CGIAR Challenge Program on
WATER & FOOD

GATHERING WISDOM FROM THE FIELD: PARTICIPATORY TECHNOLOGY DEVELOPMENT IN UPPER KARKHEH RIVER BASIN, IRAN

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Strengthening Livelihood Resilience in Upper Catchments of Dry Areas by INRM (CPWF PN 24)

7

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International Center for Agricultural Research in the Dry Areas

AEERO
Agricultural Extension, Education and Research Organization

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Research Report no. 7

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Citation: Seyed Babak Moosavi, S.B., Anthofer, J., Moazzami, M., Mobarakian, S.M., Garavand, P., Rashno, Z., Moradi, S., Moradi, M., Farhadi, M.R., Fakhri, M., Babaei, T., Azizi, H. and Rahmani, S. 2010. Gathering wisdom from the field: Participatory technology development in Upper Karkheh River Basin, Iran. Karkheh River Basin Report 7. ICARDA, Aleppo, Syria. x + 130 pp.

ISBN: 92-9127-223-X

This report is the outcome of the combined effort of many individuals who contributed to the documentation of this process, and *et al*. should be taken to read as: J. Anthofer (ICARDA), M. Moazami, (RRC, Tehran), S.M. Mobarakian, P. Garavand, (RRC, Lorestan), Z. Rashno (AEERO, Lorestan), S. Moradi, M. Moradi (independent, Lorestan), M.R. Farhadi (AEERO, Kermanshah), M. Fakhri (MoJA, Kermanshah), T. Babaei (RRC, Kermanshah), H. Azizi (Agriculture Service Center, Sar Firooz Abad, Kermanshah), and S. Rahmani (independent, Tehran).

International Center for Agricultural Research in the Dry Areas (ICARDA)
P.O. Box 5466, Aleppo, Syria.
Tel: (963-21) 2213433
Fax: (963-21) 2213490
E-mail: ICARDA@cgiar.org
Website: www.icarda.org

Acknowledgments

This report presents findings of the Participatory Technology Development (PTD) project, a component of PN24 'Livelihood Resilience in Dry Areas' which is a project of the CGIAR Challenge Program on Water and Food. The head of the Rural Research Center (RRC), Samad Rahimi Sooreh, trusted the team beyond institutional limits. Then, it was the PTD team members who took the challenge to the field, each with a unique ability, but all with a common capacity for team work and collective learning. The authors acknowledge the committed contribution of the other PTD team members: Akram Abbasi, Mohammad Effati, Yacoub Noroozi Banis, Mohammad Reza Jamalifar, and Nastaran Moosavi (Tehran), Sattar Hashemi, Nasim Moradi, and Firooz Derekvandi (Lorestan).

Our appreciation is also extended to the extension staff and the technical researchers and scientists who accompanied the technology selection, experimentation and evaluation process with their ideas and with their sincerity. There was nothing formal beforehand holding them to this collaboration and we would like to think they believed the process and the people involved. These were: Ain-Ali Amiri and Fardin Khodadoost (Ali Abad and Sar Firooz Abad Agriculture Service Centers); Manoochehr Kalhor, Ali Sepahvand, Nader Azadbakht, Dariush Mubaraki, Karim Ghorbani, Mir-Reza Jamshidi, Morad Sepahvand, Shahla Ahmadi, and Karim Khademi (all of AEERO, Lorestan); Heydar Zonnourian and Yahya Khoda Karami (AEERO, Kermanshah), Katayoon Moomivand (independent, Kermanshah), Nargess Azimi (Extension, Kermanshah), Seyyed Hossein Sabbaghpour, Reza Haq-parast (Dry Agriculture Research Institute, DARI, Kermanshah), and Parviz Mohajer Milani (Soil and Water Research Institute, SWRI, Tehran). The co-operation of the respective institutes and offices of these collaborators is also much appreciated. Most of all, this project belongs to the 250 farmers in Honam and Merek, men and women who let us unto their lives so that we could learn together.

We also sincerely acknowledge Francis Turkelboom and Adriana Bruggeman (ICARDA), the two successive project leaders of the Livelihood Resilience Project. We would also like to remember the late Mohsen Mohsenin (AEERO) who initiated and led the project early on. Our thanks also go to the project coordinators in Iran, Jahangir Porhemmat and Mohamed Ghafouri (AEERO), and to Hamid Siadat (ICARDA-Iran) for his assistance.

Institutions Participated in the Project

Institute	Address	E-mail & Website
International Center for Agricultural Research in the Dry Areas (ICARDA)	P.O. Box 5466, Aleppo, Syria	ICARDA@cgiar.org http://www.icarda.cgiar.org/
Agricultural Research, Education and Extension Organisation (AREEO)	P.O. Box 111, Tabnak Ave., Evin, Tehran 19835, Iran	AREEO@areeo.or.ir www.areeo.or.ir
Forests, Ranges and Watershed Management Organisation (FRWO)	Lashgarak Rd., Tehran, Iran	www.frw.org.ir
International Center for Tropical Agriculture (CIAT)	A.A. 6713, Cali, Colombia	CIAT@cgiar.org
Division of Geography Unit, Catholic University of Leuven (KULeuven)	Redingenstraat 16, 3000 Leuven, Belgium	Jean.Poesen@geo.kuleuven.ac.be http://ees.kuleuven.be/geography/index.html

Project Leaders: Dr. Francis Turkelboom and later Dr. Adriana Bruggeman, Integrated Water and Land Management Program (IWLM), ICARDA.

Project National Coordinator: Dr. Mohsen Mohsenin (late), Dr. Jahangir Porhemmat and later Dr. Mohammad Ghafouri.

Basin Coordinator: Dr. Sharam Ashrafi and later Dr. Nader Heydari.

Project Principal Investigators

Name	Professional discipline	Institution	Title
Dr Mohsen Mohsenin (late)	Economics	AREEO (Iran)	Head, International Agricultural Research Institutions Department
Dr. Aden Aw-Hassan	Agricultural economics	ICARDA (Syria)	Director, Social, Economic and Policy Research Progra
Dr Yaghoub Norouzi Banis	Soil erosion	SCWMRI (Iran)	Head, Research Planning and Supervision
Dr Adriana Bruggeman	Agricultural hydrologist	ICARDA (Syria)	Senior Scientist
Prof. Jean Poesen	Soil erosion, soil and water conservation	LEG (Belgium)	Head of Division, Geography Unit
Dr Abdolali Ghaffari	Agronomy	DARI (Iran)	Director General
Dr Amrali Shahmoradi	Rangeland management	RIFR (Iran)	Senior Research Scientist
Mr. Seyed Abolfazl Mirghasemi	GIS	FRWO (Iran)	Director General for Land Capability Mapping

Project Team: Seyed Babak Moosavi, Juergen Anthofer, Mitra Moazzami, Seyed Majid Mobarakian, Parviz Garavand, Ziba Rashno, Saba Moradi, Mahmood Moradi, Mohammad Reza Farhadi, Masoomeh Fakhri, Teymoor Babaei, Hamid Azizi and Shahryar Rahmani.

Contents

Preface

The Challenge Program on Water and Food (CPWF) contributes to efforts of the international community to ensure global diversions of water to agriculture are maintained at the level of the year 2000. It is a multi-institutional research initiative that aims to increase water productivity for agriculture—that is, to change the way water is managed and used to meet international food security and poverty eradication goals—in order to leave more water for other users and the environment. The CPWF conducts action-oriented research in nine river basins in Africa, Asia and Latin America, focusing on crop water productivity, fisheries and aquatic ecosystems, community arrangements for sharing water, integrated river basin management, and institutions and policies for successful implementation of developments in the water-food-environment nexus.

The CPWF project PN24 'Strengthening Livelihood Resilience in Upper Catchments of Dry Areas by Integrated Natural Resources Management' had as its overall goal to strengthen livelihood resilience of the rural poor and to improve environmental integrity in upper catchments of the dry areas. Due to the complex combination of biophysical and economic constraints, it is not an easy task to strengthen farmers' livelihoods. Besides the usual technical skills, this requires participatory skills and strong inter-disciplinary and inter-institutional co-operation.

The project combined a large-scale analysis of the Karkheh River Basin, Iran, by GIS and rapid assessments, with detailed natural resources assessments, gender and livelihood analyses and participatory development of agricultural technologies in two upstream watersheds. These two contrasting benchmark research watersheds were Merek Watershed (242 km^2) in Kermanshah Province and Honam Watershed (142 km^2) in Lorestan Province. The project operated through the active involvement of researchers and staff of five research institutes under the umbrella of the Agricultural Extension, Education and Research Organization (AEERO) and the Forest, Range and Watershed Management Organization (FRWO), all based in Tehran. At the provincial level, the main players were the Natural Resource and Agricultural Research Centers in the Provinces, which house researchers of these same institutes, the Jihad-e-Agriculture Organization, and the Agricultural Extension Offices. The project is managed by ICARDA and benefited from additional scientific support provided by the Catholic University of Leuven.

Chapter 1.

Introduction

1. Introduction

1.1. Background

In mid-2006, a sub-project on "Participatory Technology Development" (PTD) was initiated within the Livelihood Resilience Project in the Upper Karkheh River Basin, Iran. Its aim was to facilitate a participatory approach to developing agricultural technologies and improving resource management, thus adapting the process of change to the diverse livelihood of the local people and the complex, agro-ecological systems prevailing in dry mountainous areas and watersheds. Adopting such an approach would entail a shift from the linear transfer of technologies from research stations to farmers through extension staff currently being practiced in Iran, to a more interactive collaboration between researchers, farmers and extension staff.

Two trends have paved the way for participatory agricultural research approaches such as PTD: (1) the inability of conventional, discipline-specific technology research to adequately respond to the complex, diverse and interrelated dimensions of farmers' life and livelihood; and (2) the lack of participation of the end users of the agricultural technologies in the search for, selection of and experimenting with options that could provide solutions to local needs and problems. Hence, there is a need for an integrated approach that can accommodate the involvement of local people and the interaction of research and technology experts of different disciplines. A participatory approach to technology research would aim at building and strengthening an interactive farmer-researcher partnership.

1.2. The Context

Farmers' livelihoods rely on the sustainable management of water and land resources. As their ecosystems are complex and diverse, so too must their management of their resources be diverse and site specific, especially considering the competition or conflict of stakeholders at different levels for scarce resources (herders vs. farmers, upstream vs. downstream users). The lack of comprehensive and holistic management strategies has often failed to resolve problems perceived by the local communities. Therefore, there is a need for multi-disciplinary and multi-institutional approaches combined with participatory methods.

1.2.1. The conventional research paradigm in Iran

In Iran, agricultural research and their implementing institutes are considerably fragmented and follow the conceptual distinction of crops, livestock, trees, soils and socio-economics. This conceptual break-down structures skill development, institutes within the agricultural research organization, research objectives and discipline-specific methodologies, and planning and evaluation processes. Researchers have to submit a research proposal to the scientific committee of their respective research institute which evaluates the proposal from a disciplinary point of view. This set-up impedes the promotion of integrated and sustainable land and water management approaches. The structure of government line ministries also reflects this fragmentation of the natural world.

The conventional agricultural research approach in Iran may have produced high-quality scientific outputs within agricultural disciplines. However, for complex, heterogeneous agro-ecological systems prevailing in dry mountainous areas and watersheds, alternative ways for research and development are required.

In addition to disciplinary biases which shape agricultural research, there is a bias towards plot and farm-level research and a focus rather on individuals than on common resources such as water or rangeland. There is also an emphasis on agricultural production in isolation from other aspects of livelihoods and in the failure to consider social consequences of farming activities beyond the plot and household boundaries.
A consequence of the disciplinary structure of the agricultural sector is a lack of coordination between research institutes as well as links to other stakeholders in the agricultural sector to achieve wider scale impact.

Moreover, resource-poor farmers in diverse and complex biophysical and socioeconomic environments often cannot benefit from the research outputs. Many so-called "improved technologies" are inappropriate to the resources and needs of poor farmers.

1.1.2. Integrated natural resource management (INRM) as an alternative paradigm

Integrated agricultural research for development has emerged as an alternative research paradigm, seeking to integrate biophysical research with social, policy and institutional research. It is defined as "*an approach to research that aims at improving livelihoods, agro-ecosystem resilience, agricultural productivity and environmental services*" (Douthwaite *et al*. 2003). INRM looks at the interactions and trade-offs of the biophysical and social aspects that characterizes the use of natural resources, thus serving as an integrative framework for research and development.

1.1.3. The Livelihood Resilience Project and the PTD process

The Livelihood Resilience Project in the Karkheh River Basin in Iran tries to address these issues following a multi-stakeholder INRM and participatory approach. Initial research initiatives have been undertaken by various Iranian agricultural research institutes under the umbrella of the Agricultural Extension, Education and Research Organization (AEERO) and with the support of ICARDA to assess the extent and causes of land degradation in relation to the availability and utilization of water in the basin.
The current status of livelihoods in the representative communities including their coping strategies to reduce their vulnerability is being assessed (Rafati *et al*. 2009). A gender analysis with focus on water-related issues has been conducted already (Effati *et al*. 2009). The project also identified and assessed local innovations to manage land and water resources and to diversify income opportunities (Noorozi Banis *et al*. 2008).

1.1.4. Changing the technology development approach

In the beginning, the Livelihood Resilience Project used the procedures and management structures of AEERO. However, due to the project's aim to introduce new ways in research, it is not surprising that this could not be fully achieved by applying the conventional research structure.

Initial experiments to test improved agricultural practices on-farm were carried out by different institutes after the approval of their scientific committees. However, promising local innovations

which were identified by surveys (Noorozi Banis *et al*. 2008) were largely neglected and options were often assessed from a disciplinary perspective only.
Hence, there was a need for a more participatory approach to facilitate the interactive collaboration between researchers, farmers and facilitators towards developing technologies more appropriate to local realities.

1.1.5. The participatory technology development (PTD) process

During a workshop on 'impact pathways' in April 2006 (Douthwaite *et al*. 2006), the key actors of the project developed an impact pathway, a model of how the project sees itself achieving impact (Douthwaite *et al*. 2003). The PTD component was embedded within the wider Livelihood Resilience Project. A one-week planning workshop followed at the Rural Research Centre (RRC), using problem and objective trees and transforming the results to a project planning matrix for the whole project period. Monitoring criteria were developed and a national and two provincial PTD teams for the two project sites were formed, comprising RRC staff and additional experts from different disciplines. A one-week training course on PTD was conducted with provincial staff, followed by several short follow-up sessions which included reflections on the work, introduction of new participatory research tools and agreements on how these tools could be used until the next follow-up visit.

Hence the process comprised theoretical learning, practical application and critical reflections of the previous experience. In April 2007, a 'PTD traveling workshop' was organized. Members of the national and provincial PTD teams as well as some of the researchers of other departments and staff of non-research organizations were invited for one week to ICARDA headquarters in Aleppo, Syria, to get exposed to some of the participatory land management work undertaken by ICARDA. This institutional cross-visit proved to be very effective since for many of the participants it was the first time that they could see participatory research in action and interact with both researchers and farmers.

The experience of the first year showed that skills in participatory methods can not be obtained by one time training sessions only. Continuous follow-up and reflections on success stories and failures are essential for success.

Since the PTD component was initiated rather late trying to overcome some of the previous shortcoming of the conventional research approach, it did not follow the chronological steps of PTD, namely problem and needs assessment, group formation, planning, experimentation, and monitoring and evaluation (van Veldhuizen *et al*. 1997). Rather, it tried to shift on-going activities into a more participatory direction attempting to integrate activities of different partners and other stakeholders. Rather than adhering strictly to the chronological steps of the methodology from the outset, the PTD group had to adapt itself to seeking, and iteratively building upon opportunities for instigating methodological, attitudinal and perhaps even institutional change with respect to participatory research.

1.3. Goals and Objectives

1.3.1. Overall goal

- Participatory development and adaptation of agricultural technologies with the objective of increasing livelihood resilience in farming communities

1.3.2. Specific objectives

- Identification of promising options with active participation of farmers
- Assessing the adaptability of selected options through on-farm experimentation (jointly with farmers, extension, relevant research institutes)
- Developing strategies for outscaling of promising options jointly with other stakeholders
- Documentation of the PTD process
- Institutionalization of participatory research approaches.

This report is meant to describe the evolution of the PTD process that unfolded over its 30-month lifespan. Chapter 2 provides an overview of the philosophy of adopting a participatory approach to technology research and development, as well as describing the path we intended to follow for this project. Chapters 3 to 6 describe and reflect upon different stages within the PTD cycle: resource and problem identification; technology selection; experimentation process; and technology evaluations. A natural follow-up to a PTD cycle would be outscaling the process principles, methods, findings and learning. Chapter 7 seeks to know what outscaling of PTD entails, and whether the project did enough to expect promising outcomes in the future. To complement the outscaling of the process, Chapter 9 discusses what is required to upscale and mainstream the approach at various planning and policy-making levels. In between, Chapter 8 looks at the individual and group capacities needed to facilitate and contribute to the effective implementation of a PTD process. Finally, Chapter 10 tries to summarize some of the lessons learned.

Chapter 2.

Approach and Methodology

2. Approach and Methodology

2.1. The Context

2.1.1. Poor agriculture communities and livelihood resilience

Most poor people's realities are *local* (specific to their natural, economic, cultural and socio-political conditions), *complex* (influenced by many interlinked factors), *diverse, dynamic and unpredictable* (Chambers 1997). Therefore, in order to survive and become more resilient in the face of climatic, economic and socio-political change, the livelihood strategies of farmers also become, over the course of time, complex and diverse by nature. Chambers cites the analogy of the fox and the hedgehog, reasoning that while the hedgehog (like most people who are employed in one job or seek livelihood from one source) has one big idea, foxes (like most poor people and farmers) have many small ideas, that is, they seek several sources of support rather than one.

Compared to the industrial agriculture of the more developed countries, and the green revolution agriculture of the well-watered fertile plains in developing countries, the complex, diverse and risk-prone (CDR) agriculture in poorer communities is mainly "*rainfed, on undulating land, and found in hinterlands, mountains, hills, wetlands and the semi-arid, sub-humid and humid tropics*" (Chambers 1993).

Another classification of the different types of agricultural systems divides them into low-external-input and sustainable agriculture (LEISA), high-external-input agriculture (HEIA) and traditional agriculture (van Veldhuizen *et al*. 1997).

HEIA represents the conventional approach to agricultural development. It relies heavily on external inputs such as hybrid seeds, fertilizer, biocides, mechanization and credit in order to enhance productivity. This type of agriculture involves strong links among farmers and commercial and government services. It is generally market-oriented, and is specialized in a narrow range of crops and livestock.

The main disadvantage of HEIA is its limited applicability to dry and risk-prone farming areas. It lacks the flexibility needed to adapt to the diverse and changing conditions of these areas. HEIA also underutilizes resources available locally, including indigenous knowledge, and overutilizes non-renewable resources. Farmers become increasingly dependent on outsiders and their input.

Traditional agriculture is based on indigenous knowledge and practices that have evolved over many generations. It is generally oriented towards subsistence, using resources available locally, and making little use of external resources. Farmers practicing traditional agriculture in CDR areas cannot always increase productivity sufficiently, and they may be forced to expand into marginal areas. This would increase the risks of over-exploitation, erosion and other forms of environmental degradation. Therefore, the challenge would be to enable CDR agriculture to become more sustainable and productive systems.

2.1.2. Sustainable agriculture

Sustainable agriculture is generally known to imply a way of managing

Box 2.1. Sustainable agriculture

Sustainable agriculture is:

- economically viable: [i.e.] farmers produce at an adequate and stable level, at a risk level acceptable to them;
- ecologically sound: [i.e.] the quality of the environment is maintained or enhanced and natural resources are conserved. Ecologically sound agricultural systems are healthy and highly resistant to stress and shock;
- socially just: [i.e.] the agricultural system assures equal access to land, capital, information and markets for all people involved;
- humane: [meaning] all forms of life (plant, animal, human) are respected and treated with dignity; [and]
- adaptable: [meaning] sustainable agricultural communities are able to adjust to constantly changing conditions such as population growth, and new policies and market demand (Gips 1986).

Source: van Veldhuizen *et al*. 1997

resources which satisfy human needs while maintaining the quality of the environment and conserving natural resources (van Veldhuizen *et al*. 1997). However, sustainable agriculture can no longer be viewed as having only biophysical properties. Other dimensions and conditions are considered vital for sustainable agriculture to be achieved (Bruges and Smith 2008).
Therefore, improving agricultural sustainability would require holistic and integrated strategies that are relevant and legitimate at the local level.

2.1.3. Low-external-input and sustainable agriculture

LEISA relies primarily on local resources. It aims to integrate soil fertility management, arable farming and animal husbandry. It also intends to make efficient use of nutrients, water and energy, recycling them as much as possible. External inputs are often only used to compensate for local deficiencies. LEISA involves site- and context-specific farming practices, and incorporates the best of indigenous knowledge and practices, sustainable agricultural experiences and conventional scientific knowledge, aiming at stable and long-lasting production levels (Reijntjes *et al*. 1992).

Ultimately, the purpose of outsiders' involvement in improving local agricultural systems, production and practices would be to enable and empower local farmers, and particularly the weaker and more resource-poor farmers, to take the initiative in reflecting more critically upon their status quo, and purposefully seeking options that can better adapt to their needs and conditions, especially in the long term.

2.2. Agricultural Research Paradigms

2.2.1. Normal professionalism and agricultural research

In agricultural research and extension, the normal professional paradigm can be described as 'transfer-of-technology' or TOT, where priorities are basically determined by scientists. Scientists experiment in-laboratory and on-station to generate new technology, and

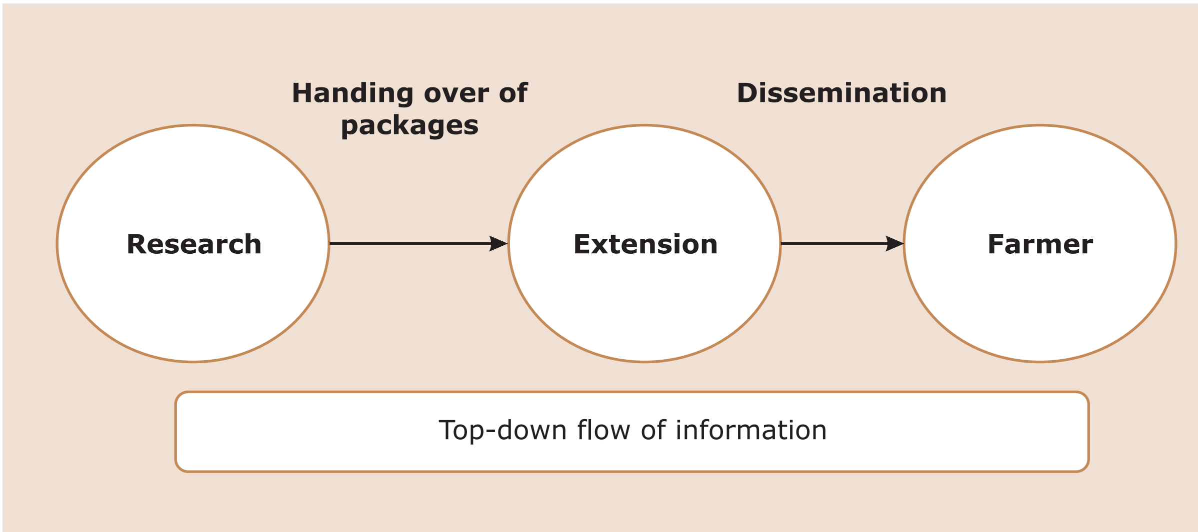


Figure 2.1 (Anthofer *et al*. 2007). Conventional approach to technology generation and dissemination.

this is then handed over to extension for transfer to farmers. TOT is also reflected in the behavior of the various stakeholders in the field. The outsiders usually behave as though they are, or are expected to be, the most credible source of knowledge. Consequently, the farmers have come to behave like uninformed people waiting to be guided by someone who is more informed.
In normal agronomic research, only a few variables are manipulated, and the output has often been simple packages suitable for controlled environments. Packages have served to standardize farming systems, and have linked very conveniently with the issues of mechanization and subsidies.

