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El Sebae A.S.

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Technology Transfer and Adoption: ICARDA's Experience

Samir El-Sebae Ahmed¹

International Center for Agricultural Research in the Dry Areas (ICARDA), Aleppo (Syria)

Abstract. The development and transfer of improved technology and its utilization by farmers are the most critical factors in agricultural development. Other factors influence, directly or indirectly, the decisions of both farmers and policy makers in accepting the new developed technology. Lack of trained personnel and extension specialists in most developing countries, among other factors, are responsible for the gap between the available technology and its adoption. Thus, there is a demand for renewed emphasis on training research and extension workers, and for a better understanding of the process of agricultural technology development and transfer.

The International Center for Agricultural Research in the Dry Areas (ICARDA) recognizes the complexity of the process of technology development and transfer, and the need for close cooperation between the different individuals and parties involved in this process. The Center also believes that agricultural research efforts and results are of no value unless the approved technology is transferred and fully utilized by its ultimate users: the farmers.

ICARDA's efforts and experience in the process of technology development and transfer are reported in this presentation. Special emphasis is placed on ICARDA's activities in on-farm research, training, extension work and institutions building.

Key words. Technology Transfer – Agricultural Research – Extension activities – ICARDA

Titre. Transfert et adoption des technologies : l'expérience de l'ICARDA.

Résumé. Le développement et le transfert des technologies améliorées ainsi que leur utilisation par les agriculteurs sont les points les plus déterminants du développement agricole. D'autres facteurs influencent, directement ou indirectement, les décisions des agriculteurs et des décideurs dans l'acceptation de nouvelles technologies. Le manque de personnel formé et de spécialistes de la vulgarisation dans la plupart des pays en voie de développement est la cause, parmi d'autres facteurs, du décalage dans le temps entre les technologies disponibles et leur adoption. Par conséquent, on doit de nouveau insister sur la priorité à accorder à la formation des chercheurs et vulgarisateurs leur permettant une meilleure compréhension du processus de développement et de transfert des techniques agricoles.

Le Centre International de Recherche Agricole dans les Régions Sèches (ICARDA) reconnaît la complexité du processus de développement technologique et de son transfert ainsi que la nécessité d'une étroite collaboration entre les différents individus et structures concernés par ce processus. D'autre part, d'après le Centre, les efforts et les résultats de la recherche agricole sont sans valeur à moins que la technologie choisie soit transférée et pleinement maîtrisée par ses ultimes utilisateurs : les agriculteurs.

Les efforts de l'ICARDA et son expérience dans le processus de développement et de transfert technologique sont évoqués dans

ce texte qui insiste plus particulièrement sur les activités de l'ICARDA dans les domaines de la recherche sur site, de la formation, de la vulgarisation et de l'appui institutionnel.

Mots clés. Transfert technologique – Recherche agricole – Vulgarisation – ICARDA

I. – Introduction

Generation of improved technology and its utilization by farmers are the key factors for increasing crop productivity and, therefore, improving the standard of living for farming communities. Several factors influence, directly or indirectly, the decisions of both farmers and policy makers in accepting the new developed technology. Lack of trained research personnel and extension workers in most developing countries, among other factors, are responsible for the gap between the available technology and its adoption. Thus, there is a demand for renewed emphasis on training research and extension workers as well as updating their technical knowledge.

In most countries of the West Asia and North Africa (WANA) regions, priorities for agricultural research and human resource development depend, to a large extent, on the available financial resources, and stem from a perceived national desire to decrease dependence on food imports. Decisions on these priorities are often made by several policy makers who often belong to separate institutions or ministries, and are then passed down to the research, extension and training specialists with only a limited or unclear system for interaction or feedback.

Furthermore, the 1986 report of the Technical Advisory Committee (TAC) of the Consultative Group on International Agricultural Research (CGIAR) concluded that "in most nations, the agricultural knowledge system is not sufficiently articulated to work as effective as it should. Usually the

components of the system are dispersed among many separate authorities and institutions, so that even if the official research component is well organized, it may be isolated from many of the others". The first recommendation of this study team was that "nations should be encouraged to put their agricultural knowledge system into better order". The International Agricultural Research Centers (IARCs), of which ICARDA is one, can certainly play an important role in this endeavour.

