Farmer Participation and Use of Local Knowledge in Breeding Barley for Specific Adaptation

GTZ Project No. 95.7860.0-001.13

ANNUAL REPORT 1998

The International Center for Agricultural Research in the Dry Areas (ICARDA)
P.O. Box 5466, Aleppo, Syria

Part I. PROJECT SUMMARY

Title: Farmer Participation and Use of Local Knowledge in Breeding Barley for Specific Adaptation

Objectives of research

1. Improved barley varieties that fulfill the needs and objectives of poor farmers in the marginal rainfed environments.
2. Enhanced rate of adoption of new varieties through farmers' participation in selection and testing.
3. A participatory approach to breeding barley for stress conditions.

Abstract: Breeding philosophies and methodologies developed for favorable conditions and high input agriculture have been ineffective in generating improved cultivars for marginal conditions and low input agriculture. The proposed program will develop and implement a novel breeding approach for barley improvement in low potential, marginal rainfall environments of northern Syria based on: (a) early selection and testing under real farmer conditions, (b) use of farmers' selection criteria, (c) use of market derived economic criteria during both selection and testing, and (d) validation and quantification of grain and straw qualities used as selection criteria. The research will utilize the subjective assessments of producers and consumers to establish objective indicators of crop quality.

The expected outputs include increased adoption of new varieties in low-input agriculture and crop quality indicators, which are appropriate to the needs of producers and consumers. The new breeding program, targeted at marginal conditions and low-input agriculture, will move selection and testing work outside experiment stations and put breeding into the hands of farmers. We expect that, even in a relatively small geographical area, farmers will tend to exploit specific adaptation. Specific adaptation benefits biodiversity through selection and spreading of a number of different cultivars, instead of the few, often closely related, cultivars characteristic of conventional breeding for wide adaptation.

IARC programme and unit: Germplasm Enhancement and Breeding: Project 1.1 Barley Improvement, within the Germplasm Program of ICARDA

IARC project coordinator: Dr. Salvatore Ceccarelli, Barley Breeder, Germplasm Program

Collaborating institutions: Institut für Agrar- und Sozialökonomie in den Trope und Subtropen, University of Hohenheim, Germany
Agricultural Research Center, Ministry of Agriculture and Agrarian Reform, Syria

Project scientists (financed): Proportional time commitment of senior ICARDA staff
One National professional Officer, ICARDA
One Ph.D. student, University of Hohenheim
Research Technician at ICARDA

Project duration: January 1, 1996 to December 31, 1998

Budget summary (in DM):

	Year 1	Year 2	Year 3	Total
ICARDA	244,500	208,000	129,000	581,500
Hohenheim	45,200	35,600	0	80,800
TOTAL	289,700	243,600	129,000	662,3

Part II. ANALYTICAL SUMMARY

1. Identifying information

Project No.: 95.7860.0-001.13	Date:

Title: Farmer Participation and Use of Local Knowledge in Breeding Barley for Specific Adaptation	Reporting period: January-December 1998
Reporter: Dr. S. Ceccarelli, Barley Breeder, Germplasm Program, ICARDA, Project Coordinator	Address: ICARDA, P.O. Box 5466, Aleppo (Syria) Tel: +963 21 2225112 Fax +963 21 2213490

2. Project Characterization

Characteristics of research	Increase in Productivity	Environmental Protection	Safeguarding of biodiversity	Policy, Socio economic Research	Consolidation of National Programmes
Basic + Strategic	60	20	60	80	50
Adaptive-on Farm	25	80	30		
Networking					
Training	10		10	20	50
Information	5				
Other					
	100	100	100	100	100

