The team observed classrooms at ICARDA headquarters that were new and well equipped, and there is adequate support staff.

Between 2005 – 2009, advanced training courses have been held at ICARDA headquarters (N=14), Egypt (1), Jordan (2), Morocco (1), Pakistan (1) and Uzbekistan (2). The trainees represented a broad range of interests, training and experience.

Among the capacity building activities, it should be mentioned the program developed with Japanese funds (JICA) relative to the water use efficiency and water productivity domain, and those with the United Nations University and the Totori University (Japan) on drylands water and land management.

No information was provided to the Panel about the value of individual training courses from the perspective of the trainees. However, during the visit to Jordan and Egypt by Panel members, these training courses were referred by former trainees and NARS staff with great appreciation.

The IWLMP staff has also organized and participated in 29 conferences, workshops and annual meetings held in Egypt (2), Ethiopia (1), Iran (2), Jordan (3), Lebanon (1), Morocco (2), Pakistan (1), Syria (16), and Tunisia (1). The staff has also conducted two Knowledge Bridging Workshops and Specialized Group Training Courses dealing with sustainable management of wastewater and saline water in agriculture; saline land and water resources in Central Asia and data processing, and statistical analysis of salinity related data. The staff also has worked with awardees of Borlaug and Fulbright Fellowships which sponsor researchers to work at US Universities, and at ICARDA headquarters.

The IWLMP staff also helps supervise students working on MSc and PhD degrees at local and regional universities, in particular within the Water Benchmarks Project, where PhD also included the socio-economic domain.

Considering the extensive range of IWLMP themes, the broad range of interests, training and experience of the trainees, and the small number of research staff of IWLMP, it would be reasonable to question whether the training program can adequately serve the needs of ICARDA. This concern is mitigated in part because of close coordination other ICARDA programs, NARS staff, local and regional Universities. These obviously facilitate a broad-reaching program within the targeted region, and an extensive number

of training options and opportunities for students and staff of NARS. The filling of vacant staff positions will be particularly helpful in the future.

13. Major research outputs and their potential adoption and impact on improving sustainable water use, food security, farm income, and the alleviation of poverty.

The IWLMP is conducting good research in the dry regions as referred before (see Section 3 and Annex 3 of this report). Appreciations on improving sustainable water use, food security, farm income, and the alleviation of poverty are provided in Sections 2, 4, 5 and 6 of Section 4. IWLMP research outputs concern the main agro-ecosystems of Dry Areas: rangeland, rainfed agriculture and irrigated agriculture. Through enhancing the productivity and the sustainability of these systems, IWLMP research results and technological innovations contribute to improve the livelihoods of the farm communities. In the rangelands (badia) agro-ecosystems, research has been successful in developing and promoting water harvesting, the rehabilitation of the degraded rangelands and in reversing desertification. This has allowed for the increase of available forage resources and has often stabilized and improved households' income generated from animal rearing. In rainfed agro ecosystems, the development and the successful implementation of supplemental irrigation techniques is a major achievement, which has contributed to stabilize and increase the yields of staple crops, hence improving households' food security, increasing the share of market oriented production and household monetary income generated from farming activities. In irrigated areas the program focused on increasing irrigation water productivity and combating land salinization. Responses of cereals and legumes to salinity and drought stresses are evaluated for those crops. A new objective is also to promote the development of irrigated horticulture, including fruit production. This new research orientation is likely to contribute to the diversification of farming systems and of farm households' income sources.

Methodologies used for research and technology development are increasingly based on participatory and community based approaches, which are proving to be a crucial instrument for the facilitation of technology adoption by farmers. Within the framework of the implementation of these new approaches, researchers get to work in close relationships with farm communities, extension services and development associations, which often provide farmers with financing schemes (micro credit) that encourage farmers to adopt technological innovations. Also the benchmark site

approach, based on an agro-ecological zoning methodology, is contributing to expanding the dissemination scale of research results, which lead to improvement in farming systems in larger geographical areas.

The program developed and tested methodologies to assess water and land resources and management in many countries of the dry areas. Assessments of groundwater and marginal quality water were also conducted. There has been great deal of research on participatory technology development to test and fine-tune suitable soil and water conservation and water harvesting. The program carried out research on the use of marginal water joint initiative of ICARDA and the International Water Management Institute) which is an important source of water in dry lands. More is expected in the area of the use of wastewater and grey water as well.

The existing know-how allows suggesting that more work is needed on the socio-economic and policy research of the program, which is conducted through the SEPRP staff and is integrated in several projects, e.g., the benchmarks project, the Karkheh basin project, and the land management projects in Syria. However, given the importance of the socio-economic and policy research in context of ICARDA projects, it is advisable to strengthen the capabilities of ICARDA through a joint appointment of staff by IWLMP and the implementation of community based development oriented research projects

The research by ICARDA does not directly address the farmers and rural populations, thus IWLMP does not directly address food security, farm income, and the alleviation of poverty. However, the program addresses these important aspects indirectly together with the NARS partners. These apply the research findings in the local contexts and assume the responsibilities for training of non-research personnel and the farmers. However, IWLMP contributes to the ultimate transfer of knowledge through supporting training at the NARS level. This transfer of knowledge, particularly the actions that provide for the progressive implementation and adoption of innovation by farmers, certainly contributes to improved food security, farm income, and the alleviation of poverty.

Although not all situations are under consideration, and the fact that the responsibility for addressing the solutions at the local rural level are with the NARS partners, the CCER panel considers that the research program of IWLMP appropriately addresses the

strategic aspects of sustainable use of limited water resources, in the context of livelihoods and poverty alleviation in non-tropical dry areas. It should be noted that without a close coordination with NARS (see also item 3 in Section 4 and items 5 and 12 in Section 5), generation and application of innovative technologies, as developed under the program, would have never been implemented.

14. Major gaps in the program research and recommendations on how to fill those gaps

1st part: Water and land management technical research

Recommendations listed below do not correspond to gaps but to the normal evolution of research being developed by IWLMP; however, some recommendations may imply a reorientation of research activities. An overview of research is presented in Section 3 and a list of research themes and related projects is provided in Annex 3.

- a) Research by IWLMP focuses three agroecosystems: rangelands, rainfed agriculture and irrigated agriculture. This approach, focusing these agroecosystems, should be maintained and further developed.
- b) In the rangelands (*badia*) agro-ecosystems, research has been successful in developing and promoting water harvesting, the rehabilitation of the degraded rangelands and in reversing desertification. Research has been developed with the SEPRP and DSIPSP, as well as with GISU. Results already obtained and field data available, including the GIS databases, call for continuing and/or developing work on:
 - hydrological modeling of the *wadi* watersheds of these low rainfall areas,
 - modeling the economic impacts of water harvesting for evaluating their environmental and direct benefits,
 - implications of land tenure and institutional arrangements on the adoption of improved systems, and
 - implications of policies on technological innovation, taking into consideration the specificities of the various countries of the Dry Areas.

- c) In rainfed agro ecosystems, a good knowledge on supplemental irrigation has been developed. The existing know-how and data make it advisable to continue and further develop work on:
- the economics of supplemental irrigation in relation to the crops, the production systems and the water source,
 - analyzing water productivities and land productivities in physical, economical, nutritional and environmental terms,
 - finding the optimal allocation of water to supplemental (and full irrigation) taking into consideration the source of water – groundwater, canal water and marginal-quality water (including treated wastewater),
 - the adoption of appropriately calibrated and validated irrigation scheduling simulation models that could support the development of alternative supplemental irrigation schedules and be useful for NARS to adopt for support of end users.
 - the simulation of water-crop yield models to better assess the impacts of water stress on yields and to outscale research results.
- d) In irrigated areas the program focused on increasing irrigation water productivity and combating land salinization. Responses of cereals and legumes to salinity and drought stresses are evaluated for those crops. The existing know-how allows to suggest that more work is needed on:
- modeling the soil-water-plant dynamics, either using water balance simulation models for irrigation scheduling, or more demanding deterministic models when dealing with salts transport as continuation of related model comparison studies presently being developed,
 - adaptive research on irrigation systems technologies aiming at effectively assessing the performance of farm irrigation systems and the constraints imposed by these systems on the application of water saving and salinity control practices,

- extending the collaboration with IWMI on adaptive research relative to delivery scheduling in canal systems since the scheduling mode conditions the adoption of irrigation schedules,
 - evaluating the environmental impacts of irrigated agriculture.
- e) The program developed and tested methodologies to assess water and land resources and management in many countries of the dry areas. Assessments of groundwater availability and use need to be further developed aiming at developing guidelines for:
- reducing/controlling the demand of groundwater
 - controlling/avoiding the degradation of groundwater
- f) Relative to marginal quality water, base studies have been conducted and problems were identified relative to health and environmental impacts of using wastewater. Therefore, aiming at supporting the expansion of using this marginal resource it is advisable to:
- further develop studies on the chemical and microbial characteristics of treated wastewaters,
 - assess treatment requirements aiming at safe use of wastewaters in irrigation and/or recharge,
 - develop guidelines for monitoring the areas where production relies on wastewaters,
 - develop procedures for enforcing crop restrictions or similar actions that aim at protecting consumer health,
 - assess the social, economic and financial feasibility, constraints and benefits of using treated wastewaters.
- g) Relative to land use and combating land degradation, important research is being produced both for rangelands (as referred above) and farmlands, including in hilly areas. This research needs to be continued and developed, specially with respect to:

- Improving the knowledge on dominant wind and water erosion processes,
 - using modeling, including with GIS, for out-scaling and for assessing possible changes in storm water regimes that impact erosion,
 - modeling to address the impacts of conservation on biomass productivity, economics, and ecosystem services at watershed level and under different agro-ecosystems,
 - conduct research approaches that may provide for a better soil database in the dry areas and the possible use of radioactive material in erosion studies,
 - developing guidelines for the economic and environmental benefits of soil and water conservation, and
 - developing decision support systems using integrative knowledge, e.g., adopting multicriteria analysis considering criteria of technological, social, economical and environmental nature.
- h) IWLMP developed and implemented successful regional research and development projects using benchmark sites, located in different climates and agro-ecological zones with different levels of water scarcity within the regional scope of ICARDA. These sites are the cornerstone of a robust program to conduct research studies testing alternative land and water management strategies relevant to specific regions and to evaluate their adoptability by farming communities. The program developed an important methodology for selecting and characterizing these benchmark sites and important GIS databases with the NARS of Jordan. Outcomes provide for further developments in various technical domains and on:
- modeling to further refine the agro ecological-zoning processes and for out-scaling with GIS support,
 - extending to regions depending totally on non-renewable groundwater (e.g. oases), taking into consideration the existing indigenous knowledge,
 - strengthening the existing cooperative work with GISU in using GIS technologies.