ICARDA recognizes the complexity of the process of technology transfer, and the need for close cooperation between all concerned individuals and organizations, including the government planners, research staff, extension workers, education and training personnel, non-governmental organizations and farmers. It also believes that agricultural research efforts and results will be of no value unless the approved technology is transferred to (and fully utilized by) its ultimate users: the farmers.

ICARDA is one of the 18 International Agricultural Research Centers (IARCs) supported by the Consultative Group on International Agricultural Research (CGIAR), which is an international group of representatives of donor agencies, eminent agricultural scientists, and institutional administrators from developed and developing countries who guide and support its activities.

The Center focuses its research efforts on areas with a dry summer and where precipitation in winter ranges from 200 to 600 mm. ICARDA has a world responsibility for the improvement of barley, lentil and faba bean, and a regional responsibility, in the West Asia and North Africa regions, for the improvement of wheat, chickpea, and pasture and forage crops and the associated farming systems.

The improved technology developed by ICARDA is transferred through its cooperation with national and regional research institutions, with agricultural universities and ministries of agriculture, and through the technical assistance and training that the center develops. A range of training courses are annually offered extending from group long-term courses to advanced research opportunities for individuals. These efforts are supported by seminars, publications, and specialized information services.

This presentation is not aimed at discussing the process of technology transfer in depth, but at presenting ICARDA's efforts and experience in technology development and transfer, particularly through its activities in on-farm research, training, extension and institutions building. The views expressed in this paper are those of the author and stem from his

relatively long experience and direct involvement in the areas of training, technology development and transfer and institutions building at ICARDA, CIMMYT and other institutions. These views do not necessarily represent those of ICARDA.

II. – On-farm Research

In collaboration with National Agricultural Research Systems (NARSs) in West Asia and North Africa, ICARDA conducts, annually, several on-farm verification and demonstration trials on farmers' fields. This type of adaptive research is essential for complementing the work conducted on research stations, and for providing more realistic evaluation of the new technology developed under farmers' conditions. It also provides an excellent opportunity for farmers, for whom the new technology is targeted, to participate, to learn, and to increase farmers confidence in the recommendations drawn. Other important objectives of this adaptive research are to build up and strengthen the research–extension–farmers and policy makers dialogue. Social and economic value and aspects of the tested technologies can also be evaluated in comparison with the farmers' existing practices.

The move from on-station to on-farm research, through to on-farm verification, to on-farm demonstration and pilot production or village projects, ensures a viable feedback mechanism between farmers and researchers as well as policy makers. Such mechanism, if effectively linked with the extension services at the appropriate stage, is expected to significantly assist the research systems to be continuously and adequately responsive to the evolving farm circumstances, and assist in research priority setting and adjustments.

In addition, on-farm sites offer ICARDA and NARSs an excellent opportunity for organizing field days and visits and for promoting their new technology. Research scientists, extension specialists, farmers, seed production specialists, government officials and representatives from the concerned international/regional organizations, and representatives from the universities and donors community usually participate in the field days organized at the on-farm sites, expressing opinions and making comments on the performance of the new innovations under farmers' conditions.

The face-to-face communication between farmers and policy makers during these field days assists in overcoming several of the non-technical constraints to the spread of the new technology such as marketing and availability of inputs.

III. – Training

Training and research are of equal importance for the success of national development and cannot be separated from each other. Since its inception in 1977, training at ICARDA has been considered an integral component of the center's overall activities, and is recognized not only as an educational process which requires more than information giving or skill development, but also requires a thorough understanding of the training process and the role and value of continuous and vigorous evaluation.

ICARDA's training activities are designed to respond to the different needs for human resources development in the countries of West Asia and North Africa, in particular, and in other countries of the world, in general.

The Center's various training activities strive to improve the capabilities of national scientists and technicians, up-dating their technical knowledge and improving their skills so that they can, independently, identify and overcome agricultural constraints that limit food production and farm income in their own countries. This also assists them in understanding the process of technology transfer and the complexity of farmers' decisions in adopting new technologies.

The Center offers a wide variety of training activities to meet the evolving needs of its client countries. These include: the long-term group courses, the specialized short-term courses, the individual non-degree and degree courses, the regional courses, the sub-regional courses and the in-country training courses. The latter three courses are usually conducted in close collaboration with the concerned NARSs. Each of these training programs is aimed towards improving the professional skills of the training participants and, hence, the development of their national programs.