3. Achievements and Constraints

4. Implication from Current Reporting Period.

Communication and Dissemination of Information

6. Status of Work Programme

	Work Plan for current reporting period	Work Plan for next reporting period	Remarks
Work Programme	Jan 01 - Dec 31,1999		
Component 1	Concluded	Concluded	
Component 2 Output 1	a) observation and analysis of farmers' selection criteria b) relationship between the two selection cycles	Concluded	
Component 2 Output 2	a) desirable characteristics verified during selection both by individual farmers and farmers' groups b) one or more validated lists of desirable characteristics	Concluded	
Component 2 Output 3	a) observation and analysis of perception of g x e interaction by comparing lines selected in different environments	Concluded	

Component 3	a) validation of the model	Concluded	
Component 4	a) selection by farmers and breeders in farmers fields and in the experiment stations b) lines selected by farmers and breeders	Concluded	
Component 5	a) multiplication of the most promising lines for feeding trials b) analysis of data on straw and grain quality on each of the lines in 1997/98 season and correlation with farmers and breeder selection	Concluded	

7. Status of Funding

Please refer to Financial Report submitted separately.

Part III. SCIENTIFIC SUMMARY

component 4: Participatory Breeding

In 1999 we prepared a specific trial for each of the nine locations using the lines selected in 1998 by the farmers and the breeder (Table 2.42). One location was changed since the farmer who collaborated with us in Ibbin sold his property. The location was replaced by Tef Tanaz, not far from Ibbin and representing the same farming system and climatic and management conditions. The layout was as in 1998 and included systematic checks every ten entries. In one farmer's site (Al Bab), where the farmer has introduced a forage legume in the rotation (common vetch, *Vicia sativa*), the trial was planted twice, once after barley and once after vetch.

All the nine trials were also planted in Tel Hadya and Breda, two of ICARDA's research stations. The details of each trial are shown in Table 2.42.

Table 2.42. Composition of the 1998/99 trials

Location (code)	Nr. of lines	Nr. of checks	Layout	Check
Tef Tanaz (01)	107	13	30 x 4	Rhn-03
Ebla (02)	117	15	33 x 4	Rhn-03
Tel Brak (03)	103	13	29 x 4	Tadmor
Jurn El-Aswad (04)	103	13	29 x 4	Tadmor
Baylonan (05)	116	12	32 x 4	Zanbaka
Al Bab (06)after barley	113	15	32 x 4	Sara
Al Bab (10)after vetch	95	13	27 x 4	Sara
Melabya (07)	120	12	33 x 4	Zanbaka
Bari Sharki (08)	107	13	30 x 4	Zanbaka
Sauran (09)	106	14	30 x 4	Arta

Each farmer was given a field book where he recorded the rainfall (measured through a rain gauge) and their selections. The field book reported for each entry the plot numbers in both 1997 and 1998. Therefore the farmers had the possibility of consulting the 1997 field book and the notes taken on those entries that were selected. In most of the locations, groups of between 4 and 11 farmers including the host farmer did selection. Their preferences, expresses with a

score from 0 = undesirable to 4 = the best, were averaged and the mean score used for further comparisons.

Rainfall (Table 2.43) ranged from a minimum of 122 mm in Melabya to a maximum of 355 mm in Ebla. Rainfall distribution in the locations in Raqqa and Hassakeh provinces (location codes 03, 04, 05 and 07) was poor, with a late start of the rain that delayed crop establishment: the good rains in March came too late to compensate for the poor start. As a consequence, there was no grain produced in the three locations (03, 07 and 08) that received 130 mm rainfall or less (Table 2.44).

Table 2.43. Monthly and total rainfall (recorded by farmers through rain-gauges) in the nine locations[a].