- i) Soil fertility research, including the impact of chemical fertilizer application and crop rotation has been recently expanded to cover various aspects of conservation agriculture. The later is expected to be of great importance for rainfed and irrigated agriculture in dry areas. The existing know-how shall provide to:
- develop and investigate 'smarter' cropping systems - environmentally friendly, resource efficient, economically viable and able to sustain the food production basis
 - improve knowledge on beneficial effects of conservation agriculture such as integration of legumes, and rational application of chemicals and organic fertilizers
 - better understand of the nutrient dynamics of cropping systems in dry areas
 - appropriately integrate (deficit) irrigation in the production system to control the risk of resource mismanagement.
- j) Results so far obtained with conservation agriculture ask for further studies aiming at:
- improved understanding of the changes produced by no-tillage and minimum tillage on the water balance (e.g., increased infiltration, reduced evaporation) and in the nutrient balance, particularly nitrogen,
 - using models to simulate optimal water management strategies under scarcity,
 - further modeling to address the impact of climate change (e.g., rising temperatures and CO₂ and reduced and more variable rainfall) on wheat productivity, considering possible mitigation strategies, such as early planting, supplemental irrigation, short(er)-season varieties.
- k) BIGM works on cultivar characterization and identification of agro-physiological traits associated with drought tolerance and nitrogen use efficiency. IWLMP contributes to that. This activity will be strengthened and enlarged in coming years
- to other abiotic stresses such as salinity,

- for assessing the interactions of planting date, zero tillage, water regime and genotypes of bread wheat focusing on the improved use of rainwater.
- l) In irrigated agroecosystems progress exists in the field of marginal-quality water resources and salt-affected soils through ICARDA-IWMI joint projects. It is desirable that ICARDA continues collaboration with IWMI on this topic and extend this collaboration to groundwater management in dry areas and canal delivery scheduling and management, and water user associations.
- m) Following progress in the management and productivity of salt-affected soils and saline water resources, it is desirable to
- develop appropriate follow-up in terms of facilitating technology transfer and assessment on the improvement of the livelihoods of the concerned communities
 - assessing models that address salinity management, either for irrigation with saline waters or cultivation of salt-affected soils. This important move shall help ICARDA in technology transfer to NARS.
- n) The program leads a Mediterranean drought network but new and upgraded lines of research on drought needs to be developed aimed at risk management, e.g. data handling for quality and trend analysis, time series analysis of drought indices and developing early warning tools. These activities may be of great interest for the NARS since droughts occur with variable frequency and intensity in the Dry Areas.
- o) Climate change (CC) works refer to the impact of CC on crop production in relation to temperature and rainfall variation. Further developments are required aimed at:
- exploring models able to simulate the impacts of various water stresses on crop yields under different scenarios of predicted CC to base further research on adaptation measures,
 - further developing the analysis of trends in climatic weather data series, particularly relative to the on-set of rainfall, temperature extremes and rainfall (and runoff) extremes,

- providing for a clearer strategy emphasizing risk management and adaptation.
- p) Capacity building efforts undertaken by IWLMP are excellent and should be continued. Capacity building through involving post-graduate students in IWLMP research is highly desirable.

2nd part: Socio-economic and policies research

Recommendations below are considered as a way to promote a favorable environment for the effective integration of socio-economic and IWLM research at ICARDA. Several items were analyzed before in item 1 of Section 4 (relative to EPMR Recommendation 3) and in items 2, 4, 8, and 10 of this Section 5, Research. Recommendations require that the Management Board of ICARDA defines further orientations about the socio-economic and policies research and on the relationships and work integration of SEPRP with IWLMP and eventually with other programs. Recommendations are the following:

- a) The social and economic aspects regarding the water and land technologies and their adoption by the farmers need to be further investigated. This requires encouraging interdisciplinary practices and creating the necessary conditions for an integration of the socio economic dimensions of water and land management.
- b) The socio-economic and policy research of the program, which is conducted through the SEPRP staff and is part of several projects, has a great relevance both to develop well-adapted technologies and to evaluate the research findings, the conditions for their adoption at farm, and to base policies on water and land. The integrated work between IWLMP and SEPRP needs to be reinforced and upgraded. In this perspective, it is advisable to strengthen the capabilities of ICARDA through a joint appointment of staff by IWLMP and SEPRP.
- c) There is the need for reinforcement of available expertise in socioeconomic and policy issues, with the recruitment of social scientists trained in interdisciplinary work, farming systems approaches and community-based research.
- d) It is advantageous to further develop and implement training courses in community-based research and integration of social analysis in agricultural research, targeting both IWLMP and SEPRP scientists, as well as scientists and students of NARS.

- e) There is advantage in developing joint interdisciplinary partnerships (for research and training) with international research institutions with expertise in sociological research applied to agricultural development.
- f) It is also advantageous to develop a scholarship program, such as available through funding sources that support post-doc positions, and associate positions to attract young social scientists.
- g) Reinforcement and extension of the use of multidisciplinary participatory methods is needed at all stages of the research process, particularly for the phase of technology development.
- h) Promote the exchange of experiences and of methodological tools between teams and projects.
- i) There is the need for working towards the homogenization and formalization of research methods and tools in order to ensure an effective application of participatory and interdisciplinary approaches.
- j) There is also the need to adopt a more global view of policy related issues and to take into consideration their diverse dimensions (economic, social and institutional aspects).
- k) It is needed the development of research projects that investigate policy issues at farm and local level (how do farmers and local communities respond to, adapt to, make use of policies or bypass them?).
- l) Also needed is to further integrate the different levels of analyses at which policy issues are to be investigated and to extend them at all phases of the research project.
- m) The assessment of policy impacts and identification of policy options should also be based on a participatory approach.
- n) A periodic follow-up evaluation can be performed by the IWLMP in cooperation with NARS to ensure the best benefits from its projects and associated findings.

6. Administrative and Financial Management

1. Effectiveness and efficiency of the Program's financial, administrative and research management procedures.

The program follows the Center regulations regarding financial and administrative management and procedures. Opportunities and guidelines are provided by the Project Development Office. The management is project-based where project managers enjoy sufficient autonomy. Oversight, leadership and monitoring is provided by the Program Director. Support on administration and finance is provided at the Center level. Generally the administrative and financial procedures and management of the Program and the projects within the program are sound and in line with the center regulations and procedures. Most IWLMP projects are not required to have a special audit, as this is requested by relatively few donors.

2. Effectiveness and efficiency of the project management, monitoring and reporting arrangements within the program.

Project Managers/coordinators take most of the decisions in consultation with the project team and the program director including financial management within the budgets, and work plans consistent with the project objectives as specified in the agreement with donors. The projects are well managed and donor reports are submitted in time with help of the Project office and Finance. Delays are few and haven't caused significant problems. Processes are in place for the ex ante assessment of project plans.

3. Functioning of internal communications within the Program on priority-setting and task execution.

Priority setting, strategic issues, and task execution are the topics of regular meetings of Program staff. Decisions on initiating new projects are taken based on the Medium Term plan, and on feedback from (a) scientists who interact with NARS, (b) donors, (c) partner institutions, and (d) invitations by other parties. Meetings for specific projects take place according to needs with staff associated with the projects; and open discussions occur often between leaders, senior and junior scientists (with all categories) to ensure getting the voice of everybody.

Interactions within the program are healthy and of team type operations. Generally most of the project scientists are involved in the proposals development and implementation,

and they work as a team. Interactions are also good with scientists in other programs. The Director relations with staff are very positive; although the Director provides strong leadership. Responsibilities are often delegated to relevant staff.

The projects are diverse and cover the major themes of the program as well as the priorities set by the center regarding water and land management. Project development usually involves consultations with NARS and sometimes also the donors. Annual meetings with stakeholders are conducted for all the projects and sufficient monitoring of the activities and timely outputs are generally insured.

4. Mechanism for linking the Program's research priorities to resource mobilization efforts and the ability of the program to attract restricted funding

The Program revisits its priorities periodically, internally with the ICARDA management, and, externally, with its counterparts (NARS). Similar to the other programs of ICARDA, and other CGIAR Centers, the Program is experiencing a decreasing proportion of unrestricted funding versus restricted project funding. The Program is very aware of the need to attract donor funds, and for 2009 its annual expenditure was a total of USD \$2.9M of which 77% was from restricted funds and 23% from unrestricted funding. This compares favorably with the other programs at ICARDA.

7. Personnel

1. Program's ability to fill positions with the international level of science quality staff required.

There are 3 vacant positions in IWLMP. These positions are difficult to fill because there is a clear lack of well qualified scientists knowledgeable about hydrology and water and land management in dry areas as set out in the domains required by the program. However, the program has always filled the positions with very qualified staff. Thus, difficulties always been overcome demonstrating the Program has had the ability to fill positions; however, current recruitment difficulties are delaying activities in new fields and application of new approaches currently being developed by the program.

2. Extent to which Program staff at all levels is up to date with, and have the required capacity in, the latest relevant technologies and science, and the provision of adequate training and staff development opportunities.

The program personnel includes in addition to the Director, 6 P staff, 2 postdocs, 4 NPOs and several other research assistants and workers. The staff is generally well qualified, loyal and dedicated. Systems are in place for performance measurement of all staff. This system is followed by ICARDA as a whole for all programs. Staff is mostly young, well educated and is up to date on latest science developments. Discussions with the staff and the appreciation of their publications, as well as the responsibilities they assume in terms of projects management, confirm that staff are up-to-date and have the required qualifications in terms of research and cooperation with the NARS. They however, are overstretched with activities.