While showing some success in largely homogeneous and resource-rich agro-ecosystems and environments, where conditions are predictable, uniform and straightforward, normal conventional research has been less successful in addressing the complexity of small-scale resource-poor farming households in marginalized areas. CDR farmers seek to reduce risk by diversifying their farming systems, and by relying on factors of production that are under their control. In contrast, normal transfer of technology seeks to simplify and standardize methods and practices, and stresses purchased inputs. For CDR farmers, these can add to risk.

The conventional approach to agricultural research also suffers from a lack of interaction among farmers, researchers and extension workers, and a lack of mechanisms by which farmers can influence the process of problem identification and technology development. The role of the farmer is usually limited to receiving extension messages. "*Technology development, adaptation and adoption are not linear processes, but an interactive [and iterative] learning and development process for both farmers and scientists*" (Roling 1996).

"*In the conventional research paradigm, researchers provide the only source of knowledge. In the process of participatory research, farmers contribute their intrinsic knowledge of local agricultural*

Table 2.1. Research and extension: beliefs, and socio-economic research frontiers 1950-2000.

	Explanation of farmers' non-adoption	Prescription	Key extension activity	Socio-economic research frontiers	Dominant research methods
1950s 1960s	Ignorance	Extension	Teaching	Understanding the diffusion and adoption of technology	Questionnaire surveys
1970s 1980s	Farm-level constraints	Remove constraints	Supply inputs	Understanding farming systems	Constraints analysis; farming systems research
1990s	Technology does not fit	Change the process	Facilitating farmer participation	Enhancing farmers' competence; understanding and changing professional behavior	Participatory research by and with farmers

Source: Chambers 1993.

practices and innovations whereas researchers provide their scientific knowledge" (Schulz *et al*. 2001).

This recognition has resulted in alternative research and development approaches like participatory technology development (PTD), where farmers' priorities and participation are pivotal to the process.

2.2.2. The shift towards participatory research

The driving force behind the shift from TOT to participatory research and technology development is made up of several significant reversals. For example, in explaining the farmers' non-adoption of new technology, the normal response would somehow point at farmers' ignorance, whereas in a participatory approach, we would seek the reasons more in the deficiencies in the technology and the process that generated it.

Another reversal is in the source and direction of learning. Participatory approaches have researchers and extension workers learning from farmers, at least as much as the farmers can learn from outsiders. Knowledge and priorities vary, both within communities, and between rural people and outsider professionals, and one important guiding question would be whose knowledge and priorities should count more in the process.

There is more focus on the interactions between outsider professionals and rural people. More priority is given to outsiders' behavior and attitudes. Also, there is more concern about how analysis by farmers, and especially by female and resource-poor farmers, can be supported. Location and roles are also reversed, with farms and farmers central to the whole process instead of research stations, laboratories and scientists.

Table 2.2. TOT and participatory approaches compared.

	TOT	Participatory approaches
Main objective	Transfer technology	Empower farmers – farmers' agricultural self-management
Analysis of needs and priorities by	Outsiders	Farmers facilitated by outsiders
Transferred by outsiders to farmers	Precepts Messages Packages of practices	Principles Methods Baskets of choices
The 'menu' (what is on offer to choose from)	Fixed	A la carte (open range from which the farmers can choose based on their need and preference)
Source of information	Research organizations	Farmers complemented by research organizations
Experimental approach	Scientific procedures	Farmers' methods complemented by simple scientific procedures
Farmers' behavior	Hear messages Act on precepts Adopt, adapt or reject package	Use methods Apply principles Choose from basket and experiment
Outsiders' desired outcomes emphasize	Widespread adoption of package	Wider choices for farmers Farmers' enhanced adaptability
Main mode of extension	Agent-to-farmer	Farmer-to-farmer
Roles of outsiders	Teacher Trainer Control compliance with regulations	Facilitator Searcher for and provider of choice

Source: Chambers (1993) and van Veldhuizen *et al.* (1997).

2.2.3. The purpose of participation

Over the past few decades, increasing emphasis has been placed upon the involvement of local people in the shaping of development programs. For some, this is a means of making programs more effective and sustainable even after the programs have ended. Indeed, farmer participation can result in higher rates of adoption of new technologies developed by researchers, especially in resource-poor areas with diverse farming systems, as well as reduced costs of research and extension. Farmer participation can link technology development with farmers' knowledge of the local situation. It compensates for the limited capacity of formal research and development institutes to develop locally specific technology adaptations for all conditions.

Others argue that the very core of the development process is the increased control that people gain over shaping their own lives, meaning that a more significant motive for promoting farmers' participation would be to generate countervailing power at the grassroots level and transfer the initiative to poorer farmers. In line with this perspective,

Table 2.3. Types of farmer participation in research.

Mode	Objective
Contractual	• Researchers contract farmers to provide land or services • Researchers plan and implement the trial and evaluate the results • The farmers' role is passive, with limited or no participation • Can be employed for basic research under on-farm conditions
Consultative	• Researchers consult farmers about their problems and then develop solutions • Farmers are involved in the diagnosis of problems and (possibly) in the evaluation of proposed solutions
Collaborative	• Researchers and farmers collaborate as equal partners. • Researchers and farmers jointly identify researchable problems, design and implement trials, and review progress. • Farmers participate intensively in problem identification and the evaluation of possible solution.
Collegial	• Scientists work to strengthen farmers' informal research and development systems in rural areas

Source: Biggs (1989).

it is the outsider researchers and development workers that must endeavor to participate in the ongoing development efforts of rural families and communities (van Veldhuizen *et al*. 1997).

In participatory research and technology development, embracing farmer participation implies an acceptance that local people can identify and modify their own solutions to suit their needs. Farmers' participation also facilitates their involvement in decision-making about optimal and complementary use of inputs, and this could eventually replace the excessive use of external inputs. Therefore, outsiders such as researchers, extension workers or development workers support farmers in their efforts to change their farming systems. This support focuses on enhancing farmers' capacity to innovate, to experiment, to develop their farming system in a sustainable way and to increase their control over resources and actions that affect their farms and livelihood.

2.2.4. Obstacles to participation

Despite local government agencies and bureaucratic forces' claim to advocate and support farmer participation, their actual behavior may, intentionally or unintentionally, hinder farmers' active involvement in the process. Some organizations lack the flexibility and internal openness to follow a participatory approach.

Some professionals find it hard to accept that rural people have something to contribute to technology development. They have come to believe that scientific knowledge is superior to local knowledge. Therefore, they have been inclined to continue applying conventional top-down approaches and methodologies, and this has hampered the adoption of innovative, more participatory methods and principles.

At local community level, women, who make up the majority of the rural, face special obstacles: heavy labor inputs; cultural restrictions; and a common apathy and neglect towards their expertise and interests. Moving away from the norm raises opposition. The poverty of certain parts of the rural population, added to their previous bad experiences with (non-) supporting agencies, may have removed any hope for improvement, depleted their self-confidence and increased their distrust towards outsiders. This has invariably led to what is termed 'a culture of silence'.

2.3. PTD: a People-Centered and Ecological Approach

The term 'Participatory Technology Development' (PTD) (Tan 1986) refers to the entire process in which development agents, researchers and/or other outsiders facilitate the generation and dissemination of agricultural innovations together with rural men and women. Through purposeful and creative interaction, the partners – the farmers, the researchers and the facilitators - try to increase their understanding of the main traits and dynamics of the local farming systems, to define priority problems and opportunities, and to experiment with a selection of 'best-bet' options for improvement. The options are based on ideas and experiences derived from both indigenous knowledge (both local and from farmers elsewhere) and formal science.

Box 2.2. Key features of PTD

- PTD encompasses all elements of the overall technology development process. It goes beyond appraisal, situation analysis and setting an agenda for action to include experimentation, evaluation, sharing and consolidation.
- It provides a clear link between farmer-led research and farmer-led extension, thus integrating research and extension at the farmer level instead of linking these only at the level of formal institutions.
- PTD addresses the needs of farmers and communities, and helps to better understand the local farming communities and systems.
- It facilitates the consideration of both local knowledge and formal science, and tries to ensure an integrated assessment of technologies.
- It recognizes and respects the importance of indigenous knowledge, which is seen as dynamic. One of the major challenges in PTD is to build bridges between farmers' knowledge, which is holistic by nature, and specialized scientific knowledge (Salas *et al*. 1989).
- It focuses on farmer-led experimentation, rather than demonstration and adoption of packages. It is during experimentation that farmers' own knowledge and experience are brought together with outsiders' insights, and are compared and analyzed to arrive at a locally appropriate synthesis.
- It aims at enhancing farmers' capacity to develop farming systems that are sustainable over time and that conserve and improve local resources. It increases farmers' resilience to change in their circumstances.
- It supports the generation and outscaling of agricultural innovations, and leads to the development of more sustainable options with higher adoption potential.
- It helps to transform supply-driven research into demand-driven research.

Source: van Veldhuizen *et al*. 1997.

In a PTD process, technology would include innovations and new inputs, or existing ideas that can be managed and applied differently, that have the potential to adapt to local conditions. This perception of the term technology is very much in line with the diverse needs and priorities of the farmers. Technology also includes mental constructs, certain codes and forms of management and co-operation.

This process of technology development is geared not only towards finding solutions to current problems, but also towards developing sustainable agricultural practices that conserve and enhance the natural resources so that they can still be used by future generations. Most important of all, PTD should strengthen the capacity of farmers and rural communities to analyze ongoing processes and to develop relevant, feasible and useful innovations.

PTD also fosters a process of cultural awareness, self-respect and self-confidence, as the planning and assessment obliges the participants to take account of their situation, as well as the realities of the different people in the community. Existing power relations will affect the participation process and prevent equal benefit to all. Conventional agricultural research and extension used to be biased towards male, wealthier and better educated farmers. If PTD is to avoid such biases, certain methods and tools must be applied.

It might be useful to emphasize some of the features by which a PTD process can perhaps be identified (Box 2.2). Later chapters on our process of resource and problem identification, technology selection, experimentation process and technology evaluations can then be viewed more critically, based on these features.

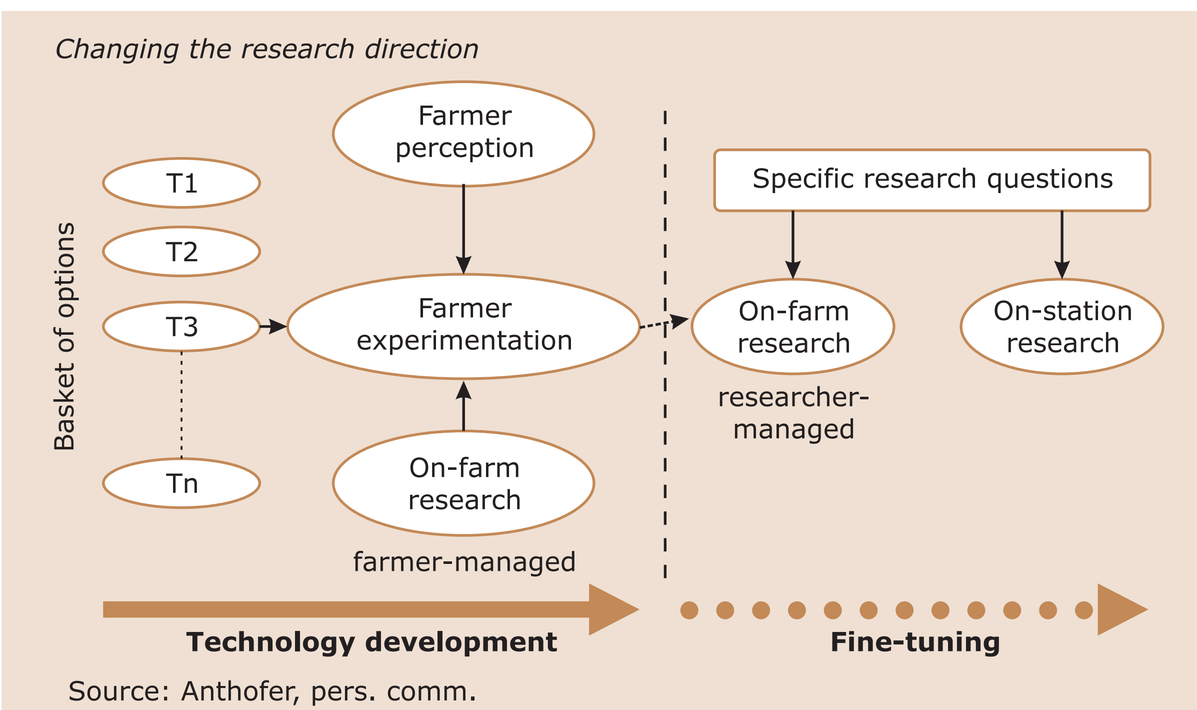


Figure 2.2. Changing the research direction.

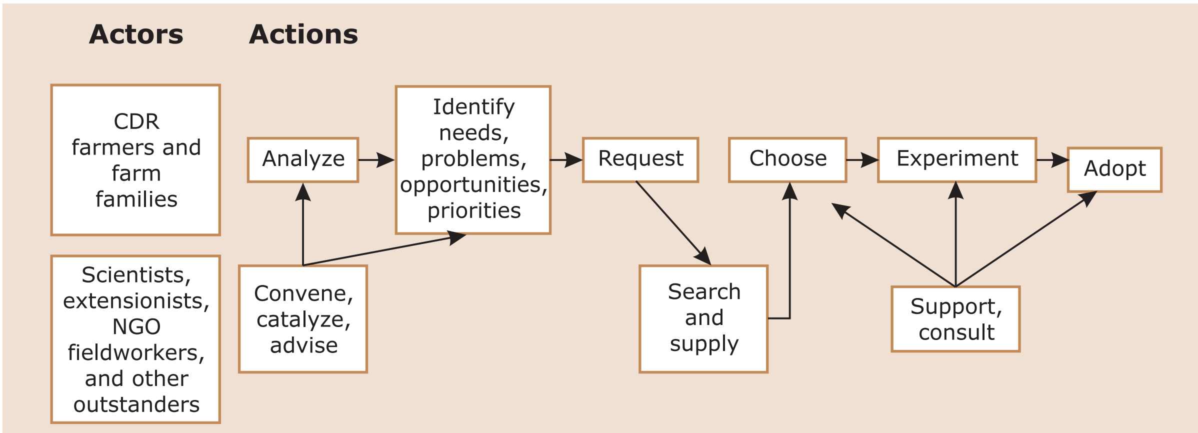


Figure 2.3. Activities in the farmers' analysis-choice-experiment approach (Chambers 1993).

In a PTD process, the research direction is reversed. In contrast to conventional on-station experiments managed by researchers, the farmers select options based on their own priorities, and manage the experiments in their real contexts. This is the process by which technology, as a means of improvement that is relevant and beneficial to the farmer, is developed. Outsiders facilitate the process, and researchers and scientists complement the experimentation by working on specific research questions that arise throughout the experimentation.

2.3.1. PTD sequence and cycle

An iterative process of farmers' analysis, choice and experiment, followed by evaluation and extension, can be envisaged for a PTD process (Chambers 1993; van Veldhuizen *et al*. 1997). This would also help to describe some of the changes needed to make research processes more participatory.

Building rapport and trust between the outsiders and the farming community is an essential, and often neglected, first step for gaining a preliminary understanding of the local socio-cultural and agro-ecological situation, and for coming to basic agreements on the form of future collaboration. Then, farmers, with their traditional knowledge of their farming systems, *analyze* and identify their priorities according to their own criteria. Outsiders facilitate participatory mapping, diagramming and ranking to support the farmers' analysis, and to obtain shared insights into local agricultural potentials and constraints. A strong driving force for a participatory program is the farmers' recognition that it really does address their particular concerns. Another important outcome at this stage would be farmers' improved skills to diagnose and analyze problems.

Outsiders then help the farmers search for and access material and information about practices, often through negotiations with researchers, institutes or local innovators. What is sought and required is not pre-fixed packages of practices of normal research and extension, but a basket of choices, that is, ideas and options, which the farmers can experiment with in various combinations, and adapt to their particular circumstances. Ideas, innovations and opportunities can come from different sources.

In order to better facilitate and support farmers' free *choice*, there have been changes in the mode of presenting the options, from, for example, conventional field days – where researchers and extension staff would try to promote 'ready-made' technologies for dissemination – to technology fairs – where, in response to the priorities analyzed by farmers, options would be presented in an open fair-like setting. Expected effects of the options can also be clarified. Such arrangements would allow and enable the farmers to observe, inquire, argue and decide whether or not to choose options for experimentation.

Experimenting, adapting and learning from observations and experience is a natural part of local agriculture as farmers continuously endeavor to secure decent livelihoods by adapting their practice to available and accessible resources and to environmental changes. The challenge for researchers, scientists and extension workers is to be able to work with the farmers as experimenting colleagues and partners. Small-scale experiments can be designed and implemented that allow for the sharing of practices, methods and principles. The focus would be on experiments that the farmers can manage and evaluate themselves. This would improve their capacity to adapt agricultural practices.

Evaluation is based on farmers' perceptions and criteria, and is carried out both during the course of and at the end of the experimentation process. With farmers' regular and even systematic inspections and cross-visits of one another's trials, assessments and *extension* are sometimes merged. Farmers can learn from each other while

Figure 2.4: PTD cycle (Anthofer *et al*. 2007).

comparing experiments, discussing problems and opportunities, and analyzing results. This process would, thus, enhance farmer-to-farmer diffusion of ideas and technologies. Ultimately, it is the farmers who would decide if the options are suitable locally. Technical guidelines for applying them can be drawn out jointly by farmers, outsider scientists and the facilitating teams.

Regular process review and *self-evaluations* are to be carried out throughout in order to reflect upon the experience of collaboration and experimentation, with a view to improving the PTD process. Farmers and outsiders would gain an increased understanding of the PTD process. The process can be documented to provide resource material for the PTD approach.

The sequence of activities in a PTD process can be summarized in the form of a cycle.

Viewing the process as a cycle also implies that for PTD to continuously evolve, this cycle should ideally be completed more than once. With each new cycle, new and more challenging frontiers and issues can be tackled, and with more active and self-initiated participation of local people. Marginalized and neglected sections of the community can be sought and involved. Lessons learnt from previous experiences and mistakes can be put to good use.

The PTD group for this project had to adapt themselves to seeking, and iteratively building upon opportunities for instigating methodological, attitudinal and perhaps even institutional change with respect to participatory research, trying as much as possible to employ and apply PTD concepts, methods and tools. As far as the approach and methodology was concerned, it can be claimed that it was a 'learning-by-doing' experience.

2.3.2. Roles of field staff in PTD

There is a need to revise the roles of researchers, extension workers and the ultimate users of agricultural research, that is, the farmers. It is now increasingly recognized that researchers alone cannot take hold of the complexity and dynamics of local livelihoods and management practices, and that farmers need to be involved in the process of technology generation at an early stage (Douthwaite *et al*. 2003). In between farmers and researchers, the conventional 'mediatory' role fulfilled by extension workers would, then, be replaced by a facilitator or ideally by a facilitating team.

This team could comprise researchers with both technical, and social and development backgrounds. Extension workers can also be part of the team, but in a new capacity. They would be less involved in transferring technologies to farmers, and more concerned with facilitating constant interaction among farmers and technology researchers and experts. The team could also include non-government actors such as non-governmental organizations (NGOs). What is expected of the facilitating team in a PTD process can change as the process evolves.

The role of this team could be, initially, to help in analyzing the present farming situation and resource base, and making farmers' criteria explicit. Then, the team would help with systematic planning, monitoring and evaluation of new experiments with farmers, and later facilitate farmers' self-organization and self-management. As ties between farmers and technology researchers and experts become stronger and more sustained and self-managed, the facilitating team could invest more effort into *networking*, by encouraging exchange among farmer-experimenters in the local area and beyond, by helping to develop linkages with relevant support organizations, by linking farmers with relevant sources of information, and by feeding back information about farmers' experiments to formal researchers.

Throughout the process, there will be instances and stages where the facilitating team act as *trainers* – enhancing farmers' diagnostic capacities, revitalizing indigenous knowledge and self-esteem in farming communities, and helping farmers increase their understanding of the processes at work in their agro-ecological system. At the same time, the team might train and brief the collaborating researchers on participatory principles and methods.

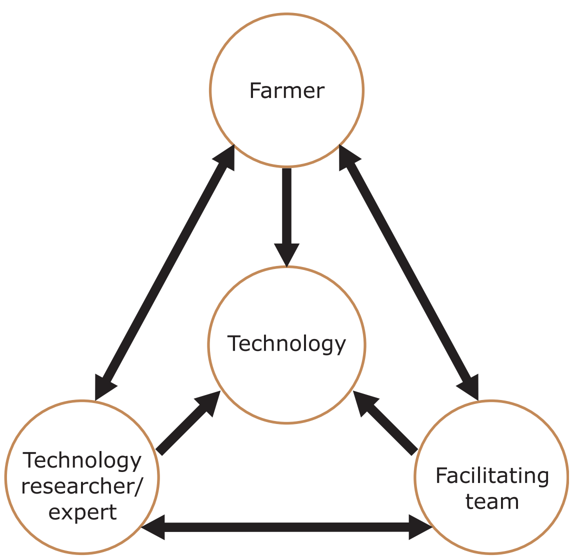


Figure 2.5. PTD interactive triangle.

In order to be able to facilitate a process of technology research and development, the team cannot remain uninvolved in the actual technology-experimentation activities. Therefore, another role would be to act as *co-researchers* in the process, where they can contribute ideas, potential solutions and information from formal research, make additional observations to support the analysis of farmers' experimentation, and document the entire process and the final evaluation of socio-cultural and agro-ecological impacts.

This participatory triangle of continuous interaction takes shape from the early stages of a PTD process, the outcome of which is a technology that can be relevant, locally adapted, and demand-driven. In a participatory approach to technology development, this interactive mode of collaboration would replace the conventional linear mode of technology transfer (described before).

Such a participatory approach to research and technology development requires fundamental changes in the attitude of all participants, particularly of researcher and extension staff, so that they can listen to and learn from farmers. A flexible, open-minded and honest approach would allow farmers to overcome their mistrust of researchers and outsiders, and participate in research which they feel could generate tangible benefits.
A change in attitude is also expected from farmers to take on a more active role to act, get involved and take responsibilities.