Location (code)	S	O	N	D	J	F	M	A	M	Total
Tef Tanaz (1)	0	2.5	47	89	41	60	53	18	0	310.5
Ebla (02)	0	0.5	49	105	39.5	54.5	77	29	0	354.5
Tel Brak (03)	0	0	0	13.5	6	28.7	26	56	0	130.2
Jurn El-Aswad (04)	0	0	5	40.5	29.5	22.5	77	15	0	189.5
Baylonan (05)	0	0	0	53	24	22	41.5	22	0	162.5
Al Bab (06)	0	0	13	44	43	38	40	25	0	203
Melabya (07)	0	0	0	7	21.9	13	47	33	0	121.9
Bari Sharki (08)	2	0	8	41	19	15	38	5	0	128
Sauran (09)	0	0.5	21.5	71.3	29.5	25	42.5	22.5	0	212.8
Breda (BR)	0	1.8	20.2	40.8	19.6	30	72.8	12	0.6	197.8
Tel Hadya (TH)	0	2.2	38.6	88.4	39.5	51	62	25.1	0	307.2

[a] There was no rain from June to August

Table 2.44. Days to heading (DH), plant height (PH in cm), grain yield (GY in kg/ha), and 1000 kernel weight (KW in g) in nine farmers' fields (FF) and in two research stations (BR = Breda and TH = Tel Hadya).

Locations (code)	DHTH	PHTH	PHBR	PHFF	GYTH	GYBR	GYFF	KWTH	KWBR	KWFF
Tef Tanaz (01)	108.2	85.3	47.9	85.5	3566	1207	2841	43.8	32.2	39.2
Ebla (02)	109.8	81.2	47.1	78.4	3758	1077	2303	41.7	32.5	43.8
Tel Brak (03)	109.2	76.0	48.7	-	3348	997	-	41.3	35.2	-
Jurn Al Aswad (04)	109.5	85.1	49.3	50.4	3868	1024	1141	41.5	36.2	27.0
Belounan (05)	109.3	85.4	47.5	33.5	3361	919	366	41.0	34.8	22.2
Al Bab (06)	107.3	85.8	48.6	51.6	3481	1052	802	43.0	36.4	28.6
Al Bab (10)	108.3	85.9	49.1	43.4	3575	1076	520	41.9	37.2	26.5
Melabya (07)	108.8	83.0	46.6	-	3485	934	-	40.8	37.5	-
Bari Sharki (08)	108.5	78.0	46.1	-	3565	960	-	46.0	43.0	-
Souran (09)	108.9	80.9	43.3	60.3	3833	1006	1554	43.4	37.6	38.2

The results of farmers' and breeder's selection in farmers' fields are summarized in Table 2.45. With few exceptions, the correlation coefficients between the visual score of the breeder and the mean score of the group of farmers and both grain yield and biomass were significant. There is no evidence of a stronger correlation between either the breeder or the farmer selection and the actual yield, indicating a similar ability of identifying the highest yielding entries. In very dry sites, such as J. Aswad, Bylounan and Al Bab, there was a positive and significant correlation between the visual score and plant height. In the two cases where it was possible to compare farmers' and breeder's selection (J. Aswad and Bylounan), the preference of farmers for tall plants appears to be much stronger than the breeder. Farmers' visual selection was strongly and positively correlated with larger kernels, with correlation coefficients nearly always significant ($P<0.01$) and larger than those between breeder's visual selection and kernel weight.

Eventually, the visual selection of the farmers and the breeder were always positively and significantly correlated. However, with the exception of J. Aswad, the correlation coefficients were low, indicating that the same entries were scored differently and that different entries were eventually selected.

Table 2.45. Simple phenotypic correlation coefficients[a] (in bold are those significant at P<0.01 and underlined those significant at P<0.05) between breeder's (B) and farmers' (F) visual score and grain yield (GY in kg/ha) total biological yield (BY in kg/ha, plant height (PH in cm) and kernel weight (KW in g). The data refer to farmers' fields.