3. The mix of personnel available within the Program in terms of representing the science capabilities needed to carry out the targeted activities and the adequacy and suitability of individual staff profiles to deliver on research needs.

The program staff is currently overstretched and therefore would have enormous difficulties to initiate new areas of research. As referred in Recommendations, part 1 of item 14 of Section 5, the panel did not identify major research gaps but just identified needs to develop new areas of research in line with those currently developed. Two exceptions refer to socio-economic and policies research studies and to droughts and climate change.

Relative to socio-economic and policies research studies it is proposed that a joint IWLMP and SEPRP position be opened for better integrating socio-economic studies in water and land management projects, as well as to support participatory research issues.

Relative to droughts and climate change, considering the priorities of ICARDA in this domain, with implications in other programs, the need for the scientist presently in charge to develop further agronomic trials that respond to the needs of better recognizing crop cultivar/germplasm responses to abiotic stresses, mainly in relation to droughts and climate change, and that research needs refer to an area of research not well covered in ICARDA (see item 3 and 14 of Section 5), the Panel proposes that a new position be open in the program relative to drought assessment and early warning and to

climate change scenarios development based upon scientific developments in the domain of hydrology and physics, with relevant capabilities in terms of spatial and time variability analysis.

4. Presence of appropriate succession-planning

Regular meetings are organized periodically for all senior scientists of the program, so that they are well briefed on program issues. There is a need, however, to develop a succession plan.

8. Coordination and Partnership

1. Extent of the collaboration of the Program with other Programs, Units and Regional/Country offices within ICARDA, with other relevant CGIAR centers, and with advanced research institutes and NARS.

The program extensively collaborates with other programs in ICARDA, particularly:

- with BIGM, with very effective developments that call for reinforcing collaboration and extending it to various abiotic stresses (see item 11 of Section 5),
- with SEPR with deep involvement in various projects; the importance of this cooperation for IWLMP and the Center calls for innovative approaches as referred in the second part of recommendations (item 14 of Section 5),
- with DISPS, which issues have already been discussed under item 1 of Section 4. That collaboration calls for reinforcing the agronomic capabilities of DISPS,
- with GISU a very successful cooperation exists that is advisable to strengthen by developing the GIS capabilities of IWLMP staff.

The collaboration with the NARS has been very positively appreciated as described in items 3 of Section 4 and items 5 and 12 of Section 5. The collaboration with other CGIAR centers is very positive as analyzed under item 3 of Section 4. In the recommendations section (alineea I) of item 14, Section 5) it is recommended that ICARDA continues collaboration with IWMI on marginal quality water and extends this collaboration to groundwater management in dry areas, canal delivery scheduling and management, and water user associations.

2. Program's relationship and advocacy with key national policymakers in the NARS.

As analyzed in items 3 of Section 4 and items 5 and 12 of Section 5, the program is effectively responding to the needs of the NARS in terms of both research and capacity building. The visits to NARS performed by the Panel members, reported in Appendices 1, 2 and 3 to the Annex 4, confirm that assertion: definitely, the IWLM program is working in line with priorities of the NARS and is involving them in the research being performed.

3. Delegation of tasks

The program director delegates project management tasks to the various program officers, thus resulting an easier management and gain of responsibilities by the younger staff. This is considered very positive.

9. Conclusions and Recommendations

The CCER Panel concludes that the EPMR5 recommendations are being successfully implemented by IWLM. In particular, the Panel found that MP3 (on desertification) and MP1 (on water) successfully merged as a single Water and Land Program (recommendation 3).

Analyzing the activities and projects implemented, as well as the collaborations developed within ICARDA and with NARS and other institutions, it is recommended that research by IWLM continues to focus the three main agroecosystems of dry areas: rangelands, rainfed agriculture and irrigated agriculture. This approach, focusing these agroecosystems, provides for appropriate integration of water and land management as well as the integration with the production, social and economic environments of the dry areas as it is successfully evidenced by achieved results.

Relative to EPMR5 Recommendation 3, that MP3 (land) activities on rangelands and policy options should be integrated with work on diversification, considering that water issues are the main constraint for the productivity and sustainability of dry rangeland agro-ecosystems, the Panel considers that the collaboration between IWLM and DSIPSP needs to be strengthened, including through reinforcing the DSIPSP staff relative to the agronomic and soil management domains of dry rangelands.

The EPMR5 Recommendation 3 states that work of former MP3 (land) on socio-economics and policy be integrated in MP5 (policies), thus, considering the importance of integrating water and land management in dry areas, joint actions by DSIPSP, IWLMP and SEPRP are required and being implemented. In addition, the EPMR5 recommendation 6 states that “MP1 embraces research on water policy, institutions and adoption strategies to further enhance a very good program in water management”, which calls for a close cooperation and work integration between IWLMP and SEPRP. Relative to the integration of socioeconomic and policy issues into water and land management research, areas of improvements have been identified under item 1 of Section 4 and item 2 of section 5. Thus, the Panel considers the need for additional efforts that should provide for:

- (1) integrating socioeconomic analyses in the different phases of the research process: diagnosis, technology development, including on farm trials, and ex-post evaluation of technological innovations;
- (2) reinforcing the move from a technology transfer approach to a participatory technological innovation approach;
- (3) assessing the costs and benefits (of financial and social nature) associated with the adoption of the innovation,
- (4) creating base information required to support research on policies.
- (5) evaluating the implications of land tenure systems and of institutional arrangements for technological innovations and adoption of improved systems.

These recommendations above identify the need for enhancing the scientific capacities of ICARDA relative to interdisciplinary research; thus it is proposed that a joint IWLMP and SEPRP position be opened for better integrating socio-economic studies in water and land management projects, as well as to support participatory research issues.

The EPMR5 Panel proposed Recommendation 7 on the need for “increased efforts in agronomy to assist countries in bridging the yield gap between actual and attainable yields, including researching the agronomy, crop management and economic incentives required to generate the needed synergies with the breeding efforts”. IWLMP is responding well to this recommendation through appropriate research on various facets of water productivity and through a very good collaboration with the BIGM Program. The Panel recommends both that collaboration with BIGMP is reinforced and that research

on land productivity develop further since land productivity is a key factor in the income of farm communities.

EPMR5 Recommendation 8 refers to reinforcing GISU “to tackle the challenges of the new Water and Land Program”. This recommendation may also be understood as demanding an increased collaboration between the GISU and the IWLPM. The Panel observed that this collaboration is excellent and could provide for more advanced results in various land and water domains; thus it is recommended to enhance GIS capabilities within IWLMP that could provide for synergies with GISU.

ICARDA recently developed the Strategic Plan 2007-2016 where new directions in water and land are adopted. Reviewing the recently implemented and proposed activities of IWLMP, the CCER panel is definitely convinced that IWLMP is successfully addressing the new directions in water and land as adopted in the ICARDA Strategic Plan 2007-2016, including the context of climate change.

Relative to the CGIAR system and NARS’ priorities and the emerging global issues associated with water and land, the Panel could observe that research activities, collaborations in research as well as capacity building actions, including the support of MS and PhD thesis, evidence that IWLMP appropriately addresses the CGIAR system and NARS’ priorities and the emerging global issues associated with water and land.

The research by ICARDA addresses the farmers and rural populations together with the NARS partners. These apply the research findings in the local contexts and assume the responsibilities for training of non-research personnel and the farmers. IWLMP contributes to the ultimate transfer of knowledge through supporting training at the NARS level. This transfer of knowledge is more effective when the community-based and participatory research is adopted as often happens in reviewed research projects. Thus, the CCER panel considers that the research program of IWLMP appropriately addresses the strategic aspects of sustainable use of limited water resources, in the context of livelihoods and poverty alleviation in non-tropical dry areas.

Taking into consideration the current research and development studies, the Panel considers that the Program covers effectively the use of various types of water resources in agriculture and should further develop research relative to groundwater conservation and control of health and salinity hazards in relation to the use of treated wastewater. Moreover, the Panel considers that the program covers the most critical

forms of water and soil degradation in the dry areas and is effectively contributing to find and implement solutions that may lead to the sustainable use of natural resources in dry areas. Related studies may be considered in many cases cutting edge activities in the international context.

The current development and implementation of technological and managerial tools for an improved use of limited water resources, to prevent soil and water degradation, and to cope with droughts and climate variability in rangeland, rainfed and irrigated agro-ecosystems, allows the Panel to consider that the outputs, outcomes and impact generated by the program are relevant to sustainable natural resource management and are achieved in an effective and efficient manner.

The Panel considers that the orientations for research and for development are well balanced, that research on water and land is also balanced, and that the scientific quality of IWLMP research is excellent.

The analysis of the work done by IWLMP, including in cooperation with other programs and institutions, evidence very positive developments as well as clear research trends. Consequently, various research recommendations of technical and scientific nature are summarized in item 14 of Section 5. A few recommendations refer to new areas of research but the opportunity for their implementation depends upon successful research funding. These areas mainly consist of:

- (1) developing new research issues on drought risk management, including early warning, mainly aiming at supporting further developments and applications by the NARS;
- (2) developing climate change scenario studies that may be useful for the BIGM program as well as for NARS in terms of adaptation to climate variability and variation and relating to the prediction of the onset of rains, temperature extremes and changes in rainfall regimes;
- (3) further developing studies on salinity, including assessing models that address salinity management, either for irrigation with saline waters or cultivation of salt-affected soils;
- (4) further developing research on using treated wastewater and greywater, mainly aiming at avoiding related health and salinity hazards;

- (5) develop research on groundwater conservation in the context of dry areas;
- (6) initiate studies on canal delivery scheduling and management aimed at solving existing constraints to adopt improved water saving and salinity management irrigation at farm level;
- (7) develop studies on irrigation water user associations whose mismanagement of irrigation systems may be constraining water use on farm.

Considering the need for new orientations in droughts and climate change research and the priorities of ICARDA in this domain, with implications in other programs, agronomic trials are needed to assess differential cultivar responses to abiotic stresses, mainly in relation to droughts, salinity and climate change. Thus, the panel considers that the existing collaboration of IWLMP with BIGMP is very important and needs to be further developed, which calls for additional time of the IWLMP staff involved. In order to respond to research needs on droughts and climate change it is advisable that a new position be open within IWLMP mostly oriented to the hydrological, meteorological and physics aspects of droughts and climate change.