2.4. An Agenda for Action for this PTD Project

A qualitative research approach is more in line with the exploratory character of participatory research (Nederlof and Dangbegnon 2007). Two principles that could guide data collection are (1) to include detail in recording events and observations; and (2) to use triangulation to validate information (see Chapter 3 for more explanation on triangulation).

The PTD team for this project was constantly up against the dilemma of whether to make their learning of the PTD process, concepts, cycle and activities more complete, or to add to the experiments and activities in the field. The team tried to react appropriately to the situation and season at hand and gradually modify and change aspects of the process into a more PTD mode. With each season they were, therefore, able to facilitate a relatively more participatory process of problem identification, technology selection, experimentation process, and evaluations.

Other things changed too, such as the team formation, so as to accommodate a more gender-balanced team, the more organized and more frequent cross-visits for most of the experiments, the more systematic reflection sessions within the team and with the technology scientists and researchers, and the more purposeful documentation of the activities.

Below is a chronological overview of the activities and events that shaped and influenced this PTD process over the course of two and a half years.

2.5. Resource and problem identification

2.5.1. Participatory situation analysis of rural life and livelihood

Understanding and respecting rural life - the way farmers manage their farm and household in often difficult situations, the complexity of the farming systems they have developed – is essential if we are to expect the PTD practitioner to be able to collaborate with farmers. A demand-driven and context-specific process of technology selection, adaptation and development should be based on a participatory assessment of local people's conditions, resources, problems and needs.

This approach recognizes farmers' comparative advantage as knowledge experts of their own farming systems. Farmers identify their priorities according to their own criteria. Outsiders can contribute by convening groups, encouraging observation, asking key questions, and facilitating participatory mapping and diagramming by farmers.

A participatory situation analysis would aim to support farmers to study and reflect on their local situation in order to identify constraints to sustainable agricultural development, as well as opportunities to overcome these constraints. A participatory program relates its activities directly to a felt need or priority problem of the beneficiaries – that is, one that needs to be addressed first, because it affects many farmers in an important agricultural activity, thus causing severe losses of income or production - and takes their situation as a starting point. A joint participatory situation analysis helps outsiders as well as farmers to better understand the local situation, generates ideas and options for future joint activities, strengthens the capacity of the local community for critical reflection and analysis in current and future development, and lays the foundation for subsequent farmers' control of, and participation in, future activities.

One of the basic arguments for, and indeed principles of, participatory analysis, is that communities are not homogeneous. Different interests exist alongside each other, and this has important implications, especially when analyzing problems, needs and priorities at the village level. There must be:

- An awareness among staff of the differentiation in communities –

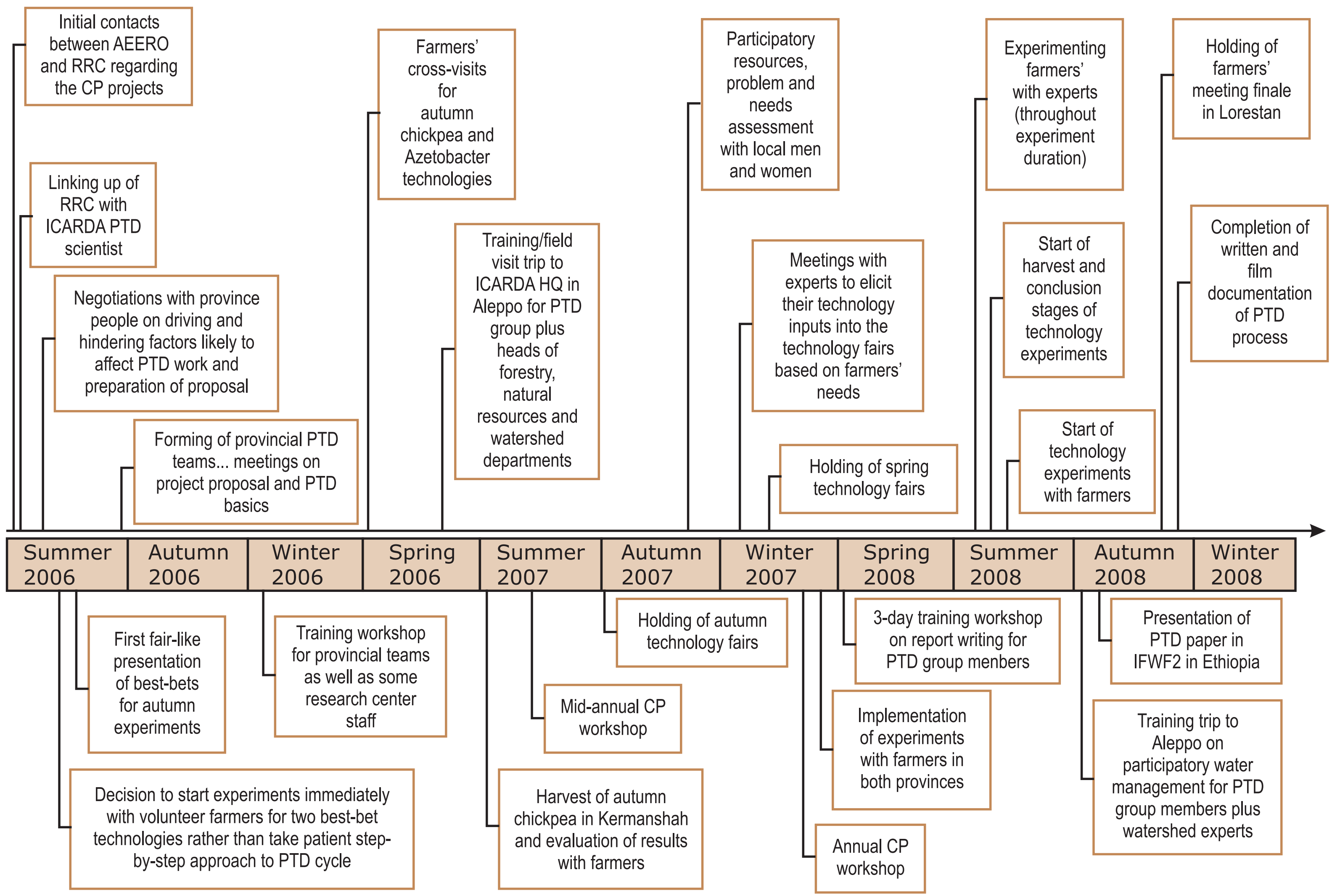
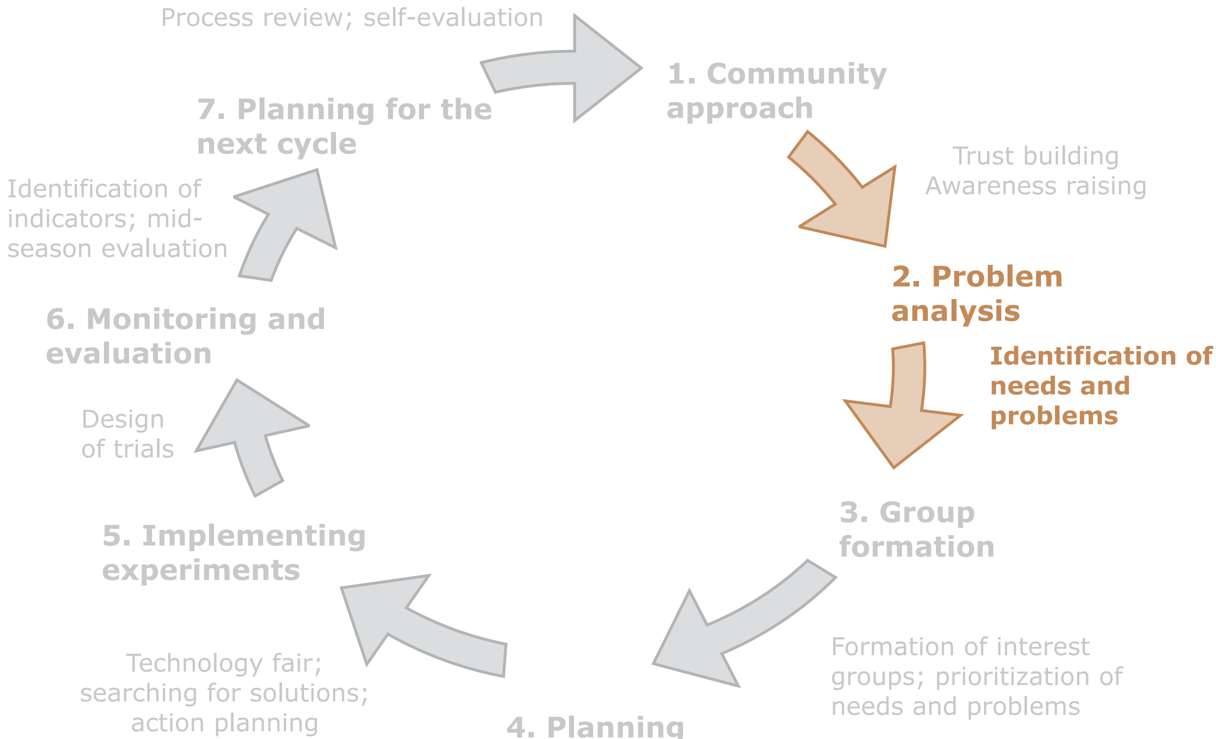


Figure 2.6: Chronological overview of this PTD process.



differences in crops grown, agro-ecological conditions, economic groups;

- A capability for finding out who is who in the area – through, for example, a wealth or well-being ranking;
- A willingness to take those differences seriously, in situation analysis, and in implementation. There is always a danger of drifting away from the weaker groups because it is often more difficult to work and find solutions with them.

We cannot expect a participatory analysis to give a complete and comprehensive picture of all dimensions of local life and livelihood. However, we can expect it to give us entry points – small activities that can provide outsiders and farmers with a chance to further understand what is required and what is possible. Of course, some questions can become significant, such as how many farmers are affected by a particular problem and to what extent is their livelihood affected. We can also try to find out whether the farmers have traditionally been capable of solving such problems.

2.6. Preventing Bias

Outsiders involved in a community process will always be influenced by their academic learning and by their professional biases. Deliberate steps need to be taken in order to offset these.

2.6.1. Road bias

Outsiders tend to stay close to the main roads in their trips to rural areas, and therefore, they only get the chance to see farms and meet with households and farmers located near the road, which are often the ones with more resources and fewer problems. Therefore, the outsiders fall into a trap which keeps them away from the reality of the poorer farmers' livelihood and living environment.

2.6.2. Elite bias

A participatory process aims to reach, or at least to include, those who are usually marginalized from processes of change and development. An obstacle to this is outsiders' tendency to only meet with better-off farmers who are well informed on new techniques, have easier access to equipment, machinery and information, have the necessary resources to support them against uncertainties, and often have other sources of income that safeguard them against the risks of agriculture. Much effort is required to reach the poorer farmers, to get them actively involved, to maintain their presence throughout the process, and to ensure that they are really the ones benefiting from the project activities.

2.6.3. Production bias

Many agriculture programs led by outsiders focus mainly on production issues, thus neglecting other significant concerns of the farmer, such as post-harvesting, preservation, processing and food preparation. Evaluating projects merely by their impact on production drives outsiders to focus all attention on ideas and methods that can increase yield, usually at the cost of missing farmers' natural criteria for deciding on and evaluating changes to their farming system.

2.6.4. Gender bias

Men and women perform different roles in agriculture. They have different responsibilities and often different interests, which are shaped by the culture, norms and tradition in the community.

Norms, values, ideas and social positions also influence the opportunity of different groups to make use of local resources: they do not have equal access to the resources. These resources include land, water, equipment, labor, cash, leadership, representative organizations, education and information. They also do not have equal control over the resources, that is, the ability to decide on their use.

Because of these differences, men's and women's views on needs and priorities to improve their situation often differ strongly. The needs may concern the day-to-day situation (practical needs), but also more strategic issues to ensure improvement in the long term.
Although there are great difference between men's and women's roles in activities and decision-making, these roles are often strongly interrelated.

Taking into consideration the above points, practical questions arise: About whom, what and from whom in the village should we seek information? Which critical topics do we need to include in our diagnosis to become aware of possible gender issues? Which methods are we going to use to ensure involvement of different groups? Whose priorities are we going to address? Who should participate in experimentation, and what are the implications of the proposed options for different groups? Who should be involved in evaluating the results?
(It is worth noting that an additional research component on gender was designed to complement the socio-economic and PTD projects of the Challenge Program (Effati *et al*. 2009), focusing more specifically on gender analysis of roles, livelihoods, needs and problems).

2.7. Farmer-Led Analysis

Another tendency for outsiders is to take home the data generated in the field analyses, even when it has been produced by the farmers, for subsequent data analysis and reporting. A participatory approach stresses the importance of affording credibility to what has been discussed, agreed and checked by various groups in the community. Outsiders' analyses, which are naturally influenced by their professional background, are meant to complement, and not eclipse or obscure, the conclusions derived in the field. This would demand that all results and conclusions be fed back to the community.

2.8. Methods

Consequently, we are looking for approaches that give the farmers the leading role and that support their own analysis of existing systems. Until the mid-80s, most analyses focusing on rural situations were either: long in duration; fixed and formal in structure; limited in scope; and usually concerned with a single issue, ignoring wider linkages and implications. They were often weak in terms of integration, even in multi-disciplinary teams. Participatory methods, if facilitated well, are meant to be: simple – to better allow farmers' involvement and their interaction with outsiders; more efficient with time – to prevent frustration and loss of interest, particularly for resource-poor farmers for whom time is a costly resource; aimed at knowing only what is needed; sensitive to social and gender differentiation; informal and accessible; and made up of group sessions alongside interactions with individuals (Chambers 1993).

2.8.1. Visualization

One of the embedded features of participatory methods and techniques is visualization, that is, making the discussions and analyses as visible to everyone as possible, and this should be done using tools that ensure no one is excluded, particularly those with less writing and reading skills. Basically, the aim is for everyone 'to see what we are talking about'.

2.8.2. Group problem analysis

Interaction with groups of farmers with a common interest, facilitated over one or more sessions, can raise farmers' awareness and motivate them. The group process can provide a basis for possible collective action.

2.8.3. Relevance and trustworthiness

With experiments, there is always the question of validity and reliability. In conventional research, these are usually linked to measurements, statistical tests and replicability. In participatory research, quality, and consequently validity and reliability, are related to (1) relevance (how useful the process and analysis is for learning and action for those involved in a particular context); and (2) trustworthiness (how closely the unfolding process and analyses represent reality from the point of view of the various stakeholders involved).

2.8.4. Triangulation

Triangulation in qualitative enquiry and research refers to the validation of findings through applying multiple methods, analyzing with different groups and people, and looking at issues from different angles and perspectives. One good example appears in Table 3.4, where the findings from the various techniques are integrated to provide a comprehensive picture of the characteristics of the farmers' livelihood and priorities. How closely do the farmers' criteria for analyzing the households' well-being correspond with the priorities and concerns addressed when discussing needs and problems, for example?

2.9. Our Resource and Problem Identification Process

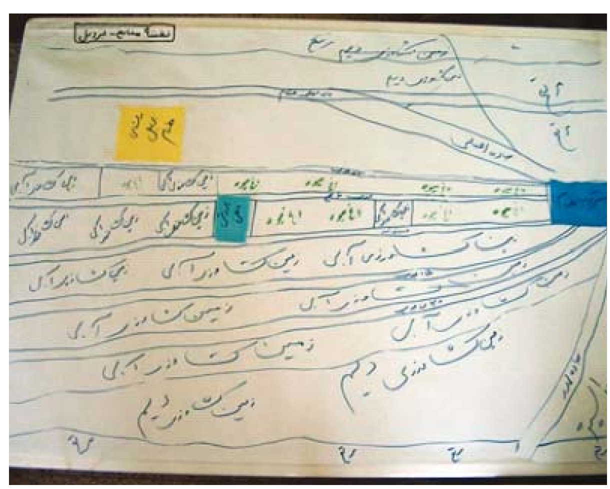
Before the spring technology fairs in the final year of the PTD project, the two provincial PTD teams conducted, over a period of three weeks in November and December 2007, a relatively comprehensive participatory resource and needs assessment in the eight villages that had been determined as project sites – Upper Peresk, Bardbal, Chahar-takhteh and Siahpoosh in Honam Watershed of Lorestan Province, and Kolah Joob, Upper Sekher, Lower Mehdi Abad, and Bagh Karam Beyg in Merek Watershed of Kermanshah Province. The teams were briefed on the participatory methodology, as well as some PRA tools and techniques that could be used in the field. Almost all the field work was conducted in separate sessions with men and women. Some of the techniques were carried out with both groups.

2.9.1. Social and resource mapping

Local people would produce maps of their physical and social environment (social maps), showing the number and location of households and other structures in the village. They would also produce separate maps of their resource base (resource maps) – location of their farm land, rangeland and water resources – and discuss issues of uses, management, ownership and access. Mapping has the added advantage of being relevant to everyone in the community. It also provides a conducive atmosphere for discussing side issues, each of which could be a lead into future discussions.

2.9.2. Household well-being rankings

The locals classify, amongst themselves and without necessarily making public the names of families, all the households in their community in terms of their socio-economic status. They then reflect upon the criteria by which they carried out the classification. Any process could then be clearer about the groups it aims to target and the aspects of local life and livelihood it intends to change and improve.

Photos 3.1 and 3.2. Village social and resource maps.

Table 3.1. Well-being ranking of households in Upper Peresk, Honam.

Very weak	Middle	Better-off
• Less than 2 ha of agriculture land • Small, mud house • Little or no literacy • Large family, around 7 • No livestock • Works as seasonal labor • Some are covered by welfare organization	• Owns maximum 5 ha of rainfed land • Brick and/or stone house • Owns up to 4 cows • Has some farming equipment • Almost one item of farming equipment for every three households • Around 2 million tomans annual income (approx. US$2000) • About a third of these households have houses in town • Children attend school up to 9th grade and high school diploma • Only one bread-winner in each household	• Owns at least 7 ha of irrigated land • House in relatively good condition • Owns light and heavy equipment and machinery • Mechanized farming • Owns house in town • Children are educated to high school and diploma level

2.9.3. Historical time lines

The locals, especially some of the older members of the community, would recall events that have been significant to them from the past 50-100 years of the community's history depending on how far back they can remember. These could include good and bitter experiences, as well as recalling how the community dealt with them. In relation to agriculture, these analyses could be very informative on traditional and indigenous farming practice.

2.9.4. Seasonal calendars and daily routines

Local people would analyze and visually show how their activities, income and expenses spread across the year (seasonal calendars), and how they divided their day between their various chores (daily routines). In some of the villages, there was a chance to carry out separate daily routine analyses for different times of the year. In Honam, the teams carried out separate seasonal calendars with livestock breeders and farmer-breeders (farmers who combined farming with livestock breeding). Seasonal and daily analyses provide a lot of insight into the households' farming practice and activities, and also into where the problems exist.

(See Table A1.1 in Appendix 1 for sample summary of findings from resource

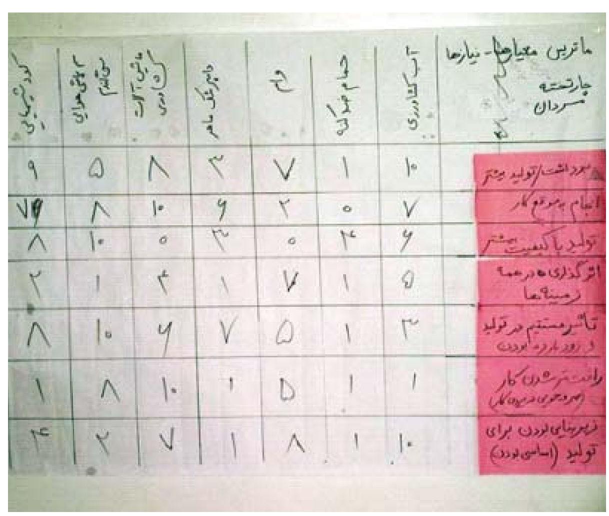


Photo 3.3. Ranking matrix of farmers' needs.

mapping, seasonal calendars and historical time lines.)

2.9.5. Card collection (or Delphi's technique)

The locals would, individually, brainstorm on, and record, pressing issues and needs. These would then be clustered, by the locals themselves, into topics of needs and problems. Any new activity would necessarily have to be relevant to these topics.

2.9.6. Pair-wise and ranking matrices

Separate matrices would be carried out for needs and problems. In the pair-wise matrix, the needs or problems would be placed in the horizontal and vertical axes and all of them would be compared to each other in terms of their priority. The more the item gets repeated in the matrix, the more its relative priority. At the same time, the locals would discuss their reasons for prioritizing certain items ahead of others. These reasons would actually form the criteria by which they could score and rank, more accurately, the same items in the second matrix. Therefore, a process of prioritization would be completed in two stages, and we would be able to get a comprehensive picture of the factors that influence their prioritization. A hundred 'shares' would be distributed among the criteria by the locals to show their relative significance. Of course, we could then go back and see which items in the second ranking matrix were given higher grades for the more significant criteria.

Both the priorities and the criteria for prioritization can provide important platforms on which we can base our search for potential ideas and solutions. Such ranking and prioritization could give the process more direction, and make clear the farmers' criteria for assessing needs and evaluating subsequent initiatives.

(See Table A1.2 in Appendix 1 for sample matrix ranking.)

2.9.7. Problem trees

The root causes and effects of the problems that emerge as the most pressing ones from the matrices, would then be analyzed in more detail in problem trees.


Photos 3.4 and 3.5. Locals surrounding PTD team members on village maps.

Photo 3.6. PTD team members and a village elder constructing a historical time line.

The earlier, more general techniques, such as the mappings, the household well-being rankings, and the historical time lines, were conducted with a diverse range of community members. In the latter stages of the needs assessment, the groups would become more and more homogeneous in terms of their socio-economic status and their livelihood and resource-base conditions.

Similarly, the issues discussed in the early stages of resource and problem identification were more general, covering a wide range of topics not necessarily directly related to agriculture and natural resources. The justification was that (1) it was important to start the analysis process from their position and look at their life and livelihood from their holistic perspective, and then allow them to eventually converge on issues, needs and priorities that were more relevant, and (2) it is difficult for outsiders to judge which issues are directly or indirectly relevant to local people's livelihood from the outset, and it might be advisable to allow the relevance of topics to emerge from their own analyses. Local people are probably more capable than outsiders in screening out impractical irrelevancies and homing in on their relevant needs. This said, it is also important to keep clear what the project is about and what domain of activities it can address.

2.10. Integration of Findings from the Four Villages in Each Area

The resource and problem identification was carried out more thoroughly in the second year of the PTD project (2007-2008). In order for the findings from the field work to provide the basis of our search for ideas and technologies for the next farming season, the results and analyses from the participatory techniques described above were integrated to give a more comprehensive picture of the socio-economic situation, priority needs and problems, and farmers' criteria. Below are some of the more significant findings. (A more detailed account of the findings can be found in Table A1.3 in Appendix 1.)