Location	Selected by	GY	BY	PH	KW	F
Tef Tanaz	B	**.251**	**.228**	-.008	.191	**.409**
	F	**.342**	**.246**	-.003	**.382**	
Ebla	F	-.064	.102	-.038	**.283**	
J. Aswad	B	**.334**	**.483**	**.291**	.116	**.761**
	F	**.296**	**.518**	**.507**	.232	
Bylounan	B	.169	.227	**.252**	.048	**.330**
	F	**.662**	**.709**	**.743**	**.227**	
Al Bab 6	F	.208	.224	**.539**	**.410**	
Al Bab 10	F	**.503**	.242	**.804**	**.441**	
Sauran	B	-.009	.098	-.029	**.378**	**.469**
	F	-.175	.010	-.194	**.453**	

[a] Correlation coefficients are based on different degrees of freedom in different trials

The relationships between the visual score given by the farmers and the breeder and four important characters such as grain yield, biomass, plant height and kernel weight was further investigated in Tel Hadya and Breda, where all the ten trials were also planted.

In Tel Hadya (Table 2.46) the correlations coefficients between the visual score of the farmers and grain yield were, on average, slightly larger than those between the visual score of the breeder and grain yield. The same difference occurs, with the exception of Sauran, in the case of biomass even though, as in the case of grain yield, the differences were not large.

In the case of both the farmers and the breeder, late maturity types received nearly always a higher score, while in general shorter lines were preferred, even though this was far from generalized. Only in a few cases there was a significant correlation between visual score and kernel weight, and in one case the correlation was negative.

Eventually, the correlation between the visual scores given by farmers and the breeder were strongly and positively correlated. The correlation coefficients were generally much higher that those observed in farmers fields (compare the last columns of Tables 2.45 and 2.46). However, the correlation coefficients in Table 2.45 refer to the average visual score of a group of farmers, while those in Tables 2.46 and 2. 47 refer to the individual farmers who came to Tel Hadya and Breda to do the selection.

Table 2.46 Simple phenotypic correlation coefficients[a] (in bold are those significant at P<0.01 and underlined those significant at P<0.05) between breeder (B) and farmers visual score and grain yield (GY in kg/ha), days to heading (DH), plant height (PH in cm) and 1000 kernel weight (KW in g) in each of ten trials planted in Tel Hadya.

Trial	Selected by	GY	DH	PH	KW	F
Tef Tanaz	B	**.462**	**.488**	-.027	.164	**.938**
	F	**.425**	**.495**	.030	.224	
Ebla	B	**.350**	**.314**	-.015	.169	**.915**
	F	**.346**	**.419**	.043	.165	
Tel Brack	B	.040	.072	-.142	-.078	**.688**
	F	.128	**.251**	**-.204**	-.062	
J. Aswad	B	**.456**	**.302**	-.028	.253	**.894**
	F	**.455**	**.360**	-.006	**.302**	
Bylounan	B	.211	**.296**	**-.296**	.045	**.521**
	F	**.401**	**.326**	**-.435**	.087	
Al Bab 6	B	**.411**	**.375**	**-.260**	**.236**	**.810**
	F	**.433**	**.466**	**-.374**	**.341**	

Al Bab 10	B	.132	**.406**	**-.413**	**.339**	**.850**
	F	.163	**.434**	**-.397**	**.288**	
Melabya	B	**.272**	**.324**	**-.229**	**.242**	**.875**
	F	**.372**	**.360**	**-.351**	**.237**	
B. Sharky	B	**.376**	**.384**	-.126	-.200	**.822**
	F	**.393**	**.401**	-.163	**-.288**	
Sauran	B	**.324**	**.271**	-.004	-.076	**.823**
	F	**.328**	**.265**	-.113	-.168	

[a] Correlation coefficients are based on different degrees of freedom in different trials

Table 2.47. Simple phenotypic correlation coefficients[a] (in bold are those significant at P<0.01 and underlined those significant at P<0.05) between breeder (B) and farmers visual score and grain yield (GY in kg/ha), days to heading (DH), plant height (PH in cm) and 1000 kernel weight (KW in g) in each of ten trials planted in Breda.