Considering the fruitful results achieved relative to salinity research, it is highly desirable that ICARDA continues collaboration with IWMI on the salinity topic and extend this collaboration to droughts and climate change, wastewater research, groundwater management in dry areas, canal management and irrigation water user associations.

The main strategy adopted to ensure the integration of socioeconomic and policy dimensions of water and land management rests on the implementation of community-based and development oriented research projects carried out at regional or local level. In order to reinforce the capacity of research teams to effectively implement community based and participatory research, IWLMP has made an important effort in terms of capacity building and training. The panel recommends that this strategy aimed at integrating socioeconomic and gender issues in IWLMP training activities be reinforced and systemized.

Outputs of various projects, mainly the Water Benchmarks project, indicate that socioeconomic issues and participatory methods are well integrated in IWLMP research projects, although improvements are required.

Aiming at the reinforcement of interdisciplinary and participatory approaches, the Panel considers the need for the Management Board of ICARDA to define further orientations

about interdisciplinary research and on the relationships and work integration of SEPRP with IWLMP and eventually with other programs. Concrete actions include:

- (1) the setting up of a committee in charge of elaborating a strategy to strengthen interdisciplinary work and participatory research,
- (2) the recruitment of social scientists trained in interdisciplinary work, farming systems approaches and community-based research,
- (3) the development and implementation of a training program in participatory approaches and integration of social analysis in agricultural research, targeting both IWLMP and SEPRP scientists, as well as scientists and students of NARS. In addition, it would also be advantageous to develop a scholarship program that support post-doc positions and associate positions to attract young social scientists.

Considering the importance of integrating social, economic and policy research in the context of water and land management projects, whatever the responsibility belongs to IWLMP or to SEPRP, there is the need for:

- (1) the reinforcement and extension of the use of multidisciplinary participatory methods at all stages of the research process, mainly for the phase of technology development, including the homogenization and formalization of research methods and tools in order to ensure an effective application of participatory and interdisciplinary approaches;
- (2) adopting a more global view of policy related issues and to take into consideration their diverse dimensions, e.g., economic, social and institutional aspects;
- (3) developing research projects that investigate policy issues at farm, community and local level;
- (4) further integrating the different levels of analyses at which policy issues are to be investigated and to extend them at all phases of a research project;
- (5) a periodic follow-up evaluation to be performed by the IWLMP in cooperation with NARS to ensure the best benefits from its projects and associated findings.

Annexes

to the Report of the

**Center Commissioned External Review of
Integrated Water and Land Management Program of ICARDA**

Annex 1

Center Commissioned External Review of Integrated Water and Land Management Program of ICARDA

Terms of Reference

Background

ICARDA's 5th External Program and Management Review (EPMR) in 2006 recommended that the Center's thematic program structure needed further realignment. Specifically it recommended that *"the two currently separate MPs focusing on natural resources, MP3 (on desertification) and MP1 (on water) should merge as a single Water and Land Program"*.

The EPMR also recommended that *"the MP1 (on water) embrace research on water policy, institutions and adoption strategies to further enhance a very good program in water management"*.

ICARDA in 2007 implemented the EPMR's recommendations and created the Integrated Water and Land Management Program (IWLMP) to foster integration and improve research efficiency. The new program developed its Medium-Term Plan (MTP) 2008-2010, and subsequent plans, to specifically embrace these changes, in line with the Center's new Strategy for 2007-2016, which places special emphasis on water and land issues in the dry areas.

ICARDA, in light of the EPMR recommendations and its new Strategic Plan 2007-2016, and to ensure that its research is consistent with the evolving mission of the CGIAR and emerging water and land issues in the dry areas, would like to assess and review the progress made in the research in the IWLMP and to seek advice for future directions. The Panel is asked to state specific recommendations to address the challenges facing sustainable water and land management within the goals of our Strategic Plan.

A Center Commissioned External Review (CCER) is planned to address the following questions:

1. Has the new program implemented the EPMR recommendations satisfactorily?
2. Does the research program address the new directions in water and land as adopted in the Center's Strategic Plan 2007-2016, especially within the context of climate change?
3. Does the program address the CGIAR system and NARS' priorities and the emerging global issues associated with water and land?

4. Does the research program address the strategic aspects of sustainable use of limited water resources, especially in the context of livelihoods and poverty alleviation, in non-tropical dry areas?
5. Does the program cover effectively the use of various types of water resources in agriculture?
6. What is the quality of science in the program?
7. To what extent the outputs, outcomes and impact generated by the program are relevant to rural poverty alleviation and sustainable natural resource management and achieved in an effective and efficient manner?

Terms of Reference

The review panel is expected to examine the following issues:

I. Research

1. Establishment of a coherent and integrated multidisciplinary program of research on water and land, with a clear balance between the two major components, and a clear strategy and research work-plans that address the critical issues of water scarcity and land degradation in the dry areas.
2. Extent to which the social and economic dimensions of water and land research are adequately addressed in the research program.
3. Congruence of the Program's research activities with ICARDA's Strategic Plan.
4. The recommendations of the 5th EPMP related to water and land and the progress made in implementing those recommendations.
5. The response of the research in IWLMP to the priorities of national agricultural research systems (NARS) in dry areas and the emerging regional and global issues, and the relevance of strategic research issues for meeting the research needs of the NARS in the medium- and long-term.
6. The extent to which the program covers the most critical forms of water and soil degradation in the dry areas addressed by research work.
7. The quality of the science in IWLMP, and the extent that the Program uses the latest cutting-edge developments in water and land sciences.
8. The appropriateness of the position of the Program on the research-for-development pathway, i.e. strategic/applied/adaptive research, and the international public good (IPG) or location-specific nature of the Program's research activities
9. The research approaches used, especially benchmark sites, working at the community level

10. The extent, intensity and integration of policy research in collaboration with ICARDA's Social, Economic and Policy Research Program (SEPRP).
11. The extent and intensity of linkages to the other ICARDA Programs (BIGM and DSIPS).
12. The capacity of the program in providing effective training to NARS on major water and land management issues.
13. Major research outputs and their potential adoption and impact on improving sustainable water use, food security, farm income, and the alleviation of poverty.
14. Major gaps in the program research and recommendations on how to fill those gaps.

II. Administrative and Financial Management:

1. Effectiveness and efficiency of the Program's financial, administrative and research management procedures.
2. Effectiveness and efficiency of the project management, monitoring and reporting arrangements within the Program.
3. Functioning of internal communications within the Program on priority-setting and task execution.
4. Mechanism for linking the Program's research priorities to resource mobilization efforts and the ability of the program to attract restricted funding.

III. Personnel:

1. Program's ability to fill positions with the international level of science quality staff required.
2. Extent to which Program staff at all levels is up to date with, and have the required capacity in, the latest relevant technologies and science, and the provision of adequate training and staff development opportunities.
3. The mix of personnel available within the Program in terms of representing the science capabilities needed to carry out the targeted activities and the adequacy and suitability of individual staff profiles to deliver on research needs.
4. Presence of appropriate succession-planning

IV. Coordination and Partnership:

1. Extent of the collaboration of the Program with other Programs, Units and Regional/Country offices within ICARDA, with other relevant CGIAR centers, and with advanced research institutes and NARS.

2. Program's relationship and advocacy with key national policymakers in the NARS.
3. Delegation of tasks.

The Review Panel is expected to develop a rigorous approach to conducting the review, using internationally recognized evaluation methodology. A section on the methodology used should be included in the report.



Annex 2

Program for the Center Commissioned External Review of the Integrated Water and Land Management Program

Panel members:

Prof. Luis Santos Pereira (Chair)

Dr. Fatma Attia

Prof. Jim Oster

Dr. Alia Gana

14-25 February 2010

ICARDA Headquarters, Aleppo, Syria

Purpose: To review the Integrated Water and Land Management Program of ICARDA

Saturday, 13th February

(Itinerary to be finalized)

Arrival of panel members
Stay at Sheraton, Aleppo

Visitors Section

Sunday, 14th February

08:30

Departure from Hotel to TH

Visitors Section

09:00 – 10:00

Meeting with DG

M. Solh

10:00 – 11:00

Meeting with ADG – CS

K. Geerts

11:00 – 11:30

Meeting with Director of Finance

B. Fraser

11:30 – 13:00

Administrative procedures

T. Oweis

13:00 – 14:00

Lunch & ICARDA film

Darling room (visitors)

14:00 – 16:00

Tour of IWLMP & ICARDA facilities

Visitors

16:00

Departure to Hotel

Visitors Section

Monday 15th. February

08:30	Departure from Hotel to Tel Hadia	Visitors Section
09:00 - 10:00	Overview of IWLM	T. Oweis
10:00 – 10:30	Discussion	
10:30 – 11:30	Output 1. W&L Res. Assessment	M. Qadir & E. De Pauw
11:30 – 12:00	Discussion	
12:00 – 13:00	<i>Lunch (Qadir & De Pauw)</i>	<i>Canteen</i>
13:00 – 14:00	Output 2: Improving W&L Productivity	T. Oweis & R. Sommer
14:00 – 14:30	Discussions	
14:30 – 15:30	Output 3: Combating water & land degradation	F. Ziadat & M. Qadir
15:30 – 16:00	Discussion	
16:00 – 17:00	panel internal discussions	CCER panel
17: 00	Departure to hotel	Visitors section

Tuesday 16th. February

08:30	Departure from Hotel to Tel Hadia	Visitors Section
09:00 – 10:00	Output 4: Drought and climate change	M. Karrou
10:00 – 10:30	Discussion	
11:00 – 12:00	Output 5. Policies	A.M. Abdelwahab
12:00 – 12:30	Discussion	
12:30 – 13:30	<i>Lunch (Karrou and Abdelwahab)</i>	<i>Canteen</i>
13:30 – 14:30	Output 6. Capacity building	F. Karam, H. Ibrahim
14:30 - 15:00	Discussion	
15:00 – 17:00	Report writing	CCER panel
17:00	Departure to Hotel	Visitors Section