- One of the criteria that characterized poorer farming households in well-being analyses in both Merek and Honam was 'working as seasonal labor in other areas'. This criterion, as well as 'unemployment' being cited as one of the problems in the area, seems to justify the farmers' pursuit of adding to and diversifying their sources of livelihood. At the same time, for farmers who do not own land and work on other farmers' land, there is a need for options that can show returns in a shorter time span. It might be difficult for the poorer farmers to take up activities or ideas that require more than one season to show significant results.
- In the historical time line analyses in Honam, farmers recalled the 'abandonment of the traditional

alternate cultivation of land' as a direct reason for the decrease in productivity. This is credible evidence of the farmers' endogenous mechanisms for the management of their local natural resources. Giving their analysis of the consequences with a sense of regret is further reason to acknowledge local people's awareness of the inter-linkages affecting their long-term livelihood. A very common need expressed by farmers was 'improved cultivation'. Ideas such as Azetobacter bio-fertilizer inoculant, pea and bean inoculants, and integrated wheat pest management, were all ideas that had the potential to respond to this particular need while conserving the natural resources and protecting the environment at the same time.

- Stressing 'loss of fisheries in the river' and 'destruction of rangeland' as pressing issues testifies to the fact that even poorer farmers can be concerned about the environment on a wider scale.
- Men farmers focused on 'no or little land owned/ need to rent land for agriculture'; 'rain-fed nature of agriculture'; 'lack of access to agricultural equipment and machinery'; 'lack of technical skills'; 'lack of money'; and 'illiteracy' as the root causes of their agricultural and livelihood problems and difficulties. Such realities emphasize the importance of seeking ideas and options that require little land - any new technology or activity taken up by the poorer farmers would have to be implemented and be effective on relatively smaller plots - and capital, are simple to implement, and do not require much equipment or machinery.
- Issues such as 'lack of water for agriculture' and needs such as 'more agriculture water' also emphasized the need for ideas to spare water resources.
- Prioritizing 'inadequate fertilizer portions' as a problem and 'increase of fertilizer portion' as a need

Box 3.1. Summary of needs assessments and problem identifications presented to technology scientists in Kermanshah

Needs:
Lower Mehdi Abad: replacing sugar beet with potato cultivation, poplar trees, sewing, mushroom growing;
Kolah Joob: potato cultivation, mushroom growing, carpet weaving, sewing, medicinal plants;
Bagh Karam Beyg: sewing, mushroom growing, potato cultivation, medicinal plants;
Upper Sekher: potato cultivation, mushroom growing, sewing, carpet weaving, geeve weaving

Problems:
Lower Mehdi Abad: no piped sewage system, seasonal unemployment;
Kolah Joob: non-implementation of Hadi Project (this is a national program aimed at renovating the physical conditions, facilities and amenities of villages), constant electricity black-outs, lack of collateral for getting loans, not having legal documents for houses;
Bagh Karam Beyg; most of our lands are rainfed, no piped sewage system, no intermediate or secondary school, no parks or trees, no bakery;
Upper Sekher: no bakery, no piped sewage system, seasonal unemployment

Box 3.2. Summary of needs assessments and problem identifications presented to technology scientists in Lorestan

Needs:
Upper Peresk: planting fruitful trees on slopes, diversity of livelihood sources, forming a beekeepers' co-operative in the village, expansion of beekeeping;
Chahartakhte: financial independence of women;
Bardbal: loans for carpet weaving and handicraft, carpet weaving and sewing training, diversity of livestock products, diversity of income sources, deep wells, planting trees on slopes;
Siahpoosh: enriched fodder, quick-return seeds

Problems:
Upper Peresk: damaged fields, infections and diseases on fruit trees;
Bardbal: livestock and agricultural losses, floods;
Siahpoosh: lack of guarantee prices for products

Local people's common criteria for prioritization of needs:
Upper Peresk: commonality;
Bardbal: economic viability, commonality;
Siahpoosh: commonality, prevention of loss of crops and livestock, specialized learning, economic viability

Ideas proposed by farmers, and later complemented by researchers and scientists:
compost; vetch fodder; increased diversification of crops on rainfed land; shallot; saffron; home mushroom growing; Azetobacter bio-fertilizer inoculant

Common needs of Upper Peresk, Chahrtakhte, Siahpoosh, Bardbal in Lorestan:
Agricultural water – covering of streams;
Agricultural water – optimal use of water;
Integrated/simultaneous aerial application of pesticides;
Livestock fodder;
Loans for buying livestock and or building animal sheds

Common problems in Lorestan:
Loss of water;
Wheat pests;
Inequitable distribution of subsidized fertilizer;
Inadequate subsidized fertilizer supply;
Delayed distribution of subsidized fertilizer;
Dispute between landowners and tenants regarding fertilizer;
Loss of livestock and small ruminants;
Unhygienic stables and sheds;
Uncontrolled piling of animal manure in villages;
Seasonal unemployment;
Unemployment of young boys and girls

Common criteria for prioritizing needs:
Human health and hygiene;
Livestock health;
Increase in income;
Increase in production

emphasized the requirement for ideas that either reduce the need for chemical fertilizers, or at least make their use more optimal.

- Another priority problem was the ‘lack of diversity of agricultural products’. It seems the farmers were well aware of the risk of concentrating on one or two products, and of the value that diversification of farming activities can add to their livelihood resilience. (This was definitely one of the incentives for the 22 farmers in Merek who pursued the idea of substituting sugar beet with potato cultivation for the first time in their area.)
- Contrary to the general belief in economic circles that farmers’ priorities, especially the poorer ones, are always guided by immediate personal benefits, farmers will always value and have time for what is best for the whole community.
- It seems that local farmers have recognized the need to learn and develop new skills and capacities to be able to change aspects of their livelihood. This is a rich potential source of motivation to participate in experimentations with new ideas.
- Ideally, in the search for potential ideas and technologies, we would be looking for options that combine farmers’ needs and their criteria. In this respect, mushroom and saffron growing were two ideas presented that responded to needs while also satisfying local criteria for prioritization.
- Some of the women farmers’ criteria for prioritizing needs – e.g. generating hope for the future; family use and consumption; easing of work; independent or direct income for women; filling leisure and idle time; indoor nature of activity – are not necessarily or solely of an economic nature, and some of them are definitely not immediately short term. In fact, many of the ranking matrices showed that non-material and non-economic criteria and concerns had priority over material and economic items. The criteria also show a holistic outlook towards their livelihood and living environment.
- ‘Reducing agricultural losses’, ‘employment generation’, ‘health’, ‘commonality’ and ‘learning new activities’ were some of the criteria that both men and women referred to for prioritizing their needs. This does show that both genders are jointly engaged in, and equally aware of, many aspects of local livelihood.

Chapter 3.

Technology Selection

3. Technology Selection

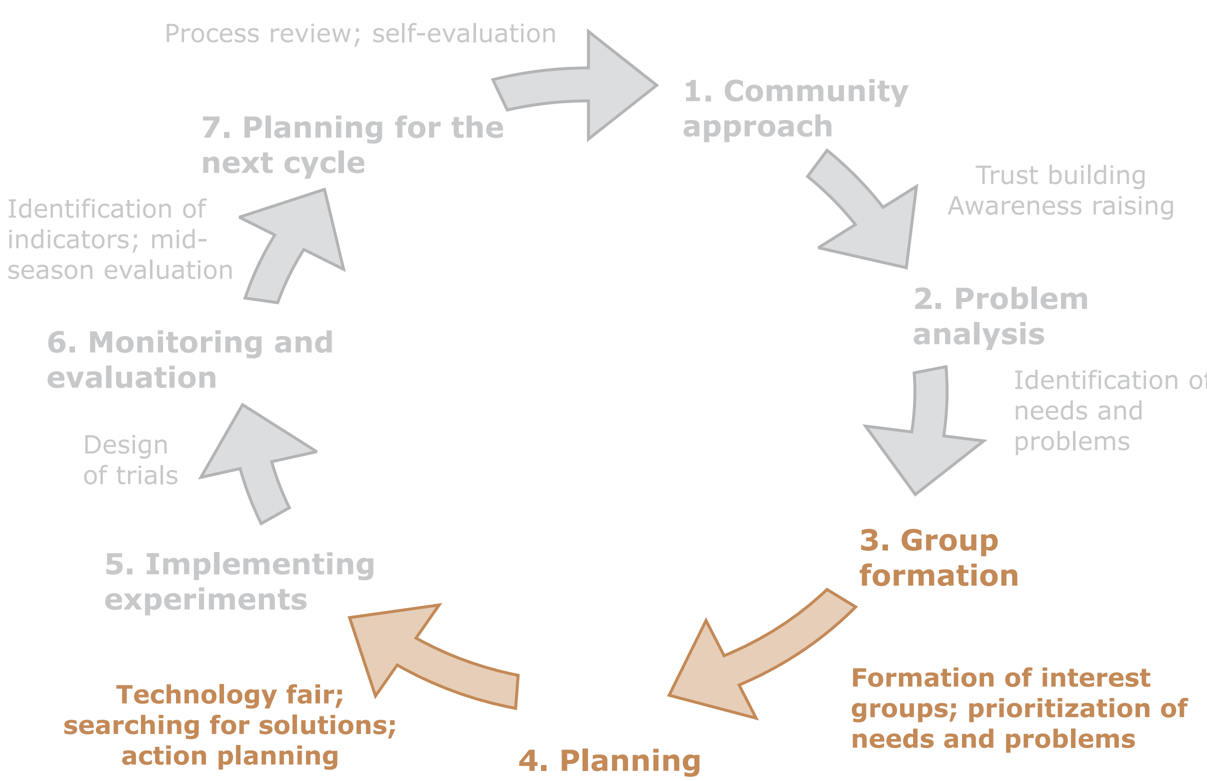
3.1. Introduction

The participatory analysis of local conditions, resources, needs and problems can express priorities and generate requests for varieties or for information. The role of the outsider is to look for and supply the farmer with information and a range of options about practices that are relevant to the findings of the needs assessment and problem identification. The demand amongst farmers is usually not for one package of optimized practices but rather, for a basket of potential options that may be able to adapt to their needs and conditions.

3.2. Our Process: Who Selects Whom?

In the early stages of the Livelihood Resilience Project, farmers were selected by the researchers for field trials according to certain criteria. The collaborating extension service and agricultural service centers often selected so-called 'co-operating farmers' who were usually the better-off farmers with more resources and better management skills. However, they often do not represent the diversity of farmers in the project area. In addition, they often received incentives for their co-operation.

As a first step of the new PTD project, existing best-bet options were introduced



to all farmers in the PTD pilot villages and explained by a team of researchers, extension staff and experienced farmers. Farmers were not expected to work for the project, but rather invited to participate *based on their own interest and benefit*. After clarifying the approach, farmers chose those technologies they were interested in.

In the first season, the project worked with two technologies that had been implemented in the field the previous two seasons, autumn chickpea and Azetobacter, albeit through the conventional approach to farmer selection and expert-farmer relationship. The PTD teams tried to get a wider range of farmers involved, on a voluntary basis and without material incentives. Although the experiments were still designed and managed by the outside experts, the PTD teams facilitated the contacts between farmers and experts, discussing doubts or problems that arose throughout the experiments.

In the second season, farmers were able to choose from a wider range of technologies in the technology fairs. The PTD teams managed to organize some cross-visits with participating farmers. The outside experts were more involved in reflecting on the process of the experiments.

The third season, the options offered in the fairs were sought and selected for the fairs, jointly by the PTD teams and researchers, in response to the results of the resource and problem identification and needs assessments. This time, the women were also involved. The PTD teams also had intensive negotiations with the experts before the implementation of the experiments in the field. Regular cross-visits were organized for most of the experiments. The experiment process was also documented in more detail, in terms of the technical progress of the experiment, the attitude and behavior of the experts and farmers, and in terms of the social dynamics of the process.

To make monitoring by farmers possible, the trials were kept as simple as possible. The learning process is on both sides. Farmers are actively involved in the entire research process, while researchers have to learn that participatory research is more than transferring complex field designs from the research station to farmers' fields.

3.2.1. Removal of incentives

Governments have traditionally sought to achieve agricultural change through a combination of extension and subsidies. In Iran, there are heavy subsidies on fertilizers and other inputs as well as guaranteed prices for wheat to achieve self-sufficiency. However, such approaches are now considered poorly suited to the challenges posed by sustainable agriculture (Vanclay and Lawrence 1995). Subsidies create artificial cost-value ratios and may make farmers dependent on external payments. Hence, farmers may only show interest and finally adopt a certain technology for the incentives paid. Technologies developed under such conditions cannot be sustainable and prevent the development of technologies that are suitable for the market situation. Therefore, within the PTD project, subsidies were not offered at all or were gradually removed.

The experiments were carried out on small plots in order to limit the risk for the farmer against any negative result with the new technology. A serious drought during the 2007 season and the consequent loss of the entire harvest was the best evidence for the necessity of working on small plots, even though the farmers' own practice was also affected by drought. "*Distributing small portions of seeds amongst the volunteer farmers was initially not received very well by them, but after the harvest was lost due to drought, the necessity of starting with small plots and expanding gradually was more clear to us*" (PTD team member).

The drought helped the farmers to understand that a technology does not always perform as expected. It allowed the technology to undergo its test under more severe conditions, thus bringing many of the potential issues to the surface, and shedding light on its performance under environmental stress.

For some of the technologies, the farmers were able to make use of existing but unutilized resources outsiders and even local people often do not see as important. This is the reason for investing time in resource identification in the early stages of the process.

3.2.2. Researcher constraints

Up to now, researchers in Iran have not been very receptive to new, more participatory approaches and methodologies. They are still apprehensive of exposing their technologies to critique and change. There could be several reasons for this, one being the fear of losing power and of being criticized. Regarded as an expert of a particular technology or field of work by the research institutes and farming communities he or she attains a respected status. Any criticism of the technology may be viewed by the researcher as a questioning and even doubting of his or her scientific ability and authority. This is especially the case in working environments where mistakes are often regarded as failure rather than as a chance to learn and improve on an idea.

Working in a participatory mode with farmers with trials implemented by farmers on their own land are research conditions with unpredictable factors and outcome. Many external factors are out of the researcher's hands compared to the controlled conditions of a research station. Also, the evaluation of staff performance within research institutes is still geared towards producing data and scientific papers rather than achieving impact at the farm level. Changing these norms towards new methods and approaches remains a challenge.

3.3. Technology Fairs

The 'technology fair' is meant to provide the farmers with a range of options from which they can make a selection to test during the upcoming farming season. It is based on their own needs and priorities. Ideas, innovations or new crops that show potential to contribute to an improved livelihood and better management of natural resources are presented as a 'basket of choices' during the technology fair, with the corresponding technical expert of each technology acting as resource person.

Prior to the autumn cultivating season in Honam and Merek in 2007, the provincial PTD teams organized two technology fairs in Upper Peresk village in the Honam district of Lorestan and in Nojoob village in the Merek district of Kermanshah in September 2007. They also provided transportation for the farmers of the other project villages to come to the fair.

For the spring season, the PTD group decided to hold separate fairs in the eight pilot villages, thus spending a half-day in each in the first half of March 2007. For all the fairs, the group tried to facilitate programs that could include:

- Open, visual presentation of technologies;
- Reversed roles of researchers and experts (from conveners of technologies to resource persons) and farmers (from passive recipients of technologies to active decision-makers on the choice of options);
- An enabling environment for the farmers to better interact with the experts as well as with other farmers from their community and other villages, and for mutual learning for all involved.

3.3.1. Preparations

In order to prepare the fairs, the PTD teams approached research experts and proposed that they present their technologies in the fairs, with an emphasis on ideas that:

- Are relevant to local conditions and needs;
- Contribute to improved management of resources;
- Are simple to understand;
- Do not change major parts of the farming systems;
- Require few external inputs.

For the spring fairs, this included a meeting where the overall results of the needs assessments conducted in the villages (Box 3.1) were presented to the experts so that the ideas and options presented at the fairs could be more relevant to local needs. In Lorestan, the experts formed thematic groups based on the needs assessment, to come up with relevant suggestions.

Before the technology fairs started, meetings between the PTD teams and the technology experts were conducted. During these meetings, the PTD teams tried to convey the important PTD messages with respect to the *expected roles of the experts* as well as the participatory mode in which the fairs were to be conducted. The researchers were made aware of some of the characteristics that distinguish PTD from a conventional research approach.

The other task of the PTD teams was to *inform the local communities* of the upcoming fairs, explaining the program and its objectives, and agreeing on a time and place for the fair to be held. Much effort went into ensuring that the *poorer and more marginalized farmers were invited and represented*. This included posting notices in common areas as well as door to door visits and personal reminders. In Lorestan, the PTD team had innovatively taken the news to the schools and the children had spread the news to their parents.

The teams then *coordinated the logistical arrangements* regarding the venue of the fairs, transportation and filming. The staff and departments at the district levels assisted in the logistics. The local agriculture departments and agricultural service centers provided vehicles, tables and chairs, and refreshments, as well as adequate support staff.

3.3.2. The fair settings

The fairs were organized in various local surroundings in the eight villages: the local mosques, open fields and house yards, local primary school, and the local health centre. It was important to provide a setting where the farmers could feel more ‘at home’ and enjoy an informal, friendly, open atmosphere, with the freedom of ‘roaming around’ and exploring what was on display, and discussing possibilities and concerns with fellow farmers, with the experts/researchers, and with the PTD teams.

3.3.3. Local innovators

Local innovators are those who are known in the community as experimenters and persons ready to try out new

Photos 4.1 to 4.5. Technology scientists presenting and discussing their innovations with men and women farmers in various settings in Honam and Merek technology fairs.

options. These people develop new ways of doing things. They try out, on their own initiative, new crop varieties, management practices and breeds of animals. They are generally quicker to perceive new opportunities (Noroozi *et al*. 2008). These local innovators or experimenters are different from so-called 'progressive farmers', who adopt introduced technologies because they have ample resources, intensive contact with extension agents, and easy access to other external resources and services.

Four farmers who had innovatively developed multiple annual reproduction of goats and sheep were approached in Honam district for the autumn fair. One of the research centre experts involved in the identification of local innovators at the start of the CP projects, introduced several of these innovators to the PTD team. The team members visited them several times and invited them to the fair. Unfortunately, inadequate visual representation of their technology resulted in little interest in their work.

3.3.4. The fair proceedings

For the autumn fairs, around 70 farmers from the four project villages of Kermanshah Province met in a mosque in Nojoob village in October 2007. The farmers who attended were mostly from the weaker sections of the local communities, most of whom had usually not been involved in previous events and activities. In Kermanshah Province, more than 110 farmers and other community members participated in the Honam technology fair, held in Upper Peresk village.

As the spring technology fairs in late 2007 were held in all the villages separately, the local people had more flexibility and ease to spend time at the fair location, with the added value that the women could also attend the fair.

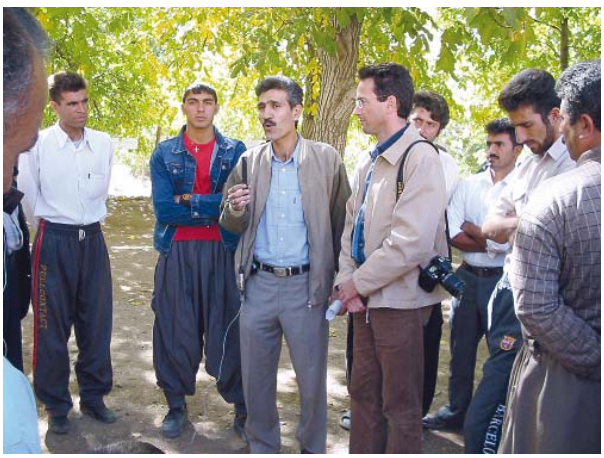
The various technologies were discussed orally by the experts, or presented together with posters, photos, videos and samples, or even using a Powerpoint presentation. The farmers were then free to walk around, discuss their specific questions and doubts with the experts and with other farmers, and finally to decide whether they wanted to experiment with any of the technologies. In all the technology fairs, it was stressed that volunteering for a technology did not necessarily guarantee involvement in the experimentation of that particular technology. It was explained that the technology groups would be formed through a participatory screening process based on preferences and priorities of the farmers, availability of the material required for the technologies and consensus amongst all parties regarding the commitments, sharing of costs and responsibilities.

3.3.5. General observations regarding the fairs

- The difference in experts' attitudes and communication approaches with farmers during the fair was very visible. Although all experts had shown a certain level of co-operation by getting involved in the technology search and presentation process, their attitudes ranged from enthusiasm over curiosity, to tolerance and indifference, and the speed and scope of the interaction each attitude and approach generated was very visible for observers.

Box 4.1. Clarification of the volunteering 'procedures'

In the Upper Peresk fair, a banner was put up stating some of the considerations to be noted when volunteering, which included:
- Using a technology will be on an experimentation basis;
- All stages of the experiment will be implemented in close co-operation with the relevant researcher and the facilitating team;
- Working groups will be formed for each technology based on the level of interest shown by the farmers;
- The main costs of implementing a technology will have to be covered by the volunteering farmer.



Photos 4.6 to 4.8. Farmers examining the innovations on display, then taking note of clarifications presented by PTD teams on the implications of volunteering, and finally enrolling as volunteers for technology experimentation.

Photo 4.9. Farmers weighing, amongst themselves and with the PTD team members, the pros and cons of the innovations after the scientists' presentations.

- This applies also to their presentations. Generally speaking, a combination of visual presentations, realistic discussions on possible outcomes and obstacles, and genuine seeking of, and patient listening to farmers' personal and local experiences, arguments and apprehensions proved to provide a very conducive environment for mutual understanding and joint learning.
- The informality of the Lorestan autumn and spring fairs created a relaxed atmosphere. There were no formal large group presentations, but rather, fair-like discussions and explanations for any visiting farmer. This was perhaps more difficult to handle for the experts but also more leveling for the relationship between experts and farmers.
- The fairs also seemed to bring together again 'old friends'. This could encourage the possibility of bringing experts of different technologies together on local needs.
- The agriculture service centers played an important role in facilitating farmers' access to seeds, tools and

Box 4.2. Impact of previous familiarity with the process

One of the influential driving factors for the Honam fairs was the familiarity of the head of the research institute with the nature of a technology fair within a participatory process. He and one of the experts had been part of an exposure visit to ICARDA headquarters in Aleppo, Syria and had witnessed a technology fair organized for local Syrian farmers.

equipment. In both project areas, the centers' personnel were very co-operative. However, it is important that anyone who is going to be part of the proceedings should be briefed on some of the 'dos' and 'don'ts'. For example, an agriculture service center might have come to see it as a normal practice to generate interest amongst farmers by mentioning subsidized inputs and services the center can provide. However, this could have a reverse effect on a process that is aiming to diminish the dependency of farmers on external resources. Meetings were arranged before and after the fairs to finalize agreements on the technology fair and its follow-up activities.

Photo 4.10. Farmers contemplating registering as volunteers for the shallot experiment.

Positives / encouraging notes	Weaknesses / noteworthy reminders
Kermanshah	
• Normally the stronger farmers and those closer and more accessible would attend such gatherings, but this fair was actually attended by those more remote from the centres. • It was good that the farmers were able to split up into smaller groups after the initial general presentations. The two-way discussions were much more informative.	• The fair should have been held earlier. Some of the farmers seemed to have already started cultivating. • Mere oral transfer of information does not seem to be adequate. • We've got to think of ways to encourage the farmers' participation so as to compensate for the eliminated material incentives. • We've got to identify the farmer innovators and have them represented in the fair. • We have to adapt the selection and presentation of technologies to the needs and priorities of the farmers. • The experts should also mention the required equipment and input for each technology. • It is important that the experts are accessible to the farmers.