Trial	Selected by	GY	DH	PH	KW	F
Tef Tanaz	B	**.300**	.198	.152	.197	**.941**
	F	**.277**	.158	.152	.219	
Ebla	B	.190	.092	**.280**	**.251**	**.953**
	F	.183	..087	**.262**	**.283**	
Tel Brack	B	.154	.106	-.017	-.014	**.912**
	F	.154	.076	-.027	.001	
J. Aswad	B	.250	.178	-.034	-.023	**.929**
	F	**.270**	.160	.029	.030	
Bylounan	B	.053	**.233**	-.170	-.001	**.437**
	F	**.293**	**.344**	.014	.087	
Al Bab 6	B	**.230**	**.258**	.029	.121	**.912**
	F	.189	.207	.038	.123	
Al Bab 10	B	**.305**	.126	.055	.189	**.905**
	F	**.323**	.195	.108	.196	
Melabya	B	**.249**	.089	-.003	.153	**.901**
	F	**.271**	.128	-.033	.144	
B. Sharky	B	**.326**	.203	**.240**	.159	**.875**
	F	**.342**	.228	**.247**	.174	
Sauran	B	**.297**	-.001	-.009	**.291**	**.871**
	F	.189	-.035	.139	.213	

[a] Correlation coefficients are based on different degrees of freedom in different trials

In Breda (Table 2.47) most of the correlation coefficients between the visual scores and grain yield were positive and significant, while there was a much lower correlation between the visual score and maturity, and even more so in the case of plant height and kernel size.

The environment had a strong effect on selection as indicated by the comparison between the correlation coefficients between the visual score and the same trait in different environments. For example, the visual score were significantly and positively correlated with plant height in J. Aswad, Bylounan and Al Bab. However, when the same trials were evaluated at Tel Hadya, the correlation coefficients were either non significant or negative, and in Breda they were all non significant.

An important issue can be addressed by examining the relationships between the selection in the research stations (Tel Hadya and Breda) and the yield in farmers' fields. This relationship is a measure of the relevance of centralized selection and can be measured by the correlation coefficients between the visual score given by the breeder to the entries in a given trial grown in Tel Hadya, and a number of traits measured in the same trial grown in a farmer field (Table 2.48).

Table 2.48 Simple phenotypic correlation coefficients[a] (in bold are those significant at P<0.01 and underlined those significant at P<0.05) between breeder (B) visual score at Tel Hadya (TH) and Breda (BR) and grain yield (GY in kg/ha), total biological yield (BY), plant height (PH in cm) and 1000 kernel weight (KW in g) in farmers fields.

Location	Selected by the breeder at	GY	BY	PH	KW
Tef Tanaz	TH	.163	**.279**	.119	-.128

	BR	.106	.235	.084	.084
Ebla	TH	.054	.158	.196	.016
	BR	-.048	.118	**.274**	.172
J. Aswad	TH	**-.298**	-.209	**-.288**	**-.428**
	BR	.059	.153	.089	.090
Bylounan	TH	-.099	-.136	**-.302**	**-.320**
	BR	.128	.007	-.170	-.109
Al Bab 6	TH	-.163	-.094	**-.404**	-.136
	BR	.134	.184	-.110	.014
Al Bab 10	TH	**-.256**	.003	**-.521**	-.251
	BR	-.018	-.041	-.186	-.022
Sauran	TH	.023	**.254**	.023	**-.285**
	BR	.075	.018	-.006	.223

[a] Correlation coefficients are based on different degrees of freedom in different trials

The grain yield and the total biomass of the entries grown in the farmers' fields were generally independent from the visual score given by the breeder in either Tel Hadya or Breda. In the case of grain yield, only two correlation coefficients were significant, and they were both negative. In the case of biomass, four correlation coefficients were significant. One was negative, and the other three refers to high yielding locations known from previous years to give a similar discrimination among genotypes as Tel Hadya.