Training programs at ICARDA are not fixed over years, but change from one year to another to respond to the different training demands of NARSs. These demands are usually presented by national scientists and discussed during the annual national, sub-regional and/or regional coordination meetings with NARSs, as well as during the visits between the two parties.

The first ICARDA training courses were offered during the 1977/78 cropping season with only a modest number of participants. Since then, the number of training participants, the number of coun-

tries served, and the type of training opportunities have increased steadily (*Appendix I and II*).

Training success is often assumed, but seldom proven. Without knowing what problems exist and understanding the causes, it is difficult to identify further improvement or enhancements. ICARDA has been fully aware of the problems related to training, and improvements have recently been made. Among these improvements are: refining selection procedures of training participants; decentralization of large parts of ICARDA's training activities from its headquarters in Aleppo, Syria, to national programs; placing more emphasis on the specialized training courses including the degree-related training programs; conducting regular follow-up study on training; improving the training material and creating and up-dating a computerized training participants database.

Success in reaching training objectives can only be seen when those who receive training apply what they have learned and when changes can be observed in practices and production. Training Follow-up Study (TFS) is the culmination of a consistent and continuous efforts by ICARDA to measure the effectiveness of its training activities and make the necessary improvements. The first ICARDA training follow-up study was conducted in 1988 by a consultant, Dr. Bryant Kearn from the University of Wisconsin, USA, and the ICARDA Training Coordination Unit (TCU). The strength and weakness of training at ICARDA were reported and the full report was published in 1991 and distributed to all concerned.

Similar to other IARCs, training programs at ICARDA are not based on a professor-student relationship but on a mature partnership, and are regarded as a two-way learning process through which exchange of experience becomes a natural outcome. ICARDA training participants, regardless of their positions or duties, are considered by all means its true ambassadors and future collaborators. They are the future leaders for their national programs, and can certainly play an active role in technology transfer and, therefore, in improving food production in their own countries.

IV. – Postdoctoral and Visiting Scientists Program

This special program at ICARDA aims at providing new Ph.D. graduates and senior scientists from NARSs with an opportunity for in-service training.

Post doctorates and visiting scientists usually join ICARDA for a period of one to three years and are assigned certain duties in the respective programs and units in a similar manner to ICARDA staff members. During their stay, they are encouraged to conduct research and develop collaborative research projects of direct importance to their national programs.

V. – Workshops, Meetings and Exchange of Visits

Workshops, travelling workshops, seminars, meetings and exchange of visits with national programs comprise an important component of ICARDA's strategy towards strengthening national programs, and serve as a forum for exchanging ideas and deciding on future collaborative activities with NARSs. These activities are often conducted at the request of national scientists and are organized either at ICARDA headquarters or outside.

In addition to ICARDA scientists, national collaborators participate in most of these activities. Proceedings of workshop and meetings are often produced and distributed to the concerned NARSs and other interested institutions. Annual National, Sub-regional and Regional Coordination Meetings are also organized with the collaborating institutions and universities in WANA and abroad.

ICARDA scientists and management members visit most countries of WANA every year and participate in several meetings with national scientists. Similarly, ICARDA receives visitors from all over the world with different backgrounds and interests. In 1992, for example, ICARDA received a total of 1,648 visitors representing more than fifty countries. Among these visitors were farmers, students, scientists, extension specialists, representatives of private companies, seed sector, donor organizations, press and media, regional and international organizations and others. Each of these visitors is usually interested in one or more of ICARDA's different activities, and their interactions with ICARDA scientists, each in his/her discipline, significantly contribute to the process of technology development, transfer and utilization.

VI. – Publication, Documentation and Exchange of Information

Through its communication, documentation and information services (CODIS), ICARDA places high priority on increasing and further improving the qua-

lity of agricultural information and its subsequent dissemination and adoption by national programs in the WANA region and beyond.

ICARDA strengthens cooperation with its partners involved in technology transfer, by providing improved services in the areas of publications, translation, library search and training. The three crop-oriented periodicals: FABIS (for faba bean), LENS (for lentils), and RACHIS (for cereals) continue to offer alternative channels for national scientists to publish results of their own research for information dissemination to all concerned. The Center also contributes to and participates in most of the regional and international agricultural information networks including AGRIS and CARIS.