Positives / encouraging notes	Weaknesses / noteworthy reminders
Lorestan	
• Some mutual trust seems to have been generated in the area, and this needs to be maintained and strengthened. • Staff and colleagues in the province are showing interest and motivation. • A forum has developed for the various staff to interact with each other. • The fairs were very much in line with the nature of the work and its objectives	• There needs to be a reassessment of the technologies presented based on the conditions of the area. • More training on the methodology and approach is required. • Overall, too little time is spent in the community by the experts. • How can we get feedback from the farmers? • The farmers were not a homogeneous group regarding their response to the presented technologies. • The range of technologies offered could have been more diverse. There are colleagues who have some good ideas and are in fact thinking along the line of this approach. • The local innovators could have been more involved in the fair.

3.3.6. Experts' evaluations and apprehensions after the fairs

Informal evaluation sessions were held with the respective experts of each fair after the events, and they were asked for their assessment of the program and any ideas or reservations they might envisage for the process. For example, these are some of their comments after the autumn technology fairs:

3.3.7. Final selection of innovations and technologies for experimentation

Of the 27 technologies and innovations on display and 'on offer' throughout the autumn and spring fairs of 2006 and 2007, 485 men and women farmers from Honam and Merek volunteered to experiment with 26 of them. Experiments were implemented for only 16 of these, however. The other ten were abandoned, at least for this particular project, for a variety of reasons, including:

- The innovation being replaced with another one on the farmers' own initiative (e.g. replacing sugar beet with potato rather than improving techniques for its cultivation);
- Missing the appropriate time for implementation (e.g. planting fruit trees on slopes);
- Failure to coordinate with the respective outsider scientist or local innovator (e.g. enriching hay, and cultivating potatoes in barrels); or
- Loss of interest of volunteering farmers after details of the innovation or technology made clearer in subsequent meetings after the fairs.

Both autumn chickpea and Azetobacter fertilizer were ideas that had been tried out the two previous seasons. It was agreed that they would be repeated again this season, but with a more participatory mode of identifying experimenting farmers and experiment management and evaluation.

It was only after 'improved techniques for sugar beet cultivation' was presented in the autumn fair of 2007 that the farmers reacted by claiming that their problem with sugar beet was less one of yield, but rather one of dealing with the lack of co-operation and fair treatment of companies and stores that were mandated to receive their production. This is where discussions led to the proposal, from the farmers, of trying out potato cultivation instead of sugar beet for the first time in the region.

Technologies that specifically targeted women were growing mushrooms and handicraft training in Kermanshah, and growing thyme, saffron and shallot in Lorestan. This said, a technology like walnut tree blight control was one for which the men volunteered, but as the experimentation process progressed, the women got more and more involved, and this was ultimately evident in the evaluation session, which was more or less actively dominated by women.

3.3.8. Who volunteered? Who experimented?

After the technology fairs conducted in Lorestan and Kermanshah, the PTD teams undertook a 'participatory screening' of experiment volunteers - farmers who had opted to try out one of the offered

Table 4.1. The technologies and innovations selected by farmers for experimentation.

	Technology / innovation	No. of volunteers	Selected but not implemented *
Autumn			
	Kermanshah		
1	New wheat and barley varieties	8	
2	Improved techniques for sugar beet cultivation	11	*
3	Autumn chickpea cultivation	3	
4	Azetobacter inoculants on wheat/barley	10	
	Lorestan		
5	Vetch fodder plants	41	
6	Growing shallots on private plain land	39	
7	Simultaneous wheat pesticide application	8	
8	Chemical and biological fertilizers	-	
9	Walnut tree blight control	7	
Spring			
	Lorestan		
10	Enriching quality of hay using urea fertilizer	11	*
11	Thyme cultivation	16	
12	Prescribing phosphor chemical dosages based on soil tests	1	
13	Liquid inoculation of beans (*Rhizobium legominozarum*)	3	
14	Liquid inoculation of chickpeas (rhizo-chickpea)	16	
15	Adapting saffron cultivation to local conditions	23	
16	Rainfed planting of grape and almond trees on slopes	18	*
17	Cultivation of potatoes in barrels (local innovation)	29	*
18	Vegetative propagation of trees through buds	29	*
19	Using animal fat for compost	1	*
20	Production of dye plants	3	*
21	Cross breeding local goats with foreign breeds in order to increase milk production	17	*
22	Double-queen bee keeping	3	
	Kermanshah		
23	Replacing sugar beet with potato cultivation	8	
24	Growing mushrooms	35	
25	Planting poplar trees around farm land	40	
26	Handicraft training (sewing, carpet weaving, etc)	95	*

Table 4.2. Main expected impact of the selected technologies.

Technology	Main anticipated change or expected impact
Potato cultivation (as a substitute for sugar beet)	Better marketing compared to the current sugar beet situation which frequently faces difficulties when delivering to companies that are mandated to purchase farmers' products; new and more optimal irrigation methods introduced
Azetobacter inoculant for wheat and barley	Low-cost, easy-to-apply, non-chemical input which can improve yield and soil quality without requiring major changes in farmers' practice
Autumn chickpea	Improve yield and soil quality compared to spring chickpea varieties; more sparing on water resources
Prescribing phosphor chemical dosages based on soil tests	Based on soil tests to make application of chemicals more conservative and more purposeful
Liquid inoculants for chickpea (rhizo-chickpea)	Improve the quality of existing chickpea cultivation
Liquid inoculants for beans (Rhizobium legominozarum)	Improve the quality of existing bean cultivation
Walnut trees pest management/blight control	Better awareness amongst farmers on types of diseases and methods for managing them
Simultaneous wheat pesticide application	More effective pest control, pests cannot escape to neighboring untreated fields
Mushroom growing	Side income for households, with accessible and affordable material
Growing shallot on private plain land	Legalizing a highly popular and profitable illegal activity by cultivation on farms
Adapting saffron cultivation to local conditions	Reestablishing an old and profitable farm enterprise
Vetch fodder plants	Efficient nutrition for livestock which is less taxing on natural resources
Double-queen bee keeping Planting poplar trees	Increasing value of ongoing economic activity Long-term replacement of existing trees with one that is taller, and of higher economic value
New wheat and barley varieties	More drought tolerant
Thyme cultivation	Potentially profitable medicinal plant that could be suitable to the area's ecology

technology options introduced during the technology fairs. Before the actual implementation of the experiments, the teams visited the farmers who had opted for the technologies in order to emphasize the trial nature of the work, and the possibility of a poor outcome of the experiment. These discussions generated more transparency regarding what could be expected as outputs and outcomes of the experiments, and gave the farmers the chance to re-assess their choice and either pull out or reconfirm their decision to participate.

For this reason, it was natural for the number of farmers volunteering initially to be different to the actual number of farmers experimenting. At the same time, other farmers who were not present at the fairs still had the chance to join the process before the implementation of the experiments.

3.3.8. Expected outcome of technologies and innovations implemented in the project

Technologies and innovations presented to farmers, and subsequently selected for experimentation, will either improve or substitute for existing options and methods. It is important for the different stakeholders involved to have a clear and common understanding of the anticipated advantages and expected outcomes of each of the innovations and experiments (Bellon 2001). The expected outcome of implementing technologies selected by the farmers for experimentation in this particular project is shown in the Table 4.2.

Chapter 4.

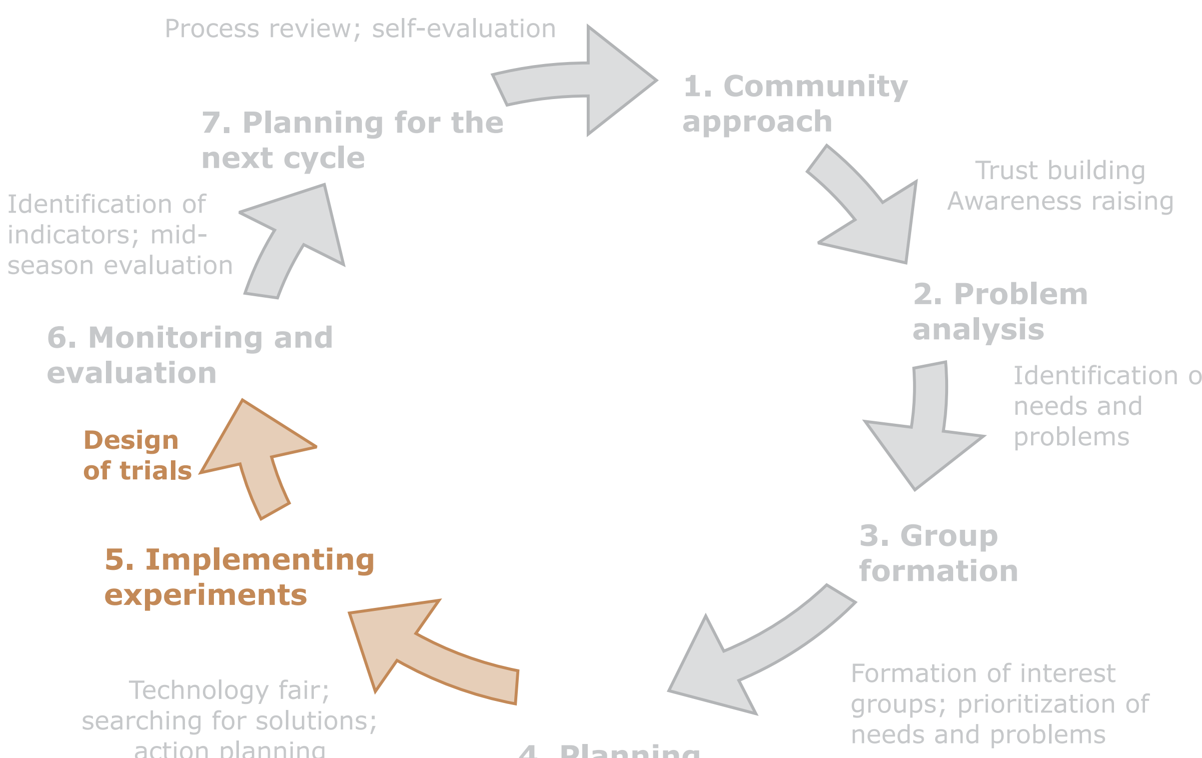
Experimentation Process

4. Experimentation Process

4.1. Introduction

Farmers have traditionally been experimenting, innovating and adapting new ways of farming on their own initiative, and have been observing and learning from the experience (Johnson 1972; Richards 1985; Rhoades 1987; 1989). It is not only with the introduction of new technologies from outside that farmers are exposed to experiments. For generations, farmers have carried out, in their own particular way, experiments in almost all aspects of farming: crop and livestock breed selection; animal feeding and care; crop protection; fertilization and other cultural practices in cropping; or the processing and storage of crop and livestock products. Their reasons could be (Rhoades and Bebbington 1991): "*Curiosity with respect to an idea that comes to mind; finding solutions for pressing problems; or adapting technologies to local conditions and to farmers' specific interests and preferences*". Experimenting with new ideas is, therefore, a farmers' way of adapting their practices to the surrounding conditions, and consequently making their livelihood more resilient in the face of uncertainty and change.

When farmers work with researchers and facilitating teams as colleagues, what is shared, in a collaborative and interactive mode, are not so much packages and precepts, but rather, choices of breeds, material and equipment, and of practices,



methods and principles. When farmers work with, learn and adopt new methods and principles, they can apply the principles in a variety of locally adapted ways.

Many methodological issues arise as a consequence of this collaboration. One problem is enabling farmers to 'own' their experiments, and not to be dominated by outsiders.
Enhancing farmers' capacity to take active part in farmer-designed and farmer-managed trials is a vital aspect of participatory on-farm research. Research organizations, development projects and NGOs are also involved in agricultural research, whether on-station or on-farm. They often claim to work in a participatory manner with farmers but farmers' participation is often limited to providing land and labor or commenting on trial results. All too often, the process is designed and controlled by outsiders, and effectiveness of technologies is based on their criteria – which are primarily technical.

Farmers' experimentation, other than being a technical and economic process, is a process of appropriation (making it one's own), by transforming the technologies coming from outside the community and harmonizing them with the local culture. Farmers' experimentation is closely related to the cultural concepts and values of their social group: their ways of thinking and communicating, their relationship to nature, and the norms that shape their lives. Long-term experience with their farms plays an important role in this process. Changes that have been embraced and internalized in farming communities, especially among weaker farmers, are those that have shown and maintained a certain level of coherence with the various dimensions of local life and livelihood. Therefore, farmers'

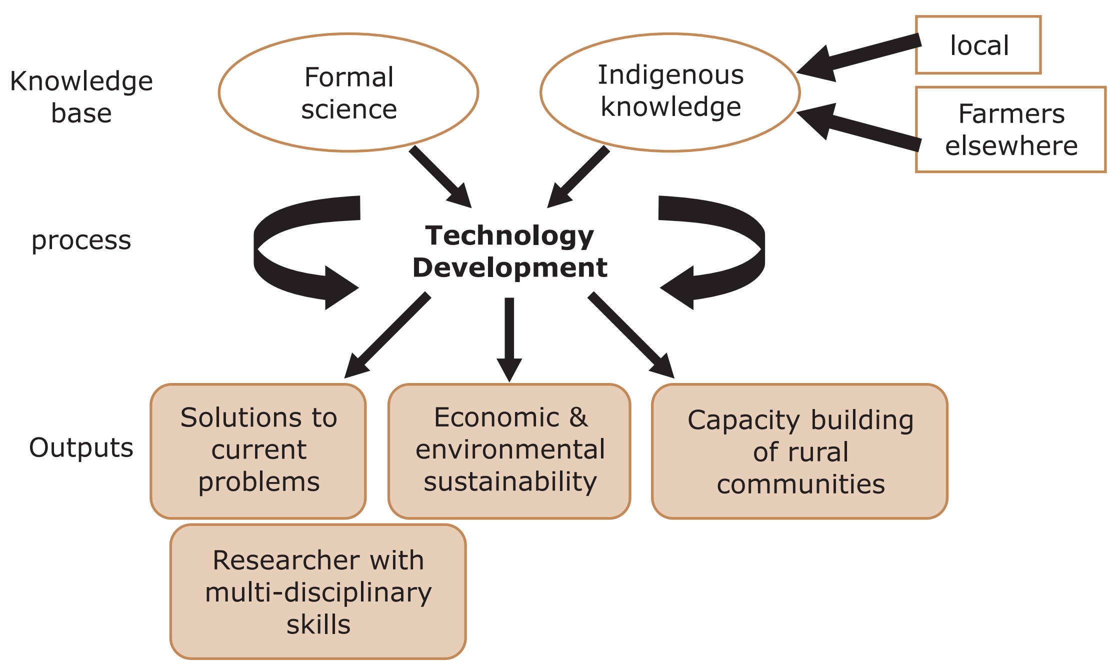


Figure 5.1. Inputs and outputs of PTD. Source: J. Anthofer, pers. comm.

assessment of new ideas is, by nature and necessity, more holistic than that of outsiders.

4.2. Experimentation in PTD

PTD gives priority to farmers' experimentation, which refers to "*experiments that are defined, controlled, implemented and assessed by the farmers themselves, using their own inputs and doing their own observation and recording*" (van Veldhuizen *et al*. 1997).

Supporting farmers' experimentation through a PTD process is vital when technologies specific to certain sites or farming systems are being sought. This process can lead to appropriate technologies, and also to increased capacity to innovate, both among farmers and scientists/researchers.

PTD is primarily aimed at stimulating the generation of local knowledge and reinforcing local capacities to develop sustainable farming systems. Facilitators encourage farmers and farm communities to analyze how they carry out experiments, to relate this to their way of life (their culture), and to recognize the value of their own experimentation and innovation.

In PTD, the starting point is the farmer with his/her multiple aims and site-specific farm system. It is not assumed that complete packages can be designed by outsiders. The farmers themselves hold the key to developing, evaluating and validating the proposed systems. Whether the new ideas are coming from local innovating farmers or from outside researchers, the farmers willing to take part in the experiments would link up with the experts. This would combine their local knowledge of the conditions and factors affecting technology appropriateness in the local environment with the expert and scientific knowledge of the outsiders on the technical details that could improve the quality and reliability of technologies and innovations.

At any one time, a farmer may be experimenting with a number of incremental and seemingly unrelated options in his or her farm plan and practices, and may ultimately incorporate only a few of them. However, after some years, this may result in major shifts in the farm system and management.

PTD focuses on transforming local experimentation from being relatively ad hoc, unorganized and individual to being more focused, systematic and organized. What takes shape is meant to be a community process of technology development. Methods of small-scale experimentation can be agreed on, which would make it possible to be flexible about mistakes. Much can be learnt about approach and methods from honest accounts of difficulties as well as successes.

Experimental groups can be formed in many ways, depending on the local culture, the farmers' interests, and the working approach of the supporting agency. In general, these groups emerge slowly during the initial diagnostic and planning stages. The outsider helps to make sure that all categories of the population – especially the poorer people – can take an active part in analyzing the situation and looking for things to try out. The facilitator encourages those farmers who wish to try out new options to collaborate in designing and organizing the trials.

On-farm trials carried out within the framework of the Livelihood Resilience Project had been gradually simplified within the introduced PTD approach and became increasingly farmer-managed. The focus of data collection and analysis shifted from comparing many different treatments towards the collection of site-specific parameters affecting the performance of the most promising options selected by farmers compared to the farmers' practice. These data collected on many farmers' fields help to identify bottlenecks of the investigated technologies. Only in later stages of the research process did researcher-managed trials become important again. Therefore, the research direction is being reversed from general to specific research questions (Figure 2.4).

Participatory on-farm research and experimentation:

- Is more than just transferring on-station experimental designs to farmers' fields;
- Has its own research methods to capture the variability found in diverse farming environments (e.g. through adaptability analysis and risk assessment, Milani and Anthofer 2007);
- Focuses more on the identification of factors to explain yield differences rather than on the comparison of many main and sub treatments;
- Uses farmer assessments to overcome bottlenecks instead of convincing farmers.

4.3. Requirements of a PTD Experimentation Process

Apart from changing the experimental designs, there needs to be a redefinition of roles of the principle researchers, field staff and of the farmers themselves. For experiments to become more farmer-managed, the researchers have to compromise on their conventional position as experiment designers and managers and take on a more consultatory or advisor's role, who is accessible to farmers for discussing elements of the technology and experiment, and who is flexible enough to be open to changes in the 'package' of his/her technology. At the same time, the farmer has to be willing to take control of the experiment process. He or she should mitigate their expectation towards the researcher as process 'director' and towards the other outsiders as problem solvers.

For both the farmers and outsiders to adapt themselves to these new roles and this new type of relationship would require a fundamental change in the attitude on both sides. The farmer has to be recognized as a competent partner in negotiations, decisions and assessments. One thing that can affect their attitudes towards themselves, each other and the process, is more and better communication. The facilitators have to ensure that farmers and researchers meet and discuss the experiment regularly.

4.4. Recording and Assessing Experiments

PTD focuses not only on technology development but also on strengthening local capacities to innovate. The monitoring and evaluation activities should cover both of these aspects from the start. The emphasis is to support farmers in their own efforts to record and assess the results of their experiments. This does not exclude the possibility that outsiders collect and record additional data. This may have the dual purpose of (1) helping to verify results of farmers' experiments in discussions with farmers and (2) meeting requirements set by the outsiders' professional organization.

4.4.1. Farmers' criteria

What is most significant is that the whole experiment process be influenced by the farmers' criteria: they will vary between households, depending on the resources controlled and social status but also within households. This means that different household members will evaluate a technology according to different criteria, which are related to their role and functions in the household.

Criteria to assess a specific technology must be made explicit when screening the technical options prior to experimentation, and can be used again when defining what to record and how to assess the results of the experiments.

4.4.2. Training

Ideally, training of farmers on certain technical aspects of a technology or innovation would be planned and designed according to the type of technology and the training requirement of the targeted farmers. The training itself would be done in the field in a farmer field school mode rather than in a classroom session. Examples in this project included the short training that the farmers in Merek received for hygienic preparation of potato tubers before planting, or that one conducted for the mushroom growing experimenters on how to prepare their rooms. In Honam, specific field training was conducted for the experiment on urea fertilizer application based on soil tests.

Apart from these specific training sessions, the technology experts and researchers continuously provided guidance and on-the-spot training as the experiments progressed and as issues arose.

4.4.3. Tests and controls

It is expected of experiments to enable comparisons that can form the basis of assessments and evaluations. For each new option to be tested, there needs to be a control for comparison.
In this PTD project, the farmers had control plots next to plots where a new technology was tested, e.g. Azetobacter was applied to wheat as the test treatment with untreated wheat as control plot. Likewise, untreated trees served as control next to trees treated for walnut blights. The controls for some of the other technologies did not adhere so much to conventional 'standards'.
For autumn chickpea, the control with which the farmers could compare their findings from the experiment was the farmers' own practice of local chickpea varieties cultivated in spring. For potato cultivation, the control was the yield and market performance of sugar beet from previous years, because ultimately this was the crop it was meant to replace in that area. For mushroom and saffron growing, the control was the fiscal or even non-fiscal cost of the opportunity if they had not implemented these ideas.

Having a control allows the farmer to draw conclusions on the effect of the technology: on their farming system, the relevance of the idea to local needs and conditions, the socio-acceptance, economic viability, environmental friendliness, and also sustainability of the new idea based on his or her own priorities and criteria. Reaching reliable conclusions may take more than one season. Therefore, it is preferable to continue experiments over several seasons, which would allow an examination of the technology under different weather conditions and under a varying economic environment where prices could change.

4.4.4. Cross-visits

Conventional 'field days' are often used to promote ready technologies for dissemination, where the main actors are researchers and extension workers trying to explain 'their' technologies. Participating farmers are often the more advanced and connected ones and are hardly representative of the whole farming community. They would remain rather passive recipients of information (Rogers 2003).

Such classic field days with the aim to promote readily available technologies shift, in a PTD process, towards farmer-to-farmer cross visits, where the research team facilitates open discussions among farmers and where technologies are viewed as options rather than final solutions. Within the PTD process, farmer

Photo 5.1. A typical cross-visit involving farmer-experimenters, the technology scientist and PTD team for potato cultivation in Merek.

cross visits have a double function: (1) to have a critical feedback from average farmers which is taken seriously and may affect further experimentation; (2) to provide the basis for outscaling successful technologies to other farmers and farming communities.