Wednesday 17th. February

08:30	Departure from Hotel to Tel Hadia	Visitors Section
09:00 – 10:00	Meeting with BIGM program	M. Baum & staff
10:00 – 11:00	Meeting with DISPS program	B. Rischkowsky & staff
11:00 – 12:00	Meeting SEPR program	A. Aw Hassan & staff
12:00 – 13:00	<i>Lunch (Ziadat and Sommer)</i>	<i>Canteen</i>
13:00 – 14:00	Meeting with GISU Head	E. De-Pauw
14:00 – 15:00	Meeting with CBSU Head	Z. Abdul-Hadi
15:00 – 16:00	Meeting with CDU A-head	H. Ibrahim
16:00 – 17:00	Report writing	CCER panel
17:00	Departure to Hotel	Visitors Section

Thursday, Friday, Saturday and Sunday 18, 19, 20, 21 February

- Visits to the Water Benchmarks Project and NARS in Jordan, Egypt and former projects and NARS in Syria.
- Members to visit each country: Jordan – Luis S, Pereira, Egypt – Fatma Attia; Syria – Jim Oster and Alia Gana.
- Program for each country developed in consultation with relevant regional coordinators

Monday 22nd. February

08:30	Departure from Hotel to Tel Hadia	Visitors Section
09:00 – 10:00	Meeting with DDG research	M. Van Ginkel
10:00 – 11:00	Meeting with ADG Syria relations	M. Jamal
11:00 – 13:30	Meetings as requested by panel	CCER Panel
12:30 – 13:30	<i>Lunch (van Ginkel and Jamal)</i>	
13:30 – 17:00	Report Writing & interviews	CCER Panel
17:00	Departure to Hotel	Visitors Section

Tuesday 23rd. February

08:30	Departure from Hotel to Tel Hadia	Visitors Section
09:00 – 10:00	Meeting with ADG IC	K. Shideed
10:00 – 11:00	Interviews as requested by panel	CCER Panel
12:30 – 13:30	<i>Lunch (Shideed and Ibrahim)</i>	<i>Canteen</i>
13:30 – 17:00	Report Writing	CCER Panel
17:00	Departure to hotel	Visitors Section

Wednesday 24th. February

08:30	Departure from Hotel to Tel Hadia	Visitors Section
09:00 – 10:00	Meeting with head of CODIS	L. Clarke
10:00 – 12:30	Report writing & interviews	CCER Panel
12:30 – 13:30	<i>Lunch (Baum and Aw Hassan)</i>	<i>Canteen</i>
13:30 – 17:00	Report writing & interviews	CCER Panel
17:00	Departure to Hotel	Visitors Section

Thursday 25th February

8:30	Departure from Hotel to Tel Hadia	Visitors Section
09:00 – 10:00	Presentation to ICARDA Management and Staff of Highlights of the draft report and recommendations	CCER Panel
10:00 – 11:00	wrap up meeting with Management	CCER Panel
11:00 – 12:30	Discussions with IWLMP Staff	CCER Panel
12:30 – 13:30	<i>Lunch (Management)</i>	<i>Canteen</i>
13:30 – 15:00	Draft report refinement	CCER Panel
15:00	Departure to Hotel	Visitors Section

Friday 26th February

(Itinerary to be finalized)	CCER Panel Departure	Visitors Section
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Sunday 7th. March

Panel chair submits draft report to ICARDA

Thursday 11th. March

ICARDA submits to panel chair “factual” corrections and remarks

Thursday 18th. March

Panel chair submits final report to ICARDA

Annex 3

Themes of Research and Technology Transfer by IWLMP and Respective Projects

Theme 1: Assessment of Water and Land Resources for Agriculture

The assessment of the availability and the potential of water and land resources in agriculture is a pre-requisite to identify the constraints to improve resource use in agriculture. WLMP assesses water and land resources' productivity and degradation under present and future scenarios at the farm-, ecosystem- and basin-levels. The research in this theme focuses on:

1. Assessment of the quantity and quality of available water resources for agriculture, including rainwater, surface water, ground water and marginal-quality water in the dry areas and projections for the future.
2. Assessment of water productivity in agriculture at the plant, field, farm, and basin levels.
3. Assessment of the potential of using water-use efficient practices and the consequences on productivity and the environment.
4. Assessment of the availability and potential use of marginal-quality water in agriculture in the dry areas and the environmental consequences, of its use.

Projects Supporting Theme 1:

- Water Benchmarks of CWANA
- Improving Water Productivity in Karkheh River Basin
- Efficient On-Farm Water and Soil Fertility Management in Central Asia
- GIS for watershed management
- Livelihood Resilience Project
- SUMAMAD project
- FoodWadi-Watershed Project
- Rainwater harvesting benchmarks project
- SWUP-MED Project

Theme 2: Increasing Agricultural Water Productivity in Dry Areas

Improving agricultural water productivity at the farm level is achieved by using improved crop varieties, by applying precision agriculture, by using modern irrigation, by improved cropping patterns and most importantly, by improved water management. IWLMP is developing appropriate technologies and integrated management options to maximize water productivity at the plot-, field-, farm- and basin-levels. Improving water and land productivities is achieved through:

1. Developing options and tools for improved rainwater productivity in dryland farming systems through improved agro-management, germplasm enhancement and conjunctive use of supplemental irrigation
2. Identify and integrate appropriate water harvesting techniques in the crop-range-livestock system of the marginal drier environments
3. Develop packages for increased irrigation water productivity, through improving irrigation management, water use efficient germplasm, cropping patterns and scaling out to other areas

Projects Supporting Theme 2:

- Water Benchmarks of CWANA
- Improving Water Productivity in Karkheh River Basin
- Mechanized microcatchment water harvesting (Vallerani water harvesting project)
- Efficient On-Farm Water and Soil Fertility Management in Central Asia
- Bright Spots of Salinity Management in Central Asia
- Field crops response to salinity & drought
- Information technology for improving irrigation water use efficiency
- FoodWadi-Watershed Project
- Bepazazri Rooftop water harvesting project
- Rainwater harvesting benchmarks project
- Vallerani-North Africa Project
- SWUP-MED Project

Theme 3: Combating Land Degradation

Soil erosion, salinity and the absence of vegetative cover are early-warning signs of desertification. IWLMP develops and disseminates practical, low-cost options to protect soil and water resources in dry areas. However, many of the developed technologies are not widely adopted due to technical, socioeconomic and policy constraints, but most importantly the lack of awareness and active participation of the communities. Farmers are the most valued partners of our land degradation research agenda. Farming communities actively participate at all stages of its research, from planning experiments to testing and disseminating the results. It lays thrust on:

1. Combating land degradation and contributing to mitigation of, and adaptation to climate change through sustainable management and utilization of natural resources, including soil, in cropland and rangelands.
2. Development of multi-scale tools and methods to assess land degradation (location, extent, driving forces, causes, impacts and consequences of desertification in dry areas)

3. Development of holistic approach to improved land management to combat desertification (loss of biodiversity, soil erosion, salinization, alkalization and waterlogging)
4. "Best-bet" technologies and practices developed for sustainable management of land, biodiversity and rangeland resources, including community-based land management practices

Projects under Theme 3:

- Water Benchmarks of CWANA
- Improving Water Productivity in Karkheh River Basin
- Mechanized microcatchment water harvesting (Vallerani water harvesting project)
- Improving Water Productivity of Fully Irrigated Crops
- Bright Spots of Salinity Management in Central Asia
- Livelihood Resilience in Karkheh River Basin
- SUMAMAD project
- Soil Erosion and Conservation in Hilly Olive Orchards
- Jabbul Agro-Ecosystem
- FoodWadi-Watershed Project
- Vallerani-North Africa Project
- SWUP-MED Project

Theme 4: Drought/Climate change preparedness and mitigation

Drought has a devastating effect on the livelihoods of the poor and threatens the fragile ecosystems in the dry areas. This is expected to be intensified with climate change in the coming decades. IWLMP looks for ways to prepare for and mitigate the effects of droughts and climate change through proper management of water and land resources under existing and future climate change. It is focused on:

1. Developing methodologies for characterizing drought in the major dry areas environments
2. Assessment of existing community, national and regional strategies and policies for the preparedness and mitigation of drought and climate change
3. Evaluate germplasm for adaptation to drought and other options and strategies for the preparedness and mitigation of drought at various levels
4. Enhance linkages and cooperation between CWANA countries on drought preparedness and mitigation
5. To better understand the potential impacts of climate change, IWLMP closely works on the three broad agro-ecologies in the CWANA region- rainfed systems, irrigated systems and rangelands

Projects under Theme 4:

- Water Benchmarks of CWANA
- Field crops response to salinity & drought
- NEMEDCA (Near East, Mediterranean and Central Asia) Drought network
- SWUP-MED Project

Theme 5: Integration of policies and institutional options

IWLMP develops frameworks for conservation and sustainable management of ecosystems with emphasis on their multi-functionality. It involves a local multi-stakeholder process that links land users with policy- and decision makers. The program links research to policy in terms of water and land management to broaden the partnership-base to include civil society and local research institutes. Improved policy and institutional options for better water and land management is to be achieved by:

1. Developing methodologies for scarce water resource valuation for major environments and socioeconomic conditions
2. Studying current policies on water allocation, valuation and use and develop alternatives for improved water demand management
3. Reviewing existing water management institutions and develop appropriate alternative institutions to improve irrigation management

Projects under Theme 5:

- Water Benchmarks of CWANA
- Improving Water Productivity in Karkheh River Basin
- Mechanized microcatchment water harvesting (Vallerani water harvesting project)
- Improving Water Productivity of Fully Irrigated Crops
- Efficient On-Farm Water and Soil Fertility Management in Central Asia
- Bright Spots of Salinity Management in Central Asia
- Jabbul Agro-Ecosystem
- Vallerani-North Africa Project