Recently, the ICARDA library expanded its information services through the acquisition of additional data base on CD-ROM discs, covering the areas of biology, agriculture, water resources, world weather, women in development, and science and technology. Also two in-house data bases were recently developed. These are: PUBLIST which covers ICARDA publications from 1977 to 1990 (also issued in catalogue form), and STEPPE which compiles literature on steppe-related studies in WANA countries since 1970.

VII. – Agricultural Extension

In a recent publication, Willem Zijp, an extension specialist at the World Bank, reported that around 600,000 people are currently involved in extension services worldwide. Of these, 90% work for government, 80% are field workers and 13% are women. Since the 1960s, countless extension agents have practiced their art to communicate new technologies and information to farmers throughout the world.

From technology generation to utilization, agricultural knowledge passes through different stages. Therefore, it is essential for researchers and extension workers to be fully aware of each stage, so that they can direct their research activities and responsibilities towards the actual needs of their clientele: the farmers.

Productive linkages between research–extension and farmers also creates proper channels through which products, data, information, knowledge and experience are exchanged between the various partners in the development process. Thus, the stronger the linkages, the more effective and efficient the transfer of the new innovations to the users. Technology generators and extension specialists should also understand how farmers arrive

at their decisions and therefore, design and disseminate information and new technology for more rapid adoption.

Similar to other international agricultural research centers, ICARDA does not conduct specific research on or offer training in agricultural extension. However, it recognizes that improved technology has no impact and is almost pointless unless it is adopted by farmers. Therefore, ICARDA plays an indirect, but important, role in technology development and transfer through several means, including on-farm testing, organization of field days and visits for farmers and policy makers, and organization of travelling workshops, training courses and roundtable discussions for farmers, researchers, extension workers and government officials; as well as assisting in the production of some field guides and extension publications related to the utilization of the new technology. Such joint activities help bridge the gap between researchers and extension specialists.

VIII. – Professional and Institution Building

In the WANA region, national programs vary considerably in their stage of development, capability and needs. ICARDA's approach to meet the different needs and opportunities of WANA countries and beyond is represented by its six regional programs, which represent the major agro-ecological zones. These are:

- Nile Valley Regional Program (Egypt, Sudan, Ethiopia);
- North Africa Regional Program (Algeria, Morocco, Tunisia, Libya);
- Arabian Peninsula Regional Program (UAE, Bahrain, Kuwait, Qatar, Saudi Arabia, Sultanate of Oman and The Republic of Yemen);
- West Asia Regional Program (Syria, Lebanon, Jordan, Iraq, Cyprus, Turkey, Iran);
- Highland Regional Program (Highlands of Syria, Turkey, Iran, Lebanon, Pakistan and the newly CIS);
- Latin America Regional Program (located in CIMMYT, Mexico);

Within these regional programs, support is given for continuing ICARDA's catalytic role in working with NARSs for encouraging sharing information and experience, conducting specific collaborative research projects, offering training, promoting innovations, providing germplasm, and, where possible, developing collaborative projects for funding by donor agencies. In other words, to continue provi-

ding the major mechanisms to permit the joint ICARDA/NARSs research and training continuum to operate in both directions and, therefore, strengthen the emerging partnerships. ICARDA is also encouraged by NARSs to strengthen and to up-stream linkages with other IARCs, particularly with international centers such as CIMMYT, ICRISAT, IBPGR, IIMI and ISNAR.

Research and Training Networks (RTNs) are effective mechanisms in linking national scientists with each other and with the concerned regional and international organizations. These national, sub-regional and regional networks also insure a continuous flow of information among interested scientists, and provide opportunities for donor organizations to allocate financial support to the networks of their priorities and interest. Funds required for RTNs often come from interested donor organizations or the cooperating countries. Financial support from ICARDA can also be obtained for some networks. *Appendix III* presents a list of some of the more formal RTNs coordinated by ICARDA, and their source of funding.

The above mentioned mechanisms are just a few examples of ICARDA's attempts to better tailor its research and training strategies and modalities of cooperation with its clients to meet the specific, but variable needs of NARSs, and therefore, contribute to the process of technology development, transfer and utilization.