The cross visits organized and facilitated throughout this project were co-hosted by the experimenting farmers. The technical expert was no longer the *only* resource person regarding the technology. Interaction amongst the farmers was relaxed and informal. Experimenting farmers would relate the technology to the local context in very familiar discourse. There was ample opportunity for experimenting and non-experimenting farmers to raise issues related to the technical and particularly the non-technical aspects of the technology. There was no pressure to be 'convinced' on the technologies. It was possible to observe changes in the behavior of both experts and farmers, for example:

- More frequent visits of the experts to the field. The technology experts had anticipated a few visits to the field based on their knowledge of the anticipated process, but many of them were encouraged to meet the farmer-experimenters more frequently after experiencing the interaction and the emergence of unanticipated issues in the first couple of cross-visits.
- Increased excitement of experts to see the outcome of their technology after becoming more aware of the interrelations of technical and contextual aspects of the experiment. Many of the experts involved in the PTD experiments in Lorestan and Kermanshah openly expressed their excitement at discovering new possibilities and being faced with new questions (shallot, potato, mushroom).
- Gradual shift from an expert-to-farmer guiding of experiments to a more two-way dialogue on changes observed and problems perceived (potato, autumn chickpea, mushroom, blight control).
- More interaction amongst the farmers themselves rather than

merely expecting instructions from the expert. More and more, the expert became one actor and participant in group discussions and critical assessments where farmers would address each other on the comparative advantages and disadvantages of each of their experiments (potato, autumn chickpea). In some cases, there was even advice from experimenting farmers to experts on modifications to better adapt the technology to the local conditions (shallot). This could lead to the expert increasingly respecting the farmer as a source of valuable knowledge.

- Leveling of the power relations between expert and farmer and generation of a sense of empathy towards the farmers, as the expert witnessed the effort put in by the farmers despite limited resources, as well as the effect of factors out of the farmer's control (mushroom, potato). At least, the experts were less indifferent to farmers' constraints and concerns. This could change a common perception that non-adoption or ineffectiveness of technologies is due to farmers' ignorance.
- Experts compromising on their 'all or nothing' attitude towards the requirements for implementing the technology, and entering a joint learning process with the farmer on modifications that considers the farmer's conditions. Even experts who had been working on their technologies for many years were more willing to listen to proposed changes (potato, autumn chickpea).
- Other local people participating in the cross visits as the relevance of the topic of the experiment becomes clearer to them. For the walnut blight experiment, there were, with each cross visit, more women taking part and questioning the expert, even though it was the men who had volunteered for the experiment. It became apparent that women were more involved in walnuts than men. So there was evidence that the cross visits and the experiment process were open enough to accommodate new participants. Around 100 farmers were invited to the harvest day for autumn chickpea, providing an open setting for reflection of non-experimenting farmers on the experimenters' experience.
- Although this particular project had not been able to form interest groups on the technologies before the start of the experiments, the cross visits did facilitate an almost natural formation of interest groups (potato, autumn chickpea, mushroom, blight control, simultaneous application of wheat pesticide).

(See Appendix 2 for PTD characteristics of the experiments.)

Chapter 5.

Technology Evaluations

5. Technology Evaluations

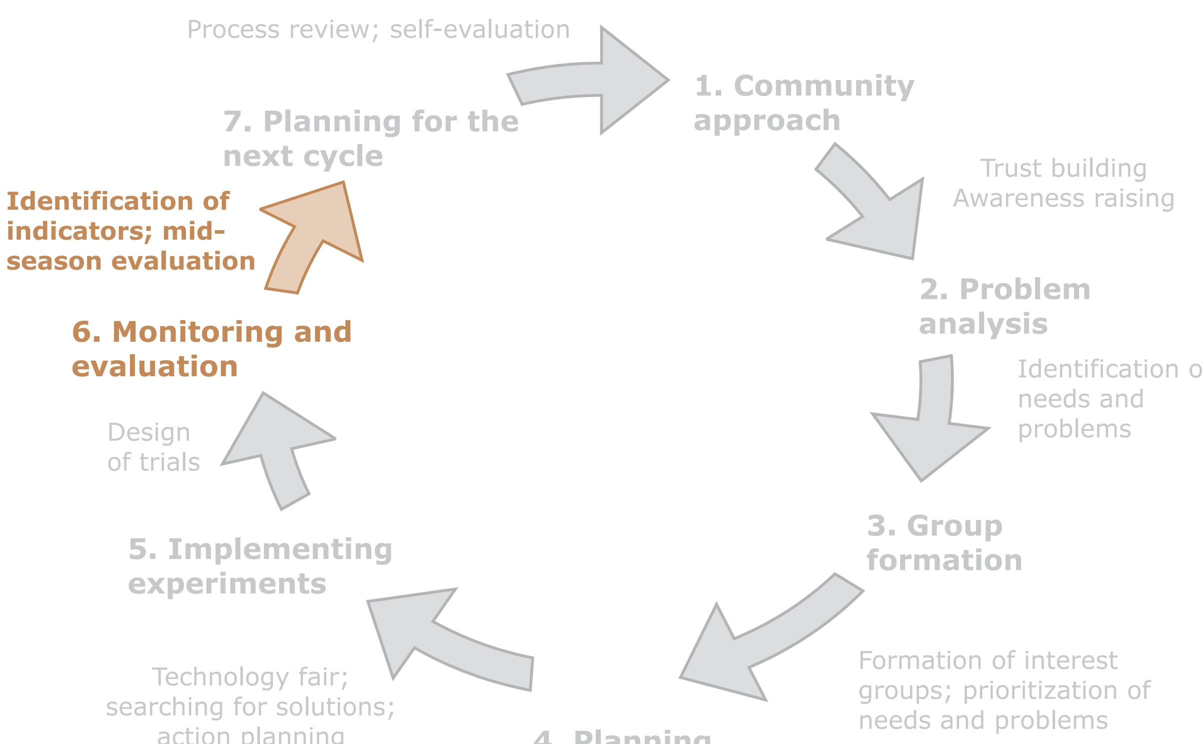
5.1. Introduction

In participatory approaches, evaluation is not done by scientists, but is based on farmers' views and perceptions. Hence there is a shift from external to self evaluation. There will also be differences in the evaluations of different farmers. Each will have their own preferences, resources, and constraints, and will therefore have a unique individual perception of the balance between the positive and negative traits of an innovation or technology.

5.2. The Evaluation Process

A combination of methodologies was used for the evaluation of the technology experiments in this project. For technologies such as autumn chickpea, walnut blight control, wheat sunn pest management and Azetobacter bio-fertilizer inoculants, the corresponding scientists and researchers carried out conventional quantitative experiments to compare parameters like yield, changes in soil quality, and changes in the extent of infection. Some of these are briefly mentioned in the evaluation results of the technologies below.

On the other hand, the participatory evaluation process, which was carried out for all the experiments, was designed to give farmers the chance to reflect upon their experiment, together with the respective scientist and the PTD team: the preparation, implementation and



harvest stages; comparative strengths and weaknesses; farmers' suggestions and recommendations; and the scientists' responses to some of the ambiguities. Different visualization tools (color cards, flip charts, etc.) were used.

It was anticipated that this process would provide the farmers a chance to critically review the experimentation process, raise questions, discuss possibilities for change and modification, assess constraints and finally come to a conclusion on whether the technology can have an impact on improving their livelihood or not. Although the PTD teams had planned a procedure for the participatory evaluations of the experiments, these were open to changes (e.g. Box 6.1). Each of the actual evaluation sessions were later assessed within the PTD teams.

Evaluation of the experiment process and results can be carried out in more than one stage and session. Apart from the fact that it would allow all experimenters to provide and contribute their assessment at a time and place which is convenient to their living and working conditions, it would also allow ideas like replacing sugar beet with potato to be evaluated more holistically, rather than be overshadowed totally by something like price fluctuations and uncertainties.

It is also possible, as was shown for the Azetobacter trials, to apply other forms of assessments and analyses when comparing an introduced technology with the farmers' practice under farmers' management (Milani and Anthofer 2007), (Box 6.2).

Box 6.1. Modifying PTD experiments

For example, the three farmers who took part in the double queen bee experiment (producing honey with two queen bees in the same hive) were of the opinion, unlike the expert, that the experiment process could not be divided into the three stages of preparation, implementation and harvest. In the end, the team went along with the farmers' preferred procedure.

Box 6.2. Risk assessment, and adaptability and economic analyses for Azetobacter treatments and farmers' practices

Using data from test and control plots, "*the probability that the yield … falls below a critical level in a randomly chosen environment was calculated*" (risk assessment). "*The risk analysis discovered that regardless of the critical yield of choice, it was always likely to achieve a higher yield with the Azetobacter treatment than with the control*". The data were also used to "*assess the adaptability of the treatment to the productivity level of each farmer's location*" (adaptability analysis). "*The adaptability analysis revealed that yield differences varied among locations and significantly increased with improved productivity levels of the farm site*". The economic analysis was "*based on net returns per treatment, [with] the return and cost factors differing among treatments [being] taken into account. The economic risk of Azetobacter application to be outperformed by the control was 14% and therefore similarly low as the agronomic risk*" (Milani and Anthofer 2007)

5.3. The Nature of Farmers' Evaluations

There is plenty of evidence that the perceived strengths and weaknesses of the experiment process by the farmers can be quite diverse in nature, covering for example, topics such as yield, profitability, workload, social impacts and enhanced capacity. Here, we have tried to cluster the different types of views emerging from all the evaluations and recommendations in each of the two project areas (Honam and Merek), regardless of the positive or negative weight of the view, to see what topics and aspects of life and livelihood the evaluations converge on. This might shed light on the dimensions that are important for the farmers when evaluating a technology. (See Appendix 3 for detailed account of qualitative and available quantitative results of the technology evaluations.)

(Note: The proposed topic heading for each set of views comes at the before each set, in italics, to the right, but it must be emphasized that the headings are suggestions based on the contents of the clusters. Of course, these headings reflect only one way of clustering the views. More significant than the actual headings, is the fact that there are so many dimensions to local people's evaluations and assessments, which once again testify to the holistic and integrated characteristics of local life and livelihood.)

5.3.1. Demands on human resources

- Labor requirements: 'harvest coincides with season of higher labor demand'; 'women and children can help with harvest'; 'planting need only be done once every seven years'; 'planting takes much energy'; 'harvest is costly for household that rely on hired labor'
- Weeding: 'no weeds in field at time of harvest'; 'does not require weeding'; 'a lot of weed on irrigated land'

5.3.2. Demand on water resources

- Requires water when other plants do not
- Only needs one irrigation

5.3.3. Outsiders' behavior and performance

- Technology scientists' attitude and approach: 'scientist invested a lot of time in the visits'; 'scientist was very dedicated'; 'more cross visits should have been organized'; 'technology scientist not present at planting'; 'monitoring after planting was weak'; 'co-operation between technology scientist and PTD team'

5.3.4. Technical adaptability of technology to available resources

- Can be planted on rangeland
- Can be planted with other crops: 'lover can be planted in between planting seasons on irrigated land'; 'first year, when harvest is not significant, crop can be planted with wheat or barley'
- Storage: 'storage period can be long'; 'have to work on storing'

5.3.5. Technical simplicity and flexibility

- Harvest: 'harvest is easy'; 'harvest time is flexible'; 'there is a lot of time for harvesting'
- Implementation: 'not difficult to cultivate'; 'easy to apply'; 'lack of attention of some farmers to scientists' advice'
- Some mistakes irreparable (referring, for example, to purchasing potato seeds from uncertain sources)

5.3.6. Inputs required

- Maintenance: 'the technology does not require much maintenance'
- Provision of equipment: 'provision of planter required'; 'harvest does not require machinery'; 'use a tractor rather than a unimac'
- Access to seeds: 'accessing the seed is difficult'; 'distance from secure sources of seeds'
- Cost of inputs: 'expensive seeds considering farmers' financial base'; 'costs would be high if we bought from open market'
- Pesticide applied a little late

5.3.7. Production aspects

- Improved quality of product: 'shifting from rangeland to plain land has made bulbs bigger'; 'harvested bulbs are fuller this season'; 'quality of production was excellent'; 'treatment plot performed 50% better than control'; 'height of crop 5cm taller than control'; 'better growth of bushes'; 'useful for wheat'
- Healthier products: 'has no infections'; 'not infected'
- Less losses: 'seed loss was much less'
- Improved byproducts, e.g. 'treatment had more hay'
- Results of technology and experiment more significant for particular crops and under particular circumstances and conditions, e.g. for rainfed, for barley and for rainfall year; 'growth was so good for rainfed barley that people thought it was irrigated'
- Proper harvest only starts second season, therefore difficult to judge after one season
- Insects that were hazardous to the compost
- Hazards for farmers: 'one of the farmers affected by pesticide due to not wearing a mask'; 'risk of contamination'

5.3.8. Added value for household economy – new source of livelihood

- New source of livelihood that can help household economy: 'satisfied to have source of livelihood'; 'helps household economy'
- Substitute for other crops: 'good substitute for clover because it is rainfed and we have no irrigation'; 'can replace beans'

5.3.9. Economic value and issues

- Market and price: 'good market demand and price'; 'fluctuating prices'; 'no guaranteed purchase'; 'difficulty in selling the product'; 'no guarantee we can sell products'; 'weak market in region'
- Profitable, or more profitable compared to existing crops ('more profitable than wheat, barley and red beans'); satisfied with income
- Not possible to plant in 2 consecutive years
- Will take a few years to become economically viable
- Not suitable for tenant farmers because harvest takes four years
- Better quality meant less problems in handing over to stores

5.3.10. Skills/knowledge/training/ insights gained

- Effectiveness of dissemination of information regarding the technology: 'information dissemination was very effective'; 'we are more aware of wheat diseases and how to combat them'; 'should have provided us with training CD'; 'farmers should be informed on application via local media'
- Personal and even unique learning and practice of farmers: 'farmers did not adhere to one method of planting, plowing, irrigation or weeding'; 'night irrigation increases yield'; 'bush does not get damaged when trampled on

by livestock, in fact, the bushes grow more'; 'after certain level of growth when plant is firmly based, leaves and branches can be cut and this will help the bulb'; 'should not be planted on northern skirts of mountains – inadequate sunlight'; 'harvest should be stored in shade'; '2 or 3 times irrigation can help'

- Impact of farmer-to-farmer interaction: 'by visiting each other's plots, we understood problems and weaknesses better'
- New methods, e.g. recommended use of sprinkler irrigation; 'processing method taught was very intricate'
- Training needs, e.g. 'need training on methods of hedgehog control'

5.3.11. Institutional aspects

- Support from local institutions: 'natural resource department can give us the bulbs it confiscates from illegal collectors (those who collect from public rangeland)'; 'support is required for accessing tools'; 'illegal reputation still puts shadow on activity'; 'not received honest treatment from village co-operatives' department'
- Support from government: 'government's policy to import and set low price has overshadowed the whole experiment'; 'government should provide half-price seeds'; 'support is required for selling product'

5.3.12. Direct benefit for women

- Direct income for women
- A new experience specific to women: 'we learned to do something new'

5.3.13. Added value for household nutrition

- Good for household consumption
- New food at home: 'we learned some new dishes'
- Protein food for family and children

5.3.14. Something new in the community

- First experience in village, and welcomed by local people
- Product sold or offered to neighbors
- Others in the village encouraged to try the idea, e.g. other women willing to try the mushroom experiment

5.3.15. By-products and additional impacts of technology

- Beneficial byproducts: 'is desirable for bees as well'; 'has medicinal characteristics'; 'hay smells better and is better eaten by livestock'; 'at the end of season, leaves and branches can be used as fodder'; 'even green leaves have market'; 'animal fat of livestock feeding on its leaves is tastier'
- More resilience of plants: 'stronger roots, making plant more resilient to cold'; 'the roots spread more'

This clustering provides significant insights into farmers' attitudes towards their life and livelihood.

No matter how high the technical value of a new idea may be, the technology has to be implementable with the resources available to the farmer. The points raised in relation to human resources, adaptability to available resources, demand on natural resources, technical simplicity and flexibility, all show that the farmer realizes that technical and material inputs from outside are at best temporary.

As was evident in the overall picture of the resource and problem identification findings, here too it can be seen that farmers take a very holistic and multi-dimensional approach towards evaluating the potential of new technologies in the farming systems. Looking at the strengths and weaknesses the farmers stated for each of the technologies, it is

Box 6.5. Connection between local people's needs and their evaluations of the experiments.

Local people's analysis of needs and criteria for prioritizing them, as well as problems and possible root causes, addressed many diverse, but at the same time, inter-related topics, including: natural resource constraints and optimization; production and economic advantage; agricultural practices and options for improvement; agricultural inputs; post-harvest and post-production; employment and livelihood opportunities; vocational skills and training; common community resources; the living environment; and individual and family welfare. This holistic outlook was further emphasized in the farmers' evaluations of the technology experiments. Their judgments on technologies revolved around: demand on human resources; demand on water resources; production aspects; technical adaptability to available resources; technical simplicity and flexibility; demand on human resources; skills, training and information acquired; value added to household nutrition; value added to household economy and sources of livelihood; economic value and issues; new learning in the community; outsiders' behavior; direct benefit for women; institutional aspects; and byproducts and additional impacts. The life and livelihood of local communities are complex, diverse and risk-prone (Chambers 1993), and any idea with the aim to improve the local livelihood and environment needs to respond to this reality.

possible to understand their criteria of choice and the key topics they aim to address: food security; employment; income; learning; new experience, etc. Therefore, any technology claiming to be useful for farmers would have to satisfy, not only technical requirements, but also, and usually more importantly, the many other aspects of farmers' criteria and priorities.

Again it can be seen that the different groups in the community, in spite of their socio-economic status and level of well-being and poverty, value non-material criteria as well as material and economic ones. From learning to behavior and quality of interactions to social relationships, men and women farmers look at changes from multiple angles. In contrast to the common view that farmers are less aware or less caring towards their natural environment, this is obviously not the case.

5.4. Did We Actually Manage To Reach The Poorer Farmers?

For each of the technology experiments, the farmers who ultimately participated were classified according to the well-being analyses carried out by the local people themselves in the resource and problem identification stage of the process (see Chapter 3, Table 3.1). This classification makes it possible to assess which of the technologies have been better able to reach the poorer and more marginalized farmers (Table 6.2 shows the socio-economic make-up of the farmer-experimenters for some of the innovations and technologies implemented in this project).

Experiments for Azetobacter, integrated wheat pesticide application, and urea and phosphor fertilizers seem to have attracted mainly the poorer farmers. Walnut blight treatment, shallot, saffron

Table 6.2. Number of farmers experimenting with various technologies stratified according to socio-economic classification.

Technology / innovation	Farmer category			
	Weaker farmers N (%)	**Medium level farmers N (%)**	**Stronger farmers N (%)**	**Total N**
Potato cultivation (as substitute for sugar beet)	3 (13%)	4 (17%)	16 (70%)	23
Azetobacter inoculant for wheat and barley	12 (50%)	6 (24%)	6 (24%)	24
Artificial liquid inoculant for chickpea and beans (rhizo-chickpea and *Rhizobium legominozarum*)	5 (62.5%)	1 (13.5%)	2 (25%)	8
Walnut trees pest management	4 (23.5%)	6 (35.3%)	7 (41.2%)	17
Simultaneous wheat pesticide application	19 (61.3%)	7 (22.6%)	5 (16.1%)	31
Mushroom growing	1 (25%)	1 (25%)	2 (50%)	4
Shallot growing on private plain land	7 (38.9%)	6 (33.3%)	5 (27.8%)	18
Saffron	8 (44.4%)	5 (27.8%)	5 (27.8%)	18
Double queen bee keeping	3 (50%)	2 (33.3%)	1 (12.7%)	6
Planting poplar trees	18 (35.3%)	18 (35.3%)	15 (29.4%)	51
New wheat and barley varieties	1 (12.5%)	6 (75%)	1 (12.5%)	8

Figures in parentheses show N as percentage of total

and mushroom growing, and double queen beehives for honey making, all have an even distribution of farmers involved. Potato cultivation seems to have been dominated by better-off farmers with more resources. However, despite the fact that potato is an irrigated crop, it is still noteworthy that seven farmers from the middle and weaker sections of the community also participated until the end of the experiment.

One important task as a follow-up to this project would be to examine if and why poorer farmers were neglected in the process despite the intention of affording them priority in the experiment groups. Was it because of the nature of the technology or due to the way the process unfolded eventually? Then, the next step would be to address some of the obstacles which might have prevented the poorer farmers from participating.

5.5. Additional Salient Features of the PTD Experiment Processes

Apart from the results of the technology experimentation, many additional features of the PTD experiment processes emerged in the group evaluation sessions.

- When farmers deviate from the experimental protocol agreed with the scientists, additional valuable options or modifications can emerge. It happened with respect to shallot, where the farmers: (1) watered the plots once or twice after spring despite the scientist's view that this was not necessary, and the results were very visible; (2) the farmers had used shallot seeds from the growing bulbs to expand their cultivation, whereas the scientist did not consider seeds as a good source for planting; and (3) the farmers had not adhered to the advised bulb spacing when planting. Modifications of the introduced technologies could also be seen in the saffron, mushroom and potato experiments. Such options could be further investigated, but the fact that the farmers had the chance to decide on their experiment had created this opportunity for comparison and practical learning. Although this approach helps to modify and adapt a technology, it is important to stick to a once agreed research protocol if the experiment is meant to collect quantitative data for scientific analysis.
- It is recommended that any new technology, including pre- and postharvest issues, be tested at a small scale. Even if unexpected shortcomings cannot be corrected, losses can be kept to a minimum, and the learning aspects can still be of value. In that way, it would become clearer what additional measures or modifications would be necessary in order to make the technology feasible and adapted to the specific location. In fact, this is the main reason for insisting on small plots for the experiments, so that the learning aspects can remain a priority.
- The evaluations showed that farmers' incentive for taking part in an experimentation process is, contrary to common opinion, not always immediate financial profit. Yes, economic viability, especially in the long term is very important, but the farmers showed that they are willing to waive immediate profit in return for learning something new which has other advantages besides pure economic ones (e.g. better nutrition)
- Another finding from the evaluations was the expressed needs by the farmers for training on storage, marketing, etc. (1) These articulated needs for training are going to be more relevant than just having training on a pre-determined topic, hence, the training can become more needs-based. (2) The requirements for expanding and sustaining the process would become apparent from the reality of the farmers' experience, rather than being influenced by outside factors.
- The farmers requested that the seeds for saffron cultivation be provided by government agencies at half price. This is a step forward from the common expectation of fully subsidized provision of inputs in Iran.
- In the saffron experiment, some of the farmers had, on their own initiative, taken regular samples and collected very accurate data throughout their experiments, hoping to discuss them with the experts. This shows that farmers are quite capable of very accurate measurements, as long as they understand the necessity for the data.

- We also realized that a perennial crop like shallot may not be suitable for tenant farmers. Tenant farmers who opted for shallot cultivation had no choice but to harvest at the end of the first season, and the produce was of a low quality and quantity. Sometimes, the inherent characteristics of a certain technology automatically exclude some categories of farmers. This once again stresses the need to assess the potential of a technology more holistically. It also shows that there is a need to discuss such obstacles and implications before farmers make their choice for an experiment.
- One of the farmer-experimenters concluded that irrigation of his walnut tree located uphill had washed mud into his shallot plot downside the slope and therefore, hindered growth of shallot. He stated that he would choose a more suitable plot to repeat the cultivation of shallot next season. This only proves that after one season it is very difficult to arrive at an all-round conclusion about any technology. With each experiment, new aspects and factors emerge which will no doubt influence farmers' decisions in the long term. It might, therefore, be recommended to have many replications (farmers) to draw conclusions with this kind of trials and to advise farmers on how and where to set up the experiment. "*In a diverse environment, the difference among locations (farmers) might be higher than among different years*" (Anthofer, pers. comm.).
- The farmers' considerations that they may plant saffron on the mountain skirts and on less fertile land testifies to the possibility of revitalizing redundant local resources. The same could be said for the family who experimented with mushroom growing in their house garage. This also re-emphasizes the importance of resource analyses conducted at the beginning of a PTD process.
- Despite guidance and training from the technology expert in the fair and in the visits, two of the farmers still interpreted the dryness of the leaves as ruined or infected crops, and had either neglected or plowed their test plot. Perhaps we can never have "too many visits". Follow-up after the fairs and initiation of the experiments must cover all technical, attitudinal and social aspects of the process.