Theme 6: Enhancing NARES human capacity to improve water and land management

Enhancement of the NARES human capacity to manage water and land resources efficiently is a priority to IWLMP. It conducts targeted training to NARES on all water management issues including Water Use Efficiency, Drought Management, Supplemental Irrigation, Water Harvesting and efficient irrigation systems. This aims at enhancing NARES capacity to conduct research that is relevant to their national needs. Particular emphasis is laid on addressing the deficiencies associated with the

implementation of the collaborative research projects. Enhanced human capacity to improve water and land use in agriculture in dry areas is through:

1. Conducting training for NARS on ways to improve water productivity,
2. Supporting MSc and PhD studies and students
3. Organizing and supporting workshops and conferences and awareness building campaigns at different stakeholder levels

Projects Supporting Theme 6:

- Water Benchmarks of CWANA
- Improving Water Productivity in Karkheh River Basin
- Mechanized microcatchment water harvesting (Vallerani water harvesting project)
- Improving Water Productivity of Fully Irrigated Crops
- Efficient On-Farm Water and Soil Fertility Management in Central Asia
- Bright Spots of Salinity Management in Central Asia
- GIS for watershed management
- Information technology for improving irrigation water use efficiency
- Capacity-building in water management for improved water use efficiency in the dry areas
- Livelihood Resilience Project
- Soil Erosion and Conservation in Hilly Olive Orchards
- Jabbul Agro-Ecosystem
- FoodWadi-Watershed Project
- Bey pazazri Rooftop water harvesting project
- Rainwater harvesting benchmarks project
- Vallerani-North Africa Project
- SWUP-MED Project

Annex 4

Methodology applied by the CCER Panel for Reviewing the IWLMP Program of ICARDA (including reports relative to country visits by panel members)

The methodology applied by the Panel consisted of analyzing the activities performed by the Program, interviewing the staff of IWLMP, discussing research and technology transfer issues with other units of ICARDA, discussing research policy issues with the Deputy and the Assistant Directors General, and visiting field projects and NARS authorities. Main review findings and recommendations were discussed with the ICARDA's Management Committee and with IWLMP staff. The draft report was then finalized and submitted to ICARDA, and the final version was submitted after taking into consideration the final comments from the Management Committee and the program officers.

Activities performed by IWLMP were analyzed through presentations by IWLMP, SEPRP and GISU staff, reviewing publications and research reports and discussions with the program scientists. This analysis allowed the Panel members to have a good and updated vision on the organization of the IWLMP into Themes and particularly relative to the way how the program is responding to the EPMR recommendations, the CGIAR and ICARDA priorities, as well as the NARS priorities. The analysis and in-house discussions also focused the (a) procedures adopted in research projects; (b) approaches used to develop research proposals; (c) procedures used to carry out technology transfer and capacity building, (d) personnel required capacity referring to latest relevant technologies and science, and the provision of adequate training and staff development opportunities; (e) administrative and financial management procedures adopted; (f) collaboration of the Program with other Programs, Units and Regional/Country offices within ICARDA; and (g) collaboration with other CGIAR centers and with advanced research institutes and NARS.

The visits to the Water Benchmark Project and NARS institutions in Jordan and Egypt (Appendices 1 and 2) as well as visits to former project areas and NARS in Syria (Appendix 3) permitted to locally analyze how projects were carried out and contacting farmers and stakeholders as well responsible personnel of NARS at various levels. The focus on the Water Benchmark Project (Appendix 2a) results from its successful development as recognized by the NARS and funding Agencies, which led to start a second phase of the same project. The visits also permitted to understand how collaboration with NARS is carried out and how NARS priorities are effectively considered by IWLMP.

Discussing research and technology transfer issues with other programs and units of ICARDA permitted to understand how in-house collaboration is developed, which weaknesses, difficulties or insufficiencies exist, or how successful are being the collaborations with other research programs (BIGMP, DISPSP, and SEPRP) and units (GISU, CBSU, and CDU). Questions relative to financing and administration of projects were discussed with the Director of the Finance Department.

Meetings with the DDG Research, Dr. M. Van Ginkel, the ADG-CS, Dr. K. Geerts, the ADG Syria relations, Dr. M. Jamal and the ADG IC, Dr. K. Shideed, allowed to understand the vision of ICARDA institutional authorities about the IWLM program, the importance attached to land and water resources, the collaboration with NARS of dry areas countries (CWANA and else) and the in-house collaborations.

The final meeting with the Management Committee allowed to explain the point of views of the panel about the strengths of the program, mainly referring to the items identified in the ToR, and of its international and in-house collaborations, as well as to discuss about identified weaknesses. Unfortunately representatives of DISPSP and SEPRP were not present despite the importance of collaborations with IWLM.

Appendix 1

Report on the visit to the Water Benchmarks Project, *badia* research site in Jordan and the NARS Institutions

In the framework of the review of the IWLMP, the Water Benchmarks Project was selected for a review visit. The *badia* research site, consisting of the watershed of Al Majedyaa and Mharib, includes a variety of water harvesting technologies such as contour Vallerani ditches and pits, check dams and water collection reservoirs. The visit allowed understanding of the main problems faced this type of low rainfall rangeland ecosystems, mainly the difficulties relative to controlling barley cultivation in such low rainfall areas as well as to control grazing, the main hydrological features relative to soil crusting, low infiltration soils and consequent rapid formation of runoff, and the poor aggregation of soils also influencing the formation of gullies. The dialogue established with the Jordanian colleagues (Dr. N. Haddad, ICARDA, Dr. E. Karadsheh and Eng. A. El Ka'abneh, NCARE) and with farmers made light on the scientific and technical approaches as well as on the participatory research adopted in the project.

The visit to the NCARE, first with its DG, Dr. Faisal Awawdweh, and later with a group of researchers (see program attached), evidenced various positive issues: (1) research priorities of NARS are well considered by IWLMP in its projects and capacity building activities; (2) projects are formulated together, thus when they come into operation the projects are not “exterior” to the NARS collaborating institutions and researchers; (3) Projects with IWLMP are an important source of funds for the NARS since the internationalization represented by that collaboration stimulates the internal recognition of the projects; (4) capacity building with IWLMP is assuming an important role in upgrading scientific capacity of the NARS personnel; (5) the involvement of post-graduate students in the projects (in the visited project they were two: Ms. Samia Akroush, NCARE and the University of Jordan; ICARDA supervisor - Dr. Kamel Shideed; and Ms. Nesreen Shawahneh, NCARE and University of Jordan, ICARDA supervisor – Dr. Theib Oweis) are essential to both assuring the quality of the research and the training of researchers.

Discussions relative to this project highlighted various aspects: (1) the integration of water, land, livestock, vegetation, socio-economics was searched from the beginning of the project and was considered successfully attained; (2) the participatory approach used is considered a positive one to be applied elsewhere; (3) the selection of the experimental watershed site was a successful combination of know-how, GIS and filed information; (4) this success led to an excellent and updated use of the GIS database capabilities to be used further in the second phase of the project and as a base for modeling; (5) the overall success of the technological developments led to the adoption of the technologies in other 2 watersheds and to their adoption for a large

development project of the Ministry of Environment relative to the rehabilitation of *badia* damaged during the Gulf war.

At NCARE, discussions also referred to socio-economic studies and other projects conducted with IWLMP, particularly the Grey-water Project. Relative to this one, it was possible to properly consider grey-water characterization, the selection of households in the *badia* area, the monitoring program and further expected developments.

Other visits:

- (1) With Dr. Abdelnabi Fardous, Director of the UN Gulf War Compensation for Badia eco-system restoration program. Ministry of Environment, and former DG of NCARE, who has shown both the interest on adopting in this restoration program the methodologies developed for *badia* with the Benchmarks Project, and that revised his past experience as DG of NCARE of collaborating with ICARDA and the IWLMP group. Particularly important his view about building up the human capacities of NCARE through the involvement of MSc and PhD students in projects, and through short courses. The importance of common projects that satisfy both the priorities of NCARE and of ICARDA was also underlined.
- (2) With Prof. Dr. Mohammed Shatanawi, Professor of Water and Irrigation at the University of Jordan (UJ) and former Minister of Agriculture, with whom it could be revised the interest in collaboration with ICARDA at both the University level and the NCARE, both for research projects and transfer of technologies.
- (3) Dr Emad Al-Karableih, Director Water and Environment Research and Study Center (UJ) who, despite being in office only recently, has evidenced the importance of ICARDA collaboration with this Center.
- (4) Professor Awni Taimeh, Professor of Soil Science at the University of Jordan (UJ), Land use specialist, former DG of NCARE and Ex Secretary General (MoA). Discussions aimed to understand better the questions relative to land management, protection and rehabilitation focusing in particular the *badia* rangelands. It was evidenced the opportunity of collaborations of NCARE with IWLMP-ICARDA on developing water harvesting for land rehabilitation and the absolute need for giving to water the main role in rehabilitation of *badia* lands.

The visit led to the conclusion that IWLMP is: (a) developing good research, appropriate to the problems of land and water in Jordan, (b) effectively contributing to the capacity building of NCARE in the domain of land and water, (c) appropriately integrating socio-economic issues with the land and water ones, (d) reinforcing the opportunities for developing research projects, and (e) contributing to the setting up research and development priorities of the country. Summarizing, that collaboration is highly desirable, responds effectively to the country needs and contributes to the NCARE objectives of technological development and transfer to the end-users for improving livelihoods and alleviating poverty of rural populations.