Notes

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APPENDIX I

National scientists trained at ICARDA during 1978–1992

Year	Program/Unit				
	Cereals	Legumes	Pasture, Forage & Livestock	Farm Resources Management	Other *
1978	6	17	3	-	-
1979	40	16	7	-	3
1980	16	23	10	6	-
1981	13	25	13	1	3
1982	59	35	15	7	9
1983	21	42	10	9	46
1984	63	42	21	20	57
1985	87	78	30	9	19
1986	90	144	22	54	87
1987	81	110	22	47	53
1988	137	166	22	78	187
1989	165	143	16	66	135
1990	136	225	43	103	186
1991	128	165	79	144	270
1992	104	199	59	92	381
Total	1146	1430	372	636	1436

* Other training activities include Genetic Resources, Seed Production, Farm Management, Computer, Library, etc.

APPENDIX II

National scientists trained at ICARDA from WANA and other countries, 1978–1992

Country	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	Total
<i>A. From WANA:</i>																
Algeria	1	4	3	3	2	-	3	1	45	63	16	34	33	30	53	291
Bahrain	-	-	-	-	1	-	-	-	-	-	-	-	-	-	2	3
Cyprus	-	4	1	-	1	-	1	1	1	-	-	3	5	3	2	22
Egypt	4	1	-	7	5	31	20	5	33	13	85	58	45	73	75	455
Iran	2	-	-	-	2	1	5	9	10	2	5	58	42	19	23	178
Iraq	-	5	-	-	1	-	2	2	7	1	-	-	14	9	14	55
Jordan	2	4	4	1	4	5	7	2	14	16	20	9	40	77	38	243
Kuwait	-	-	-	-	-	-	-	-	-	1	1	1	2	-	1	6
Lebanon	3	1	-	-	3	1	3	4	4	1	-	10	10	15	94	149
Libya	1	1	-	-	-	3	9	-	3	-	-	1	30	56	18	122
Morocco	-	4	5	1	30	-	27	62	36	12	82	58	81	42	20	460
Qatar	-	-	-	-	-	-	1	-	-	-	-	-	14	-	1	16
Saudi Arabia	-	-	2	-	-	-	1	2	1	-	46	-	1	1	-	54
S. of Oman	-	2	-	-	-	-	-	-	-	1	2	-	16	22	6	49
Sudan	-	2	7	12	4	13	8	13	29	25	15	25	20	16	23	212
Syria	10	16	8	19	41	41	70	53	55	72	67	110	134	179	169	1044
Tunisia	-	3	5	2	11	13	6	9	37	20	39	30	50	29	18	272
Turkey	2	2	7	-	-	-	-	4	57	11	36	10	40	69	43	281
R. of Yemen	-	3	2	2	2	5	7	9	14	9	47	22	30	9	32	193
U.A.E.	-	-	-	-	-	-	-	-	-	1	-	-	2	2	1	6
Ethiopia	-	3	-	1	-	2	1	6	27	38	67	28	15	45	48	281
Pakistan	-	-	3	2	5	4	20	28	7	4	6	24	6	3	6	118
<i>B. Other Countries</i>	1	11	8	5	13	9	12	13	17	23	56	44	63	45	29	349
Total	26	66	55	55	125	128	203	223	397	313	590	525	693	744	716	4859