5.6. PTD Teams' Insights from the Evaluation Process

Facilitating the farmers' group evaluations for the technology experiments provided the PTD teams with insights into some more of the features of the participatory evaluation processes. Here are some examples.

- In the evaluation session for the chickpea inoculation technology, the farmer's manner of speaking was like someone putting across a new personal experience, rather than someone who felt he had to be accountable to the outsiders and the authorities. The type of participation of farmers in experiments has an impact on the type of interaction they have with the outsiders, and empowered farmers to consider themselves the owners of the process.
- The experimenting farmers were not the only persons participating in the evaluation. Some of their wives and even one of their father-in-laws took part as well. This could be an indication that participation in the process is in no way limited to the people who are directly involved in the experiments. The process can, and usually does, address and

involve the whole household. Also, presence of other family members or other farmers in the evaluations could contribute to the outscaling of a technology.

- It was not expected from the expert to respond to every single query about the technology alone, or to have convincing answers for every question. All those involved were free to take their own conclusions from the meetings and the process.
- The expert's approach and attitude towards the evaluation session was very important. The more open the expert's approach, the more vibrant the discussions can be. Also, when an expert avoids direct insisting on do's and don'ts and instead tries to find parallels with similar cases which are more tangible for the farmers, the discussions tended to become more like a dialogue rather than arguments. Then, the expert's expertise would also be more accepted and respected.
- During the evaluation sessions, farmers' talents, skills and knowledge regarding a particular field of work or technology would emerge, and this would probably not have been possible if the atmosphere was not so informal, flexible or multi-perspective.
- The presence of the expert in the evaluation sessions would allow questions to be raised and answered if possible, and this would complete the learning experience.
- Any part of the overall process could be a point of negotiation between the farmers and outsiders, which could add some value to the process of empowerment of the local community, if only to the extent of instilling the belief in the farmers that procedures can be changed.
- It is possible that the results of an evaluation are not in line with the outsiders' expectations. For example, for the double queen bee experiment, the outsiders were expecting drought to have overshadowed the potential impacts of the technology, but the farmers insisted that this year's yield and quality was one of the better seasons. Where discussions over a topic of disagreement converges on mutual understanding, and even consensus and possible corrective action, the process gains much in terms of group synergy.
- There were instances when towards the end of an evaluation session, an expert would admit to having learned something from the experience of the farmers, which he would consider in future research. For shallot, the expert had not advised on irrigating after the rainy season in spring, but the farmers had watered the plots a couple of times, resulting in a visible improvement of the crop.
- Evaluations can be also carried out for trials where the final stage could not be achieved due to external factors (e.g. severe drought does not allow harvest). As the progess of the experiment is just as important as the final outcome, there is much that can be reflected upon other than the results. Upper Peresk farmers had not been able to harvest anything from the Azetobacter trials due to drought, but they still took part in the evaluations.
- Perhaps one of the more positive aspects of the PTD teams was their willingness to coordinate themselves and their work with the time and schedule of the local people. This might have made work more difficult sometimes, but it did ensure more relaxed and less rushed meetings and evaluations.
- If the experts had collected any data from the experiments, these were also presented to the farmers in the evaluation sessions. This could be a step towards reversing the direction of accountability to the local people in the evaluation process.

Chapter 6.

Outscaling

6. Outscaling

6.1. Introduction

The evaluations of the experiments, and of the whole process of participatory technology development, is meant to feed into succeeding cycles of seeking innovations that are relevant to local needs and adapting them to local conditions. This outscaling or spread of the experience gained can take several forms.

6.1.1. Farmer-to-farmer

The cross-visits carried out with the farmer-experimenters throughout the PTD process have been one of the most effective methods of outscaling. Farmers can assess the technologies and the process based on common criteria. They already share much in terms of their lives and livelihoods, and their common understandings and consensuses on a particular technology or a particular way of working and interacting can internalize their new learning. Depending on the purpose, cross visits can address just neighboring farmers in the same village or farmers in different villages in different locations. Extension, therefore, is not top-down, but lateral, from farmer-to-farmer. "*Farmers are often the best extension agents and the best facilitators of analysis, choice and experimentation by other farmers*" (Chambers 1993).

Farmers involved in a first PTD cycle can choose to repeat and improve on the same experiment, aiming to come to more solid conclusions on which to

Box 7.1. The final farmers' meeting in appreciation of their participation

A final farmers' meeting was held in Lorestan to mark the end of this project. All 200 farmer-experimenters as well as many other farmers gathered from the eight villages in both provinces. The first part of the program consisted of the Livelihood Resilience project leader providing an introduction on the process that had been completed, followed by a quick overview of the process in the two provinces by the two provincial PTD team leaders. The second part was a kind of technology fair where farmer-experimenters presented their experience with a specific technology or with the process of technology development and adaptation. The type of presentation was left to the farmers and on request, the PTD teams had prepared sign boards and photos for their stands. The final part of the program consisted of provincial agricultural extension and research directors acknowledging the participatory process and the role of the farmers and experts. An early version of a short film on the PTD process was also shown.

base critical future decisions regarding their agricultural livelihood. They can also apply the methods and principles of participatory experimentation and adaptation of technologies to other parts of their farming systems.

Farmers who had not taken direct part in the initial experiments can use the experience gained by the experimenting farmers as reference for initiating their experiments. Local communities have their own ways of spreading good ideas. The demonstration effect of the experimenting farmers' experience that is visible for all to see should not be underestimated.

The information on the experiments and on the process can reach out to neighboring communities and areas, just like the farmers who volunteered for the potato experiments got the idea from farmers in Hamedan province. Even in this project, there were male and female farmers who approached the PTD teams and enquired about the possibility of taking part in the experiments despite coming from villages outside the project area. Some of them participated in the potato and autumn chickpea trials.

6.1.2. Subsequent technology fairs

In subsequent technology fairs, farmers who had experimented with a technology in collaboration with outsiders, and had reached a certain level of confidence regarding the effectiveness and the conditions required for its implementation, could contribute to the presentation of the technology for new farmers. He or she would be very familiar with many of the doubts and concerns the new farmers might have.

6.1.3. Expert-to-expert

The researchers involved in the PTD process could follow up on insights gained from a new way of working on the adaptability of their technologies and with farmers. They may be willing to apply some of the principles to other sites and experiments and gradually assess the comparative advantages vis-à-vis conventional approaches.

Collective reflection on the various stages of the process with the collaborating scientists can reinforce individual learning and insights. The positive aspects of the process on which the scientists agree can go far in spreading


Photos 7.1 and 7.2. Process reflection workshop with collaborating technology scientists and researchers, and PTD team members (Lorestan, autumn 2006).

a culture of sharing within research centers and organizations, and helping to institutionalize participatory research and practice.

Collaborating experts can also have an influence on other colleagues. It is not only social scientists '*preaching*' to technical people on participatory approaches, but also peer technical researchers testifying to the advantages of adopting a more facilitative and participatory approach to technology development.

6.1.4. Training

It is important to disseminate good training methods, principles and especially the behavior and attitude changes required to better facilitate participatory research and technology development processes. Chambers (1997) emphasizes that three aspects of participatory approaches can continuously complement each other in bringing about change: sharing (with and among local people, between facilitators and the actors involved in the process, and within and between organizations), methods (tools and techniques for participatory analysis and reflection), and behavior and attitude (facilitating and not dominating). These culminate in what he terms 'group-visual synergy'. Participatory training can address all three aspects, and "*seek to create a culture of self-critical awareness and of participation*".

6.1.5. Flyers and films

With the help of the related experts and based on the farmers' evaluations, simple flyers for the technologies were produced. It was decided to keep the language simple and straight forward, to keep the steps clear, and to include the experimenting farmers' perception of the technology.

Other flyers were produced on the PTD process itself, in two languages (Farsi and English), to be handed out to interested people in research institutes and universities. These would provide a general picture on the basic principles, methods and process of PTD. Similar versions were also published in the newsletter of the Rural Research Institute, Tehran, through which the project was coordinated.

Two films on this PTD experience have been produced: one short version concentrating on the perceptions of different individuals who have been involved in the process in various capacities, and another longer version to look in more detail into the various stages of a PTD cycle.

6.1.6. Evidence of outscaling

Technology adoption is usually difficult to assess during the lifetime of a project. Only at a later stage, without the interference of the project and of outsiders, can adoption be reliably measured. Farmers involved in project experimental trials might continue or discard the technology they have tested before. Likewise, farmers attending field days or cross visits, but who were not directly involved in the experimentation process, might decide to apply the new options on their own. Other farmers might adopt certain practices after being convinced from already practicing farmers (Rogers 1983). Although quantitative data are not available at this stage, it is worth mentioning some of the observations which give indications for outscaling and adoption.

For the integrated application of wheat pesticide in Chahar-takhteh, the farmers' plots had boundaries with land of farmers from other villages. Therefore, those farmers were automatically aware of the experiment and consequently curious to learn more about the results. Relevance is perhaps one of the strongest driving forces for adoption.

Also for mushroom growing, other women in the village were closely following the progress of the female experimenters, curious to see what the outcomes will be. The most natural way of outscaling could be to initiate something small with a few farmers, which could be relevant to a wider audience. Then they will naturally become curious about the results.
The farmers suggested that the new technologies be publicly announced on local media. In fact, the farmers might have other ideas for outscaling as well. They would know best what sources most farmers rely on for their information.

Expansion and outscaling must necessarily follow a gradual trend. This would allow for a more secure process of change.

Another option for expansion and outscaling would be for farmers who have had a good experience with a technology to join up with new farmers. Working together could give them a group security, as well as a stronger structure to work with.

There are farmers who are interested in trying out an idea but who, based on the assessment of the expert, lack the basic resources to be able to implement the experiment. It is not easy to neglect these people. It might be possible to support them to acquire the needed resources. It is also possible for the expert to compromise on some of the 'basic rules' of participation in a particular technology. It is also possible that the farmer will persist in trying out the technology with minimal resources, and the results might surprise even the expert. Therefore, we have to be very careful about whom we exclude from a process. We also have to reassess our definition of 'advanced' farmers. Who is more advanced: a well-endowed farmer who has access to almost any kind of resource required for new technology or a resource-poor farmer who is confident enough to try out an idea even with minimal resources? Then it can be asked which one can be a greater source for outscaling and expansion, or which one's conditions are more relevant for the majority of the other farmers.

One of the preconditions for outscaling is to keep the process open and accessible for interested farmers willing to commit to a learning experience. For instance, Yarollah Hemmati is not a resident of any of the four pilot villages, but he persistently requested to be involved in the shallot and saffron experiments, and finally convinced the PTD team.
The evaluation sessions were carried out separately for the experimenting farmers of each village. One alternative, for technologies that had been implemented by farmers from different villages, would have been to conduct the sessions jointly. The diverse conditions of the farmers of different villages could have added an additional dimension to the results and conclusions, and could have revealed some options for later seasons.

6.2. Sustaining the Process and Phasing Out

One of the principle goals of PTD is to strengthen local problem-solving capacities, so that men and women can play their role in developing sustainable agriculture and improving their livelihoods. The implication is that when such capacities have been strengthened, interaction with support agencies may become less intensive and may change its character. This is frequently referred to as "phasing out".

Handing over responsibility to the people directly involved is an important part of working towards farmers' or communities' independence from support organizations and staff. It does, however, require strengthening individual capacities and self-confidence; generating respect among the farmers for their own knowledge; increased analytical skills; increased experimental skills; and skills in interacting and negotiating with outsiders.

On the other hand, it is also important to develop the community's institutional capacity to enable systematically organized and collective sharing, finding effective organizational patterns, and forms of collaboration based on local experiences and possibilities.
Other types of capacities that can be developed for the local community include:

- Strengthening the local information bases;
- Developing horizontal linkages with neighboring farmers and communities;
- Strengthening linkages with support organizations;
- Monitoring the capacity to innovate.

Chapter 7.

Capacity Building for PTD

7. Capacity Building for PTD

7.1. Introduction

The effectiveness of field staff is very important in implementing PTD. Therefore it is crucial to pay particular attention to the formation and systematic development of the PTD facilitating teams, for example, on what basis should the team members be selected – relevant training and education? Facilitation skills? Experience in working with local communities? Good organizational skills? Good communication? Gender balance? Then it is important to plan for an initial training to bring all team members to a relatively similar level regarding participatory approaches, and the role the teams are expected to fulfill.

Of course training and learning are not limited to one initial training session. It is suggested to have training workshops at different stages. Succeeding workshops can cover more advanced topics. This may help the team members reflect in more depth on their experience in the field. The importance of having more than one training session becomes more apparent when team members change over the course of the project. Therefore, orientation and reorientation is constantly required.

The emphasis is on active learning by the participants. Therefore, the learning process might include some focused training and reflection workshops and sessions for the team as well as for

Advanced PTD training for field experimentation

25–28 February 2007 (Kermanshah)

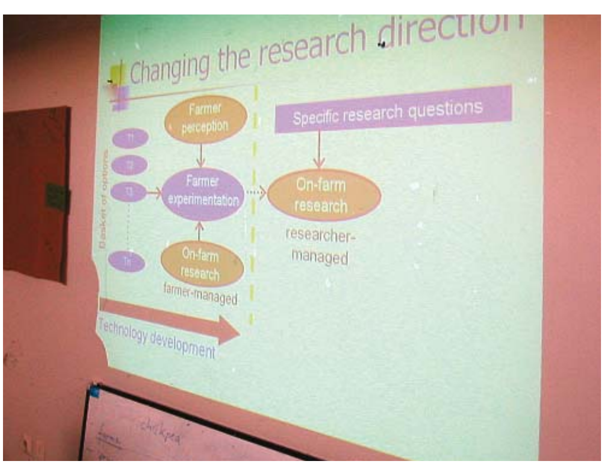
collaborating partners, periods of work in the field, and visits to research and training centers and projects abroad. The idea is to constantly alternate between action and reflection.

It is also important for a team that is meant to facilitate a PTD process to focus more on the ‘P’ rather than on the ‘T’. “*Clarifying the concept of participation and developing relevant attitudes and skills*” (van Veldhuizen *et al*. 1997) forms the basis of facilitating any participatory process. A PTD team should consist of members who are able to enjoy working with local communities, respect their life and practices, and are willing to listen and learn from them. The team should become increasingly sensitive to the delicate dynamics of the local communities.

7.2. Our Process: Team Building and Decentralized Management of Project Activities

The formation of the Tehran team and the two provincial teams in Lorestan and Kermanshah got under way almost as soon as the project had started, and the stages through which this group went had various effects on its development. These are some of the factors we believe had the most influence:

- From the start, the ICARDA PTD expert was eager to build up the capacity of the local group members on participatory research approaches, and to delegate, supportively, as much of the process facilitation to the group members as their attained capacity would allow. This was matched by the group’s acknowledgement and acceptance of him as the team coach and consultant. This mutual recognition fostered mutual trust and respect, as well as a growing confidence in each member’s own ability and that of their team-mates. This in turn generated a healthy and secure atmosphere for critical reflection and collective learning. Moreover, a sense of solidarity and empathy developed in the group.
- The ICARDA expert conducted a four-day workshop on the concepts and methods of PTD, combining theoretical background, group work, field exercises in which the participants tried to practice, and later



Photos 8.1 and 8.2. PTD training workshop for members of the PTD teams.

Box 8.1. The turning point for the provincial PTD teams

The autumn technology fairs in September 2007 were important turning points in the maturing of the provincial PTD teams. They took the initiative in organizing the fairs. After that, the Tehran team members tried to coordinate themselves more and more with the provincial teams, and to hand over more responsibilities to the provincial teams to manage the field activities. As a result, a growing autonomy at local level was observed.

reflect on some of the principles in their interaction with farmers.

- The teams' compositions during the course of the project changed several times for various reasons: disagreements leading to members leaving the team; the necessity of having female members in the teams to be able to communicate with women in the communities; competing field work; the need to temporarily substitute for team members who had to attend to unexpected personal matters; and to respond to gaps and weaknesses such as documentation. At the same time, a few core members in each of the teams stayed until the end, which ensured a decent level of continuity within each group.
- Decision-making on activities throughout the implementation of the PTD project was largely decentralized and participatory, with the process being more and more governed by the provincial teams, taking into account their interaction with the local communities and the experts.
- As the project developed, most of the team members showed a growing desire to be in the field for follow-up on previous activities and to remain accessible to local people. The team members also remained highly motivated, despite organizational

Photo 8.3. Members of the PTD team on a field visit with local farmers in a Syrian village.

Box 8.2. Example of the energy the team invested in coordinating meetings with farmers

"In Honam, the farmers were usually busy until 7 p.m. We had gone to the village a little earlier, hoping to get some film footage, but under the circumstances, we realized it would be difficult to gather the 30 or 40 farmers in one place in time to have a proper evaluation session. So we changed the plan and decided to meet with the experimenting farmers in small groups of five or six, planning each group's session according to their working schedule."

constraints and personal issues and problems.
- The technology experts' accessibility and willingness to collaborate did not come easily. The patient approach of the PTD teams led to the enhanced capacity of the team members to facilitate negotiation processes.
- The fact that local young men and women were approaching the PTD teams to suggest and request their involvement in possible experiments

Box 8.3. The PTD group's internal evaluation and conclusions after the autumn technology fair in 2007

More positive / driving factors
- The provincial PTD teams had gradually familiarized colleagues from the different research departments with the PTD process and as a result, some interest had developed. Despite the experts' general reluctance to expose themselves to a participatory interaction with local people, experts in both provinces were willing to take part in fairs and serve as resource persons for certain technologies although some of these options did not attract any farmers.
- In fact, it could be claimed that the negotiation process between the PTD teams and the experts and the somehow different relationship that started to evolve out of the interaction was one of the important unplanned features and achievements of the technology fairs. It would not be an exaggeration to say that mutual trust and respect had started to develop.
- The fairs were well-organized, especially in Lorestan where the PTD team had mobilized resources and had coordinated with local staff and departments.
- The fair was conducted in an interactive mode, without the experts or any stronger farmers dominating the process. The fair was also open to everybody in the community, avoiding a biased selection of participants. Another contributing factor was the venue: the fair was held in the open air at an easily accessible part of the village.
- Local research staff who were involved at the start of the CP project but who had dropped out for various reasons became involved again through the technology fair.
- The PTD teams were basically involved in one constant process of negotiation for a period of about three weeks – with experts, with farmers, with the people involved in the logistics – and this was invaluable during the next stages.
- The local ties of members of the PTD teams with the rural communities – Mahmood Moradi in Lorestan and Hamid Azizi in Kermanshah – was a very significant facilitating factor, immediately gaining the trust of the farmers towards the program.

Hindering forces
- The presence of additional staff must really be for a specific reason. Also, supporting staff like camera operators should be advised on the type of material that could add value to PTD documentation.
- More time should have been invested in inviting the formerly identified local innovators.
- Although the experience of facilitating a participatory technology fair is in itself very valuable, most of the technologies offered did not have a direct relationship to water resources, which was after all one of the main themes of the CP.

could be a sign of growing trust and interaction between the local communities and the PTD teams.
- The capacity of the teams was built up through formal training workshops on PTD and other topics such as report writing, but also through the alternation of fieldwork and practice, coupled with reflections afterwards; trips to ICARDA headquarters and PTD projects in Aleppo; and increasingly systematic and supervised documentation of activities.

Showing flexibility in the process of facilitating a participatory endeavor is an art: what can be changed and what not? When do you show flexibility and when do you insist on a plan? How do roles change, when changing parts of the program? These are all things that a team matures into gradually, and if there are signs, from a certain point onwards, that the team members ease into variations with minimum internal consultation, then we can be hopeful that the team building process has been successful.

Photo 8.4. PTD team members in the report writing and documentation training workshop, May 2008.

7.3. Documentation

Although the PTD teams had been recording the various aspects of the process from the outset, in the form of short and long report, presentations, and photos and films, a 3-day training workshop on report writing was arranged for the whole team at the start of 2008. After this training, one member of the training team remained with the PTD teams until the end of the project to supervise the documentation activities. During a visit to each of the provinces, he held discussions with the provincial team members and agreed with them on the various types of reports that could be useful for the project.

Although the provincial and Tehran PTD teams were producing reports and presentations from the outset of the project, documentation of the process activities and events became more and more detailed, systematic and frequent after the report writing workshop. The PTD began to produce, on a regular basis:

- Facilitators' reports to reflect upon any short or long visit any one of the team members might have had to the field;
- Experiment progress reports to keep track of what was happening within the farmers' experiments, whether anticipated or not;
- Cross-visit reports;
- Reports of meetings with technology experts or amongst the three PTD teams of Kermanshah, Lorestan and Tehran;
- Monthly reports to gather comprehensively the experience of the team.

The PTD group also managed to produce separate reports on the technology fairs, resource and problem identification and needs assessments, the steps taken to link the needs assessments to the technology fairs, technology flyers to briefly describe the technologies and the farmers' evaluations, and the training workshops.

This current final report owes a very considerable portion of its contents, especially on the process that unfolded and the specific experience of this project in Honam and Merek, to all of these reports.

Chapter 8.

Mainstreaming PTD

8. Mainstreaming PTD

8.1. Introduction; Dimensions of Change in a Participatory Process

Ultimately, participatory approaches have to be embedded, and accepted as professional and operational norms in large organizations. This is probably the biggest challenge facing approaches like PTD.

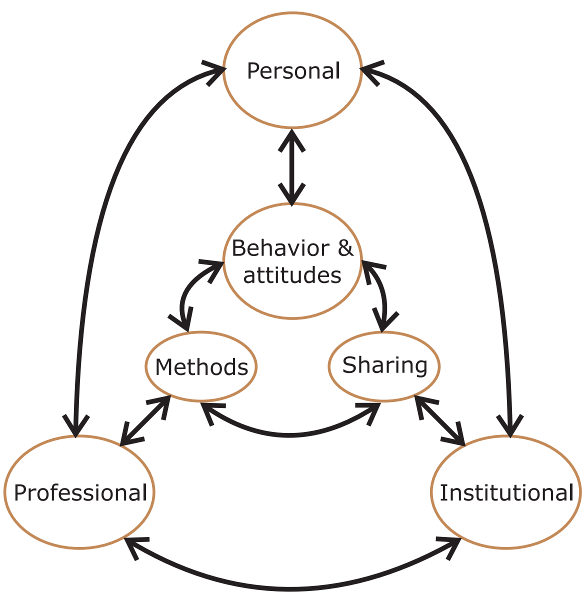


Figure 9.1. Dimensions and linkages of change (Chambers 1997).

The personal and professional dimensions of change in a participatory process can be developed through training, followed by field work and reflection, particularly if repeated several times. Outsiders become increasingly aware and critical of their own attitude and behavior, and can identify areas where change is possible. Working together in teams has the advantage that the team members can provide each other feedback on behavior in the field. Likewise, methods, tools and techniques can be learnt relatively quickly when working in groups.