The difficulty to identifying the highest yielding entries in a given location when selection is made in another location is shown in Table 2.49. The correlation coefficients between the grain yield measured in either Tel Hadya or Breda and the grain yield measured in the farmers fields were low, end even when significant, they show that only a maximum of 16% of the variation in grain yield in one location is explained by the variation in grain yield in the other location. This was the case between two dry locations such as Breda and Bylounan.

Table 2.49 Simple phenotypic correlation coefficients[a] (in bold are those significant at P<0.01 and underlined those significant at P<0.05) between grain yield (GY in kg/ha), plant height (PH in cm) and 1000 kernel weight (KW in g) in farmers fields (B), at Tel Hadya (TH) and Breda (BR).

Location	Research station	GY	PH	KW
Tef Tanaz	TH	**.274**	**.594**	**.493**
	BR	.167	**.514**	**.559**
Ebla	TH	.053	**.591**	**.872**
	BR	**.304**	**.513**	**.632**
J. Aswad	TH	-.108	**.518**	.146
	BR	**.232**	**.439**	**.319**
Bylounan	TH	-.175	**.559**	.146
	BR	**.402**	**.375**	.227
Al Bab 6	TH	-.043	**.579**	**.380**
	BR	.111	**.449**	**.410**
Al Bab 10	TH	.004	**.722**	.182
	BR	.129	**.406**	**.569**
Sauran	TH	.165	**.683**	**.594**
	BR	-.002	**.776**	**.817**

[a] Correlation coefficients are based on different degrees of freedom in different trials

At the end of this cycle of three years of participatory selection, the farmers choose to test in larger plots a total of 36 different breeding lines out of the original population of 208 breeding lines planted in the cropping season 1996/97. The main characteristics of the 36 lines are summarized in Table 2.50. Farmers' preferences changed with the environment. White-seeded types were predominant in the most favorable locations, the two row types were the most commonly selected, even though six row types were selected in some locations. Landraces were the preferred types, particularly in the driest site, but in wetter sites and where lodging is a concern (B. Sharky).

Table 2.50 Main characteristics (seed color, B = black, W = white; row type, 2 and 6; land. = landraces, mod. = unrelated to landraces; U = uniform, S = segregating; C-NP (TH or BR) = selected by the breeder on station; D-NP = selected by the breeder in the farmer's fields) of the lines selected by the farmers in their field at the end of three cycles of participatory selection.

Location	Total	Black	White	2 Row	6 Row	Land.	Mod.	U	S	C-NP (TH)	C-NP (BR)	D-NP
Ebla	2	0	2	1	1	0	2	2	0	0	0	-
Tel Brack	9	5	4	9	0	9	0	7	2	1	1	-
J. Aswad	8	3	5	8	0	5	3	7	1	0	0	1
Bylounan	3	3	0	3	0	3	0	3	0	0	1	0
Al Bab 6	1	0	1	1	0	1	0	1	0	0	0	-
Al Bab 10	7	1	6	3	4	1	6	6	1	1	1	-
Melabya	11	6	5	2	0	10	1	8	3	1	2	-
B. Sharky	4	0	4	3	1	0	4	3	1	1	1	-
Sauran	4	0	4	4	0	1	3	1	3	0	0	0

modern types were preferred to landraces. Eventually, uniform types were preferred everywhere. The last three columns show how many of the lines selected by the farmers in their field, were selected by the breeder either at Tel Hadya or Breda (centralized – non participatory selection) or in the farmers' fields (decentralized – non participatory selection).

2.2.1 A Workshop on Farmer Participatory Research

A Workshop on Farmer Participatory Research (FPR) was held at ICARDA Headquarters from May 6 to May 11, 1999.

The Workshop was co-sponsored by the Islamic Development Bank, FAO, the System Wide Program on Participatory Research and Gender Analysis (SWP PRGA) and ICARDA.