Appendix III

Research and training networks (RTN) coordinated through ICARDA

Network	Source of Financial Support	Countries/Institutions Involved
Inoculation of pasture and forage legumes(INONET)	ICARDA	11 Countries from WANA 5 Countries non-WANA
Barley Pathology	USAID	5 Countries from WANA, USA (MSU)
Durum Germplasm Evaluation	Italy	6 Countries from WANA 5 Countries non-WANA
Cereal International Nurseries	ICARDA	50 Countries worldwide, CIMMYT
International Legume Testing Network (ILTN)	ICARDA	52 Countries worldwide
North African Legume Research Network (NALRN)	ICARDA, BMZ, GTZ	4 Countries in North Africa
West Asian Legume Research Network (WALRN)	ICARDA, BMZ, GTZ	8 Countries from WANA
North African Faba Bean Research Network	BMZ, GTZ	4 Countries in North Africa
Screening Wheat and Barley for Resistance to Hessian Fly	ICARDA, MIAC	Morocco, Algeria and Tunisia
Biological Nitrogen Fixation in Legumes: Rhizobium Ecology Network (REN)	ICARDA, UNDP	4 Countries from WANA
Soil Test Calibration Network	ICARDA, UNDP, IMPHOS	11 Countries from WANA
Dryland Pasture and Forage Network	ICARDA, IBPGR	Countries of WANA, Europe, USA, Australia
WANA Plant Genetic Resources (WANANET)	to be determined	WANA Countries, IBPGR, FAO, ACSAD
Faba Bean Information Services (Fabis)	IDRC, ICARDA	Worldwide
Lentil Experimental News (Lens)	IDRC, ICARDA	Worldwide
RACHIS	ICARDA	Worldwide
WANA Seed Network	to be determined	11 Countries from WANA
Agricultural Information Network for WANA (AINWANA)	to be determined	WANA Countries, CIHEAM, ISNAR
Global Grain Legume Drought Research Network (GGLDRN)	ICARDA, ICRISAT, FAO	Worldwide, ICRISAT, FAO
DNA Fingerprinting of Chickpea Ascochyta Blight Fungus	GTZ, ICARDA	5 countries from WANA, University of Frankfurt

(RTN) Operating under the ICARDA's Nile Valley Regional Program (NVRP)

Network	Source of Financial Support	Countries/Institutions Involved
Integrated Management of Wilt Root Rots in Chickpea and Lentil	EEC, SAREC, DGIS	Egypt, Ethiopia, Sudan, ICRISAT
Development of Autogamous Faba Bean	EEC, SAREC, DGIS	Egypt, Ethiopia, Sudan
Screening of Faba Bean for Resistance to Aphids	EEC, SAREC, DGIS	Egypt, Ethiopia, Sudan
Survey of Legume Viruses	EEC, SAREC, DGIS	Egypt, Sudan, Ethiopia
Integrated Management of Chocolate Spot of Faba Bean	EEC, SAREC	Egypt, Ethiopia
Sources of Primary Inoculum of Stem and Leaf Rusts of Wheat, their Sources of Pathways and Sources of Resistance	EEC, SAREC, DGIS	Egypt, Ethiopia, Sudan
An Approach to Identify Theromtolerance in Wheat and Maintaining Yield in Hot Environment	EEC, SAREC, DGIS	Egypt, Ethiopia, Sudan, CIMMYT
Water-Use Efficiency of Wheat	EEC, DGIS	Egypt, Sudan
Integrated Control of Aphids in Wheat	EEC, DGIS	Egypt, Sudan
Screening for Barley yellow Dwarf Virus (BYDV) Resistance	EEC, DGIS	Egypt, Sudan
Survey of Barley Yellow Dwarf Virus (BYDV)	EEC, SAREC, DGIS	Egypt, Sudan, Ethiopia
Characterization of Wheat Germplasm for Resistance to Photoperiod and Vernalization	EEC, SAREC, DGIS	Egypt, Sudan, Ethiopia
Socio-Economic Studies on Adoption and Impact of Improved Technologies	EEC, SAREC, DGIS	Egypt, Sudan, Ethiopia

Barley (RTN) Operating under the ICARDA's Latin America Regional Program

Development of Stripe Rust Resistance Barley	CIMMYT, ICARDA	Countries of Latin America, OSU, CIMMYT
Development of Hull-less Barley	CIMMYT, ICARDA	CIMMYT, Canada, Australia, Colombia
Development of Barley Yellow Dwarf (DYD) Resistance Lines	CIMMYT, ICARDA	CIMMYT, Chile, Ecuador , Kenya
Development of Germplasm Resistance to Scab and Barley Yellow Mosaic Virus (BYM)	CIMMYT, ICARDA	CIMMYT, China
Development of Barley Lines Resistant to Spot Blotch Caused by H. Sativum	CIMMYT, ICARDA	CIMMYT, Vietnam, Uganda, Thailand
Development of Leaf Rust Resistant Barley	CIMMYT, ICARDA	Virginia Tech., North Dakota State University, CIMMYT, Countries of Latin America