Appendix 1a

Program of the Visit of Prof. Luis Pereira, Chair of the CCER Panel to review ICARDA IWLMP

19-20 February, 2010 Amman, Jordan

Saturday, 19 February 2010-02-21

09:00 Arrive to Amman Airport

09:00-13:30 Visit to the Badia Bench mark field sites at Al Majedyaa and Mharib

Accompanied by: Dr. Nasri Haddad (ICARDA), Dr. Esmat Karadsheh and Eng.
Awad El Ka'abneh (NCARE)

Sunday , 20 February 2010-02-21

08:00 Arrive ICARDA Amman Office and meeting with Dr. Nasri Haddad RC WARP

08:30 Leave to the National Center for Agricultural Research and Extension (NCARE)

09:00 Meeting with Dr. Faisal Awawdweh, Director General of NCARE

09:30-11:30 Meeting with NCARE team who collaborate in the joint activities with ICARDA's
ILWMP

Dr. Esmat Karadsheh and Grey-water management project

Dr. Samia Akroush (Socioeconomics, Badia Benchmark project)

Eng. Mohammed Mdaber (Water harvesting, Badia Benchmark Project)

Eng. Safa Mazahreh and GIS team (Eng. Lubna Mahasneh, Eng Mais Abu
Rbieha)

Dr. Faisal Barakeh (animal production) and Eng Mai Diab (plant production), Eng.
Rana Muhaisen and Eng. Awad Kaabneh (rangeland); Eng. Abeer Balawneh, Eng
Mohmmad Ayesh and Eng Said Zuraiqi (water and environment)

12:00-12:30 Meeting with Dr. Adelnabi Fardous, Director, UN Gulf War Compensation for
Badia eco-system restoration program. Ministry of Environment.

12:40-13:30 Meeting with HE Dr. Mohammed Shatanawi, Professor of Water and Irrigation at
the University of Jordan (UJ)

13:30-14:30 Lunch at the University of Jordan

14:30-15:00 Visit to Water and Environment Research and Study Center (UJ) and meeting
with Dr Emad Al-Karableih, Director

15:00-15:30 Meeting with Professor Awni Taimeh Land use specialist and Ex Secretary
General (MoA)

15:30-18:00 Return to hotel and departure to the Airport.

Appendix 2

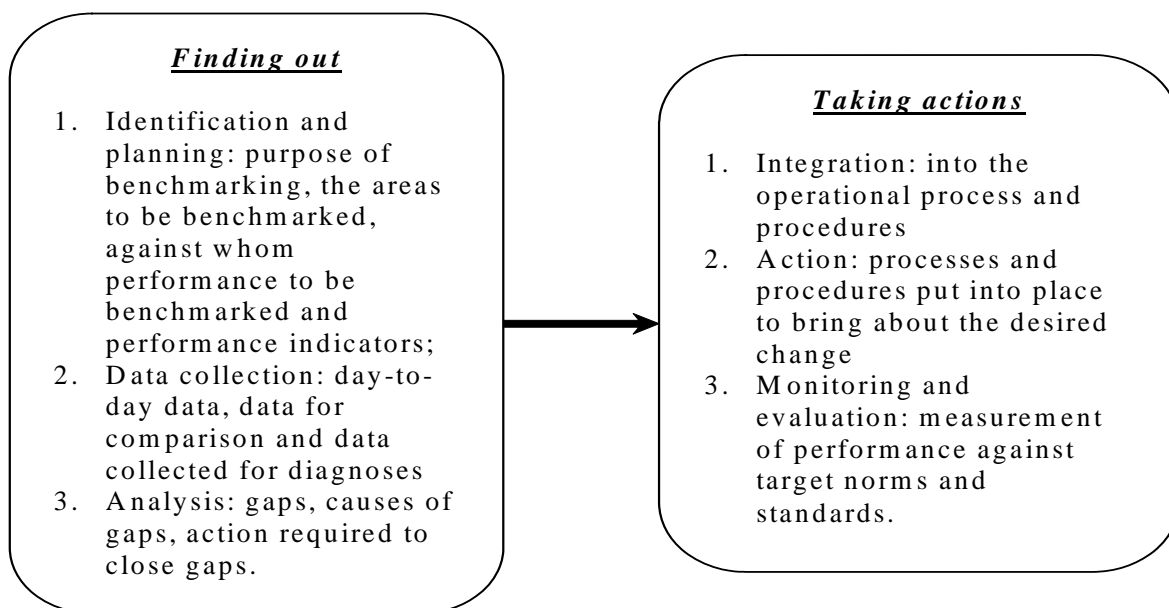
Report on the visit by Dr. Fatma Attia to the Water Benchmarks Project Irrigation site in Egypt and the NARS Institutions

Benchmarking is defined as "A systematic process for securing continual improvement through comparison with relevant and achievable internal and external norms and standards" (see Appendix 2a). It aims at improving the performance of organizational processes using experience gained from the study of similar organizations or processes. The target is to identify the gap between current and achievable performance and making changes to realize higher standard of performance.

Three characteristics are considered when dealing with benchmarking of the irrigation and drainage sector:

- Service providers operate in a natural environment
- Irrigation and drainage entails complex and interacting physical social, economic, political, technical and environmental processes
- Performance of irrigation and drainage schemes is site specific.

Benchmarking can be divided into two parts, as illustrated below.



The Meeting

The meeting was carried out at the premises of the ICARDA regional office in Cairo on Saturday February 20. Participants included representatives from NARS and a representative from the community. The details of the meeting are included in the attached table, and important points are summarized below.

- At the beginning of the project, ICARDA invited all major stakeholders to a workshop to identify the representative sites.
- The final decision on the three sites is made based on the existence of Water Users' Association to ensure a full participatory process.
- From the first day, the community has been involved which made the testing of solutions easier.
- Results of the new technologies were very promising with respect to the application of wide furrows and raised beds. Results of the first year made the farmers apply the technologies on a much larger area starting from the second year.
- The interdisciplinary team faced some problems in the beginning when every discipline used its own terminologies; but this disappeared afterwards and the team talked the same language and addressed one message.
- Some difficulties have been faced, mainly related to missing machinery to ensure full profit from the new technologies and change in crop pattern.
- The overall evaluation of the first phase is very positive, especially from the side of the community who made an excess profit of at least 30% (more crop production). From the point of view of NARS, the water use efficiency increased also by 25 to 35%.
- For the extension of the project, the team proposes to build on the success and enlarge the boundaries of the project with extensions to one new area (very poor community) with different culture, like the Farafra oasis.

Some Recommendations

1. To ensure sustainability of the first phase results, build on the success and enlarge the boundaries of the project, making sure to supply the first phase with their requirements of machinery.
2. Tackle a different area that has a different culture (indigenous people) where any small input can result in high added value of the interventions and results can be replicable to many similar agro-ecosystems in the region. Farafra oasis can be a good example as the Desert Research Center of the AUC has already started formation of users association and NARS have various opportunities to join.
3. One possibility to tackle in the second phase could be the application and evaluation of multiple use systems. One example is already in place in the western delta of Egypt which results in almost zero drainage from the unit of groundwater pumped. Land and water use include: two types of fish with fodder crops.

Question	Responses				
	Dr. Diaa	Dr. Yusry Ata	Dr. Rashad Abul Enein	Dr. Beltagui	Haga Nawal
What are the projects and activities you conducted/have been involved with the IWLM?	Benchmark coordinator of component 4, policy and institutions - Institutional reform - Water valuation	Development of new technologies (raised bed and wide furrows)	Coordinator of the benchmark	Benchmark sites invite all other themes of the IWLM program	Representing the community. Application/testing of the technologies and dissemination of results
How do you see the Benchmark project addressing Egypt's priorities and needs in on-farm water management?	To a large extent A good mean for the exchange of experiences with different countries	Addressed the main points	To the point Selection of sites is made by interdisciplinary team, based on socio-economic and agronomic studies. The criteria also is the existence of active WUAs	To the point	Very helpful. Applications were very successful. - First year, I applied results to half an acre. - Next year to 20 acres. - Results are encouraging as it decreases water use and results in 30% more crop production
How do you evaluate the cooperation between your organization and the IWLM?	- Very successful as it has created a good network for exchange of experiences. - We should build on it.	Good but needs to continue	Very good		

How do you evaluate the leadership of the IWLMP	Very qualified	Very qualified	Appropriate		
Are the approaches used in the projects appropriate to Egypt's agricultural needs (community-based, participatory)	We built on the experiences of the MWRI in this areas		Difficulties faced in the beginning could be overcome after the team became familiar with the approach and after trust was attained with the users		Pioneering as it has overcome difficulties users had in cooperating with government institutions
What do you expect in the second phase of the project	<ul style="list-style-type: none"> - Build on the first with more emphasis on decentralization and water value - Start out-scaling to macro and full scale projects - Involve other regions 		<ul style="list-style-type: none"> - Make use of the results of the first phase and implement into other agro-ecosystems. - The project developed bright ideas that need to be tested in other regions 	<ul style="list-style-type: none"> - Boundaries of agro-ecosystem zones should be extended and scaled-up and down not only in the same country but to others of similar characteristics. - Networking is very important 	Cultivation of crop types depends also on the availability of mechanized equipment which is always not available to farmers. This should be made available by gov. institutions to encourage farmers to apply the bright results of the project
Are there other projects/research areas you like to mention where ILWMP can be involved					Testing different types of crops and their impact on the return to farmers Impact of different cultures and in-house food security

How do you evaluate the cooperation between the various institutions involved in the program	Ad-hoc and needs to be institutionalized	Should be reinforced	Personal Needs to be institutionalized		Very good with the communities
The raised bed (wide furrow technology) was reported as an efficient practice, do you think it has a potential		Very useful	Needs to be adapted to other regions under various characteristics		Very promising
Any obstacles you faced and what suggestions you propose to overcome them in the future	No, due to good personal relationships	No, due to good personal relationships	No, due to good personal relationships		No, due to good personal relationships

Remarks:

1. The NARS constitutes of various institutions; but the main coordinator is the ARCs.
2. ICARDA invited all partners at the beginning of the benchmark.
3. ICARDA are high level scientist not just coordinators of programs.
4. Regional application created the bench mark program based on regional characteristics, including climate, soils, water, human-being and culture

Appendix 2a

Benchmarking Research

The Concept

Benchmarking is a systematic process for securing continual improvement through comparison with relevant and achievable internal or external norms and standards. Essentially, it involves learning, sharing information and adopting best practices. Broadly, the benchmarking process spreads over six stages: identification and planning, data collection, analysis, integration, action and monitoring and evaluation.

ICARDA's best known benchmark project on water management is the Water Benchmarks of West Asia and North Africa (WANA). This project explicitly defines benchmark sites for water management research across WANA and works with communities and NARS partners to develop, test and adapt improved water management options at the farm, irrigation scheme and watershed levels. Taking in to consideration the different agro-ecologies and levels of water scarcity in the region benchmark sites were established in Jordan, Morocco and Egypt to represent the marginal drylands (*Badia*) with range-livestock system, the rainfed environment and the conventional fully irrigated environment respectively.