Prof. Dr. A. El-Beltagy, Director General of ICARDA, officially opened the Workshop. He underlined the significance of having such a workshop in the area where agriculture began several thousand years ago. He pointed out that there are numerous research activities conducted at ICARDA in collaboration with different national programs that directly involve farmers. Farmer participatory research has become one of the strategic pillars of the ICARDA's present and future research approach. He indicated the wide range of variation in degrees, types, and objectives of farmer participation. Several participatory plant breeding projects are currently implemented by ICARDA. However many scientists in the region are not aware of the research approach. Similarly, several Natural Resources Management Projects use farmer participatory approaches but there have been few opportunities for interaction among the researchers. Many believe that farmer participation holds the key to research success, particularly, in the dry environments where the environmental variation and associated risk in agriculture requires greater adaptation of the technologies than in more favored ecosystems. Since, farmer-participatory research is based on the involvement of people (men and women) with different interests and stakes in which type of technology is designed, those who have espoused farmer-participatory research are becoming increasingly aware of the need to bring different types of stakeholders in the research process.

The objectives of the Workshop were to generate interest towards FPR and to promote its use as a new research strategy by providing researchers from a number of countries with a forum to discuss and exchange ideas about farmer participation. The output of the workshop was the recommendations listed below. To reach its objective the Workshop was structured in four components:

1. Formal presentations
2. Participation in farmer selection both in a farmer's field representing the dry areas of Syria and in a research station
3. Discussions with farmers
4. Perspectives for participatory research in various countries

In addition to formal presentations, the participants traveled to Bylounan, a village in the Raqqa province that in the last cropping season received only 162 mm rainfall. A large group of

farmers welcomed the participants who visited one of the trials conducted in the framework of a participatory barley breeding project supported by GTZ while the farmers did the selection.

The farmers were also invited at Tel Hadya (the ICARDA's headquarters) to do selections in trials planted in the research station and to participate in a discussion with the scientists attending the Workshop.

Scientists of Turkey, Mauritania, Algeria, Libya, Egypt, Pakistan, Jordan, Iraq, Iran, India, China, and Eritrea presented the perspectives for participatory research in various countries in the form of country reports.

Eventually the Workshop formulated the following recommendations:

1. Methodology in Participatory Research should take into account diversity and must be adaptable to specific conditions.
2. Farmers should be exposed to a large range of options.
3. The sustainability of the process requires the community participation by stakeholders groups, considering external stakeholders and addressing cost sharing as one of many aspects.
4. Explore ways of reinforcing existing local systems of seed production and distribution, while encouraging and supporting farmer-producers to emerge as alternative suppliers of quality seed, who have links with sources of new material and maintain close and trustworthy relationship with the seed-using community.
5. Attempts to introduce certification should be based on real need and standards that are realistic and achievable and within the capacity of the farmers to manage and sustain.
6. Where applicable, the legal issues of variety release and property rights should be made flexible so as to enhance rather than impede farmers' access and use of improved seed.
7. From the beginning of Participatory Research, social, physical and biological disciplines and concepts should be involved, in order to adequately reflect the complexity of the system.
8. Indigenous knowledge and traditional rights should be considered and engaged as the core of any partnership between researchers and farmers on equal basis.
9. The socioeconomic and technological impact of both the technologies and the processes developed through Farmers Participatory Research must be assessed.
10. A Network on Participatory Research should be established at regional level including farmers, researchers, extension workers and trainers. The Network should focus on: sharing experiences, education and training, elaboration of a newsletter, elaborate a program for information to policy makers, organize an international workshop on Participatory Research attended predominately by farmers.

The Workshop was attended by 34 scientists of National Programs of Algeria, China, Ecuador, Egypt, Eritrea, Jordan, India, Iran, Iraq, Libya, Mauritania, Morocco, Pakistan, Tunisia, Turkey, Yemen, by representatives of the Islamic Development Bank, Istituto Agronomico per l'Oltremare, Firenze (Italy), FAO, (Rome, Italy), DANIDA (Denmark), GTZ, (Germany), CIAT (Colombia), and by IPGRI (Italy) and ICARDA scientists.