The benchmark sites represent the majority of the conditions in the three agro-ecologies, but some conditions and issues related to the natural resources, environment and /or socioeconomics in the region cannot be fully represented by the benchmark sites; they need to be addressed at other locations. Examples of such issues include policies, institutions and socioeconomics. Therefore, specific research associated with these conditions and issues is conducted at satellite sites. Most importantly, the satellite sites offer immediate validation for any new practices and technologies identified at the corresponding satellite sites. They also provide an avenue for the transfer of technologies from the benchmark sites and enhance the regional dimension of the project.

Out-scaling Strategy

Theoretically, research findings and technologies developed and tested at a given benchmark site should apply to the entire agro-ecological zones (AEZ) as well as similar zones in other regions and countries (i.e., target sites). The identification of distinct AEZ and subsequent selection of benchmarks within each zone eliminates the need to conduct research at multiple sites. This saves cost, labor and time while increasing the likelihood of successful adoption. Benchmark sites and their research teams serve as a hub for capacity building and technology development and transfer. Free interactions between farmers and researchers help in the effective transfer of improved technologies and policy recommendations to wider dry areas.

Benchmarks of Major Agro-ecosystems

The main agro-ecosystems involved include:

1. The Badia benchmark;
2. The rainfed benchmark; and
3. Irrigation benchmark.

Further, each benchmark has a main site and a number of satellite sites. Table 1 summarizes the research approach followed in the various agro-ecosystems.

Research approaches

- Community-based: "Community-based research takes place in community settings and involves community members in the design and implementation of research projects. Such activities should demonstrate respect for the contributions of success which are made by community partners as well as respect for the principle of "doing no harm" to the communities involved.
- Participatory: In this approach, a range of actors including scientists, farmers, consumers, extension agents, industry stakeholders, and farmers as well as farmers' and community-based organizations and non-governmental organizations are actively involved in research and development.
- Integrated: It is an approach to national and international research topics from the perspectives of various disciplines, and in close collaboration with governments, companies, stakeholder organizations, citizens, and other knowledge institutions. The research should pay attention to the balance between three priorities in society: economics, culture and nature.

Table 2. Summary of Benchmark Activities

Benchmark	Characteristics	Objectives	Coverage
Badia	<ul style="list-style-type: none"> - The steppe (<i>Badia</i>) represents the drier environments of WANA, excluding the deserts. - These marginal areas are home to a substantial proportion of the region's rural and poorest populations. - Water is the over-riding constraint; the low and highly variable rainfall is often inadequate for economic crop production. - Rainfall distribution is highly erratic both within and between years; and occurs mostly in sporadic, intense and unpredictable storms, usually on crusting soils with low infiltration rates. 	Halt or reverse land degradation and improve the productivity and livelihoods of rural communities in these vast areas.	Muhareb watershed in the Jordan steppe is the main, Saudi Arabia and Libya are the satellite sites
Rainfed	Rainfed farming is dependent on rainfall and therefore, its productivity is low and unstable.	Optimize the use of limited surface and groundwater resources conjunctively with rainwater in supplemental irrigation system to improve water productivity at the field, farm and basin levels.	The Tadla basin in Morocco is the main, Algeria, Tunisia and Syria are the satellite sites
Irrigated	Fully irrigated areas of WANA are associated with the availability of surface water (e.g., rivers) and renewable groundwater resources.	<ul style="list-style-type: none"> - Study, at the community level, how to sustain high water productivity under various situations with varying upstream-downstream socioeconomic and biophysical conditions. - Assessing the actual productivity and determining the sources of inefficiency. 	Egypt (3 cases*) is the main, Iraq and Sudan are the tow satellite sites

* the old land, new lands and saline lands

Appendix 3

Report on the visits to former research sites in Syria and to NARS Institutions in Syria

19/02/2010 (Alia Gana)

Visit to the project “Land and Water Management, Diversification and Micro-Credits to Combat Land Degradation and Improve Livelihoods in the Mountains of Afrin”

Meeting with the president of the farmers’ union, El Maghara village

The project is supported by the Global Environment Facility (Small grant program). Its aim is to promote sustainable and productive use of land and water resources in degraded mountain watersheds, and to create more stable livelihoods, by developing land and water management technologies and introducing agricultural-based income-generating diversification options. The project develops a community micro-credit system to support land and water management and diversification options.

The project started in 2007 with a Small grant of 50.000 dollars. A village committee was elected and is in charge of the budget management. So far 52 farmers have benefited from the project: 26 farmers in 2008 (715 000 Lira) and 26 farmers in 2009 (695000 Lira). The microcredit allows farmers to finance anti-erosion works as well as other activities (purchase of animals, water cisterns.).

80 families are still living in the village. 150 have out migrated. A lot of young people work in Lebanon. Farm activities are based on olive tree production, animal rearing (goats), bee keeping and grapes. Traditional farming systems (75 years ago) gave a large place to barley and grape trees. These have been replaced by a monoculture of olive trees which has contributed to increase erosion, in relationship to the development of mechanization. 3 farmers of the community own tractors and rent them out to other farmers. Farmers interviewed indicate that mechanized plough is cheaper to than the use of draft animals.

Animal rearing include goats (100) and sheep (25). Goats graze in the forest, despite the ban.

The microcredit has to be reimbursed in 2 years (without interest). According to the farmers interviewed, the credit amount is insufficient. Also a number of farmers use the credit for other expenses. The committee is thinking about giving propriety to farmers who use the credit to finance anti-erosion works.

The community doesn’t have access to potable water. They buy water (3km) and stock it in cisterns.

Household incomes are based on olive tree production, animal production, sell of grape leafs and summak, transfer of revenues of family members. Women are importantly engaged in farm activities: harvest of olives, grapes, summuk cultivation, grazing.

Alia Gana and Jim Oster (Panel members) and Pierre Hayek (ICARDA)
2010-02-20

Vallerani project (experimentation site)

Water harvesting to grow atriplex and other. Plant growth on-site is obviously much more than the surroundings. Plant growth was also affected by the recharge area for each collection basin. Interviews with farmers' of Cheikh Hellal village (beneficiaries of the Vallerani project) 13 households out of 100 households of the village benefits. All farm households are pluri-active (off farm jobs) Farming active are animal rearing (sheep and goats), + milk production for autoconsumption. They used to grow wheat and barley, but since 1994 they are not allowed to grow cereals. The community is settled in the village since 1926.

The agroecological environment has changed. Rainfall has diminished (150mm) Pastures are grazed during 2 months: March and April. Women are very active in farming (vegetable gardens, poultry rearing, milking, cheese processing). Farm activities represent 50% of the household income. Subsistence farming+ sell of animals. Food consumption is covered to an important extent by farm production. They buy bread, rice and sugar.

Farmers want to increase the area planted in atriplex. Farmers sell part of their forage production to others.

Agha Khan foundation Salamyia.

Several water harvesting methods have been used: semicircular bunds similar to those used at the Vallerani project; continuous bunds following the contour; catchment basins, and an infiltration basin behind a small earthen dam.

Atriplex and other were planted at the base of the semicircular bunds and along the continuous bunds. Successful establishment was evident. Primary factor studied was the size of the collection area; three different collection areas were set up and the mid-sized collection area was the best – based on the cost of installation and the plant mass produced. Soil water contents were monitored using N-probe technology.

“The foundation brings support to the Vallerani project, intermediating between the farmers and the authorities. It was important to rebuild the trust. Farmers are recruited by the project to do the work, so that the community can benefit. Last year the rainfall was good (150mm), le vegetation has grown well. The income generated amounted to 60000 lira. 300 sheep use the pasture. The microcredit program has helped the farmers. Each household has around 5 sheep.

2010-02-21: Damascus

- Dr Awadis Arslan, Director of Natural Resources Research, General commission for scientific agricultural research, Ministry of Agriculture and agrarian reform
- Dr Souheil MAGHOUL, Deputy director general of GCSAR
- Interview with Dr. S. Maghoul :

Drs Arslan and Maamer were present at the meeting with the Dr. Maghoul. The organization of GCSAR, linkages with ICARDA, project objectives and adoption of results by farming communities were the topics discussed.

- GCSAR is organized in 9 administrations and 17 centers in all Syria several stations for applied research.
- Cooperation with Icarda : wheat and barley breeding, food legumes, biotechnology.
- Priorities for Syrian agriculture are food production (wheat) and forage crops (adapted to dry areas). Strategic crops are cotton, sugar beat, wheat and barley.
- Major exports : fruits, vegetables, olive oil (mostly golf countries+ Egypt), priority is to improve the quality for export to Europe. Post harvesting lacks performances. Quality program for olive oil.
- 50% of farmland in wheat, its a weak point (no rotation)
- Cotton, 2 kinds of rotation, but uses too much water, areas in cotton are decrease, because the cost of pumping is increasing.
- No subsidies to use marginal water, we conducting experiments to use saline water.

Dr Maamer, Head of the socioeconomic department

- Irrigated land represents 23%
- $\frac{3}{4}$ of the farmland is rainfed.
- Socio-economic program 20 researchers (10male&10 female).
- Research in Daraa : study on women in agriculture. They do all the work.
- Meeting with the staff of the administration of Natural Resources Research (ANRR)

Dr Arslan and leaders of his staff were present and the work of the unit was presented in several brief PP presentations. Linkages with ICARDA were highlighted. Considerable discussion occurred about the possible roles of socioeconomic analysis in project development.

Components

Policy and implementation

Capacity building, research and knowledge sharing

Improving rural livelihoods

Cooperation with Icarda:

1. Water and Livelihood Initiative
2. Conservative agriculture: seeding machine
3. Program for the development and dissemination of sustainable irrigation management in olive growing
4. Agroecological zoning in Syria + joint supervision of students and joint publications
5. Water Benchmark of CWANA, Supplemental irrigation 3 sites in Syria: Daraa, Alepo, El Hassakeh
6. Water harvesting: Cheikh Helal site (25ha), Quarryatine site (40ha)