The two dimensions, however, need to be complemented and completed by institutional changes, where the principle of sharing ought to be embedded as the norms and ethics of participatory research and technology development. This is perhaps the greatest challenge to mainstreaming the PTD approach in research and agricultural development circles.

8.2. Evidence of Change in the Context of Iran

Staff from different departments at different levels had been in touch with and involved in the 3-year lifespan of this PTD project – from field extension staff to provincial technical experts and research directors to research directors in the central research organization of the ministry (AEERO). Many of them have shown a remarkable change of attitude from skepticism to treating the approach and methodology with much more recognition and respect. Perhaps most significantly, the level of authority and decision-making over the process components has been gradually delegated to the local teams. It is now recognized that any follow-up to the project activities and findings would necessarily depend on provincial willingness, proposal, and organizational and administrative support.

The wider implications can be summarized as following:

- The need for more flexibility in

Table 9.1. Hopes and fears for institutionalization.

Hopes …	… and fears
• A marked change of attitude at different management and researcher levels of institutes and organizations from skepticism to treating the approach with respect; • Increasing decision-making autonomy of local teams … any follow-up would depend on provincial willingness, proposal and organizational and administrative support; • Identification of possibilities of linking up various research work.	• Lack of institutional commitment and support for doing this type of work; • Too little value for small, iterative and intangible steps and impacts; • The normal understanding of professionalism as well as the normal structures and procedures are still inhibiting factors; • System still very much centralized.

planning, budgeting and funding;

- Decentralization in decision-making and planning;
- Regular evaluation of activities and impact;
- Redefinition of roles of principal researchers, field staff and farmers;
- Systematic staff development;
- Change in resource allocation.

This shift in perception of government authorities is now, for the first time in Iran, reflected in official statements. Out of the six policy statements that came out of the final Challenge Program meeting in Karaj, Iran, in March 2009, the fourth was reserved exclusively for the outscaling and institutionalization of participatory research approaches based on this PTD experience (see Appendix 4 – policy action).

Discussions have been underway on how the PTD approach and methodology can contribute to a wider scale integrated watershed management system. More significantly, the level of authority and decision-making autonomy has gradually been delegated to the local teams. There is an increasing awareness that any follow-up to the project activities and findings would necessarily depend on a provincial willingness, proposal and organizational and administrative support.

Farmers and resource persons from different government organizations and institutes have been involved in an interactive process of learning and action. There has been a constant dialogue with relevant departments and individuals, which has facilitated inter-disciplinary interaction amongst experts from different departments around local needs and interests. Based on their field experiences, the experts have developed technology flyers with explanations for the farmers (translated versions are presented in Appendix 5). Hopefully, technologies can become more complementary in the future.

8.3. Challenges for the Future

The priority lies with complex, diverse, and risk-prone agriculture, and with evolving and testing approaches and methods, and striving for cost-effectiveness, outscaling and sustainability. At the same time, there is a need for all stakeholders to find and develop new modes of interaction, new methods of analysis, choice, experimenting and evaluation, and new ways of dissemination and institutionalizing existing and new approaches and methods.
There is a need to better utilize the scarce

resources of the extension and research system to look for viable solutions to improve the complex, diverse and risk-prone farming systems of small farmers. Convening farmers' groups; reorienting extension to facilitate farmers' analysis and experimentation and identifying farmers' needs are the new challenges and tasks. Moreover, farmers can be part of the dissemination system by involving them as facilitators. Agricultural scientists also need to learn and understand the priorities of farmers before developing solutions jointly with them.

8.3.1. Agricultural innovation process for integrated watershed management

Integrated watershed management would imply a holistic approach towards the interaction among local livelihoods, agro-ecosystem resilience, agricultural productivity and environmental sustainability. Such an outlook entails the consideration and combination of diverse priorities and the involvement of various stakeholders. To this end, the approaches adopted for the introduction of agricultural innovations and technologies would have to accommodate multi-stakeholder negotiations and collaborations towards identifying and experimenting with viable options that can contribute to gradual, equitable and sustainable change in the existing agricultural systems. At the same time, the wider macro concerns and trends also need to be considered and reflected in the search for solutions. Therefore, the PTD approach has many aspects in common with integrated watershed management. While PTD focuses at the micro-level in working with communities, the integrated watershed management approach considers macro-level issues.

Chapter 9.

Lessons Learnt

9. Lessons Learnt

9.1. Introduction

Participatory approaches and the farmer-first paradigm are still evolving, but some process elements seem to be increasingly supporting each other. One is the potentially synergic combination of enhancing the adaptability of farmers and that of the outsiders, through widening the choices and knowledge of both. "*For farmers, the choices are of practices and plants; for outsiders, of behavior, approaches and methods. For farmers, the adaptability is to uncertain climatic and economic conditions; for outsiders, it is to needs, opportunities and insights as they arise*" (Chambers 1993). Such a process can, with adequate decentralization and delegation of authority to those below, empower farmers to analyze, choose, experiment and evaluate, and empower outsiders to use their initiative and choose methods that are fitting for local conditions.

9.2. Process Orientation and Mmpowerment

The outputs and results of research and development initiatives are always important, especially when they have to do with the lives and livelihoods of people and communities who have limited resources, few choices, and little room for error. However, at least as significant as the end result is the process that unfolds in aiming for the results (see Annex 1 for more detail of some of the process characteristics that emerged as the PTD experiments unfolded in this project). Although achievement of desired objectives can extend benefits to many people, it is also very likely that a process that manages to link with the intended beneficiaries from the early stages and generate conditions conducive to their active participation will have a more empowering and lasting effect on the community. It is through involvement in the process that local people and farmers' ability to analyze, compare, experiment and evaluate can surface and blossom.

If the farmers are actively involved from the outset, then with each progressive stage of the process, their roles can increasingly become central, and the need for outsider facilitation can gradually diminish. Therefore, how much the farmers in any step of the way take the initiative can be an indication of the extent to which they feel at ease with the activity at hand and with the process in general.

Another sign can be how eagerly and patiently the farmers attend and actively contribute to latter meetings, for example, for evaluation. There were instances when the farmer had stated beforehand that he would have to leave the meeting early, or had initially expressed that he or she might not be able to attend the meeting due to other chores they had to attend to, but they came and indulged actively in the discussions, and invariably stayed until the end. The more aware the local people can become of the relevance of the process to their priorities and concerns through increasing participation, the more willing they would be to invest their time and resources, and consequently come to 'own' the initiative.

The experimenting farmers were not the only people involved in the experiment process. In some cases, women would join their experimenting husbands or in one case a father-in-law took part in a farmer's experiment. This could be an indication that participation in the process is in no way limited to the people who are directly involved in the experiments. The process can involve the whole household. This happened with walnut pest management, as well as mushroom growing. Local life and livelihood is socially, culturally, naturally and physically intertwined and this generates natural linkages within and among households. Activities of individuals and groups are of automatic interest to others. Again, the issue of relevance comes up.

9.3. Increasingly Inclusive Participation of Local Communities and the Growing Influence of their Realities on the Process

Throughout the two-year period of the project, the PTD group has been guided by the fundamental belief that seeking and involving the weaker and more marginalized farmers and groups is paramount to any process of development that claims to be participatory and empowering. Their reality should have the highest priority in how the process develops and how it is assessed. There is evidence that we have perhaps been able to reach some of the community members we had been neglecting previously.

Over the first year, we were able to approach and involve some of the farmers who had not been part of previous experiments. The non-involvement of women was also a major concern up to a certain point, after which the team formation, field activities and technology search were modified to facilitate their more active participation. In the second year, wider sections of the communities took part in the needs assessments, including the women and the youth, leading to a more diverse range of technological needs being addressed and technologies being introduced, and to a greater number of experiments.

It can also be claimed that the participation of the farmers has been less motivated by outside incentives and inputs. We agreed that it would be better for the process to work the experiments with fewer farmers and volunteers than to attract more people by providing monetary or material incentives. The group took deliberate steps so that those volunteering would be aware of the experiment costs, and that these would not be fully subsidized, as was previously the normal practice with new ideas and technologies. This did naturally lead to some volunteers withdrawing from the experiments. It did not, however, create any animosity, but it did give rise to optimism that any outputs and outcomes would proceed along a more realistic path of scaling out.

The volunteering farmers – especially the more resource-poor or the often neglected groups like the women of the young – were naturally apprehensive about taking part, and despite their interest, their involvement grew very gradually, but once they realized that they could take the initiative regarding a process of change, then they became committed. It is important to give this gradual building-up of confidence and initiative time to grow. Those who do participate in a new process are actually taking up a large challenge. They are not always supported or encouraged by their surroundings. This challenge can be motivating, but it can also hinder their confidence or motivation. It is important to nurture this motivation.

There are farmers who are interested in trying out an idea but who, based on the assessment of the expert, lack the basic resources to be able to implement the experiment. It is not easy to neglect these people. It might be possible to support them in becoming equipped with the needed resources. It is also possible for the expert to compromise on some of the 'basic rules' of participation in a particular technology.

It is also possible that the farmer insists in trying out the technology with minimal resources, and the results might surprise even the expert. For example, a farmer in Merek was told that the garage space he had considered for growing mushrooms was not suitable. However, he insisted in carrying out the experiment and using blankets and nylons he enclosed his garage and covered the walls to generate the hygienic and humid atmosphere required. The results of his experiment surprised the expert.

We have to be very careful about who we exclude from a process. We also have to reassess our definition of 'advanced' farmers. Who is more advanced? A well-endowed farmer who has access to almost any kind of resource required for new technology? Or a resource-poor farmer who is confident enough to try out an idea even with minimal resources? And which one can be a greater source from outscaling and expansion? Which one's conditions are more relevant for the majority of the other farmers?

9.3.1. The "P" in PTD

Much of the quality of the process and of the empowering effect of the participation of the farmers is influenced by the perception of the outsiders of the concept of participation. There are still researchers and technology experts who consider their technology as the single most important yardstick for the project. If the technology is implemented effectively and then adopted, then they consider the project a success. However, in order to 'qualify' as participatory and effective from a PTD perspective, a process has to, albeit gradually but nevertheless ultimately:

- Enhance farmers' capacity to innovate, to experiment, and to develop their farming system in a sustainable way, and increase their control over resources and decisions affecting their farms;
- Seek and involve the weaker and more marginalized farmers and groups, and enable their reality to have an increasing influence on the process and how it is assessed;
- Be less motivated by outside incentives;
- Foster enough confidence so that even farmers with modest resources can invest in activities that are relevant and one in which they have been a part of *from the early stages*.

9.3.2. Farmers' criteria

Farmers have to weigh many criteria in their daily decision-making. A farmer may decide to take part in a three-day ceremony at his cousin's village rather than transplanting already over-mature rice seedlings, if he feels that maintaining a good relationship with his cousin is, in the long run, more important than obtaining a satisfying rice yield this particular year. PTD practitioners need to be sensitive to the power issues and their implication in such complex socio-cultural settings. Their efforts will be evaluated in part according to the extent to which they help one group or another.

9.3.3. Group-visual methods

The combination of visual and group analysis, realistic discussion of possible outcomes and obstacles, and genuine seeking of farmers' own experiences and priorities can provide a very conducive environment for joint learning and commitment, and this was demonstrated in:

- The involvement of the farmers in all stages of the final season of the project – appraisal and needs assessment, technology selection, experiments, cross-visits and evaluations;
- The informal and open setting of the technology fairs and cross-visits and the freedom with which the visiting farmers could ‘roam around’ and discuss each technology with the researchers and farmer experts and amongst themselves (this was more taxing on the experts but also more leveling for the relationship);
- Revisiting the farmers who had volunteered for the technologies after the fairs in order to achieve transparency on what could and what could not be expected from participating in the experiments;
- The use of participatory tools and techniques.

9.4. Technology Development Process

We compromised on our initial insistence that the technologies be related to issues of water and natural resources, guided by the argument that diverse needs require diverse technologies. We adopted a strategy of seeking options that show potential in terms of adapting to local conditions and needs and contributing to an improved and more resilient livelihood, and to better management of resources.

9.4.1. Demand-Driven and Context-Specific Nature of Technology Selection and Adaptation

The search for potential options was based on separate participatory problem identification and needs assessments in each of the villages. At the same time, these had to be options to which the farmers could relate, and therefore apply and adjust them as they saw fit. The technologies - (technology is intended here to include new ideas and inputs, and existing ones that can be managed and applied differently and that have the potential to adapt to local conditions) - were meant to ‘be simple to understand’, ‘not require changes in major parts of the existing farming system’, and ‘rely on few external inputs and labor resources’.

Over the two years, there have been fifteen technologies for which experiments have been conducted, with the range, diversity and flexibility of the technologies and experiments gradually increasing. More important than the actual technology has been the characteristics of the experiments from a PTD perspective, each of which could be a point for reflection and entry when it comes to working on technological change with local communities. The technologies at this stage could actually be viewed as starting points in a long-term process of analyzing farmer issues and seeking appropriate and relevant options and solutions, with the initiative being handed over more and more to the local people (see Appendix 2 on features from a PTD perspective).

It is important for the experimentation process to invest time in training the basics. Whatever the expert knows and whatever some of the farmers might be familiar with, the process must start on as simple a level as possible, so as not to leave anyone behind.

9.5. Adaptability of the Technology

The adaptability of a technology refers to its flexibility; how it can be modified to fit in with diverse livelihoods and resources in different socio-economic conditions. This is different to the technical quality of a technology and is influenced by other factors as well, such as the variation of the climatic conditions under which the technology can still be effective, the resources and equipment required and how much they can be replaced or substituted for, and the level of expertise required and how easily this is accessible for and transferable to the farmers.

Only when an experimentation process with a technology is allowed to progress with flexibility, is it possible to see what aspects can be modified to better suit the farmers' conditions.

9.6. Continuous Multi-Stakeholder Negotiations and Reflections and their Impact on Professional Behavior

One of the basic aims of this PTD process has been to change the current linear transfer-of-technology approach towards a dynamic triangle of constant interaction between farming communities, technology scientists and researchers, and facilitator teams. This path has not always been smooth, but the converging outlooks and perceptions of the various stakeholders can testify to the process of dialogue and constant reflection facilitated by the PTD teams, which has included approaching researchers about the type of needs explored and assessed with the communities, and the possible technological options that could respond to these needs, discussing, repeatedly, the PTD concepts and messages of farmer-managed experiments, context-specific technology development, and changing roles, and looking back critically at previous activities.

The farmers have eventually been recognized by the experts as legitimate counterparts in the negotiations, decision-making, experiments and evaluations, and this changing attitude towards the farmers' roles has had a visible impact on the level of interaction, rapport and trust they have experienced with the farmers. The experts admitted that they had spent too little time inside the community previously, and were now seeking ways to get feedback from the farmers.

Perhaps one strategy which facilitated this change in behavior was the PTD group's constant reminder that it was not

Box 10.1. The 'milestone' experts' meeting in Lorestan

One specific meeting with the experts in Lorestan was particularly significant, and perhaps symbolic of the developing relationship between the experts and the PTD teams. The meeting started with the PTD team presenting the results of the participatory needs assessments, which was received by the researchers with mixed reactions ranging from supportive to the dismissal of its credibility. People from different disciplines then started presenting different sides to various scenarios, being openly critical but at the same time maintaining an atmosphere of respect. (In fairness to the experts, it has to be said that they were as critical of themselves and their past work as they were of ours.) The meeting continued for three and a half hours, being facilitated more and more by the experts themselves, who ultimately proposed the formation of expert working groups, based on the topics that had emerged from the needs assessments, to draw up lists of possible options for the technology fairs.

the technical credibility or effectiveness of the technologies, but rather, as mentioned before, their adaptability that we were aiming to explore in the PTD process. This probably contributed greatly to the experts' more open and flexible attitude with respect to their particular technology, allowing for a critical approach to the experiments. Experimenting with the *adaptability* of the technologies rather than their technical value was the main reason why the process provided new insights for the experts as well as the farmers. For example, the different management practices for potato cultivation provided new insights for the expert in accordance with the local conditions and constraints, and recognizing this opportunity to learn could have been one reason why the potato expert had moved from a classic detailed PowerPoint extension-mode 'teaching' of his technology to frequent on-field, farmer-responsive discussions on the various aspects of the experiment.

One of the features of the evaluation sessions towards the final stages of the experiments was the ease with which the farmers and experts would talk to each other. A common vocabulary and mutual respect was visible. This had not come automatically or easily. This was the outcome of an interactive and participatory process of working together. Some of the growing features of the farmer-expert relationship were as follows:

- Process of dialogue and constant reflection;
- Converging outlooks and perceptions of the various stakeholders;
- Farmers eventually recognized by the experts as legitimate counterparts

Many researchers fear the loss of control over 'their' trials and data. The institutional set-up and requirements for scientific publication is often counter-productive to applying participatory approaches and taking opportunities to gain new insights.

9.7. Conclusions and What We Might Have Done Differently

9.7.1. What the project would do differently

- We could have tried harder to start some of the activities earlier, such as the needs assessment, the initial negotiations with the technology experts, and the documentation training workshop. We lost a couple of useful ideas because the season had past.
- The presence in the field in the early stages could have been longer and more frequent, as this to better coordination amongst the team members, a better understanding and assessment of local capabilities and constraints, and a more realistic grasp of what to rely on and what not to rely on.
- It might be possible to invest more time in trying to generate more conducive conditions for the implementation of the technologies for farmers who are unable to fulfill the primary resource requirements for participation.
- There could be more deliberate steps taken to form interest groups amongst farmers involved in similar experiments. The exchange and consequent co-learning could improve considerably.
- Some relevant literature references could be selected and translated early on and distributed among team members and collaborating individuals as the project progresses.

9.7.2. Main lessons learned

In most cases, the shift towards participatory research approaches should imply an iterative and gradual modification of the various aspects of the research process, with facilitators on the look-out for entry points and opportunities for instigating change and transferring the initiative to local people.

Despite good intentions, the process of negotiations, reaching mutual understanding and common grounds, and agreeing on methods and criteria for action can be taxing on human resources. The facilitating team would have to consider this in their division of work and support for each other.

Experiments can explore the adaptability of technologies and innovations rather than focusing on their technical value. This could provide a more secure working environment for the researchers and more flexibility regarding possible modifications in adapting the technologies to the local context.

Team selection and team building is definitely an on-going process, and can take many shapes and forms, from the planned training workshops to informal discussions and reflections. It is important to foster a learning attitude towards the anticipated and unanticipated, towards the pleasant and seemingly unpleasant, and towards everybody's role and behavior.

One cannot ignore the counterproductive effect of incentives through other projects on farmers' participation. Likewise, the impact of national agriculture policies and pricing systems on local motivation and decisions overshadows a lot of the hard work at field level.

9.7.3. Regarding the process…

- Shift towards participatory research approaches implies flexible, iterative modification and adaptation of aspects of research process
- Even with small, simple technologies, it is possible to make problem identification, and technology selection, adaptation and evaluation more participatory and empowering – all ideas count
- Open technology fairs, cross-visits and evaluations that revolve around local people's criteria and priorities could provide a lot of common ground, as well as learning and motivation

9.7.4. Regarding the community…

- Diverse needs demand diverse technologies …
- Even local people with modest resources are prepared to invest in a process they believe to be relevant to their needs and conditions, and in one in which they have been a part of from early stages
- Recurring tendency of stronger farmers to dominate and weaker ones to drift to margins

9.7.5. Regarding the experts…

- Experiments can explore <u>adaptability</u> of technologies … open and motivating working environment for the researchers
- <u>Local</u> staff and experts need to be afforded greater recognition
- Need to acquire the attitude that this sort of unpredictable, context-specific experimenting can be credible and rewarding

9.7.6. Regarding facilitation of participatory research processes…

- Negotiations, reaching mutual understanding, agreeing on methods for action are taxing on human resources

- Combining work-based team formation with continuity
- Facilitators to be on the look-out for ...
  - entry points and opportunities for instigating change and transferring initiative to local people, and ...
  - facilitating opportunities for inter-disciplinary interaction
- Presence in the field, and not only when we have something to do or say
- The need for remaining approachable and accessible throughout the process
- Problems to be sought out and discussed, rather than ignored, understated or hidden
- Non-experimenting farmers to be seen as part of the process as well

9.7.7. Reversals are required in…

- Explanation – looking for reasons why farmers do not adopt new technology, not in the ignorance of farmer but in deficiencies in the technology and the process that generated it
- Learning - researchers and extension workers learning from farmers
- Location and roles - farms and farmers central instead of research stations, laboratories and scientists
- Individual responsibility taking the place of 'sacred' texts or manuals as the source of authority ... '*use your own best judgment at all times*' (Chambers 1997).

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Appendices

Appendix 1

Table A1.1. Findings from resource maps, seasonal calendars and historical time lines in Upper Sekher village, Merek.

Resource mapping	Water from the qanat gathers in a common village pool, from which farmers irrigate their land according to an agreed timetable. There are 16 deep and semi-deep wells in the village, which are privately owned, but licenses for new wells are not being issued. Cultivation is mainly rainfed. Bordering three villages from three sides, farm land is increasingly encroaching upon rangeland. Animal husbandry (especially sheep) has greatly expanded in the village.
Seasonal calendars	Household costs start rising from month 1 and continue until end of month 7, peaking from month 4 onwards, then fall slightly until month 11 before peaking again in month 12. Income starts at a small amount from the middle of month 2 and gradually increases until its peak at the end of month 6. During the second half of the year there is no noteworthy income. There is a lot of rain in month 1; rainfall reaches its lowest level in month 3. Rain starts to peak again from month 8 onwards. Cold weather starts in month 8 and continues until month 12. Shepherding accounts for the main bulk of farmers' workload throughout the year. Workload is at its highest in months 1, 2, 6 and 7. Most of the farmers' free time is from month 9 until month 12. Rangeland is of great value to the farmers. The village's geographical location as pasture land between two mountains means a lot of rain is naturally stored.
Time line	Some of the negative events in the village's history include sheep deaths due to diseases, the death of livestock due to flood, and mouth scars of sheep and cows leading to their death fifteen years ago. Also, the drought years caused wells to dry up, leading to the transformation of irrigated land to rainfed. The subsequent decrease in yield forced many families to migrate to other cities to work as manual labor.

Table A1.2. Needs matrix – Upper Peresk, Honam.

Pair-wise ranking of men’s needs in Upper Peresk	Agriculture water	Need for fruitful trees on slopes	Agricultural equipment	Bank facilities	Agricultural processing industries	Skilled veterinarian	Air pesticide application	Animal fodder	Fuel for agriculture machinery	Bee-keeping license	Bee-keeping co-op	Covering of streams
Agriculture water (11)		Agr. Water	Agr. Water	Agr. Water	Agr. Water	Agr. Water	Agr. Water	Agr. Water	Agr. Water	Agr. Water	Agr. Water	Agr. Water
Need for fruitful trees on slopes (5)			Fruitful trees	Bank fac.	Proc. Ind.	Fruitful trees	Fruitful trees	Fodder	Fruitful trees	License	Co-op	Cover streams
Agricultural equipment (2)				Bank fac.	Proc. Ind,	Vet.	Agr. Equip.	Fodder	Agr. Equip.	License	Co-op	Cover streams
Bank facilities (8)					Bank fac.	Bank fac.	Bank fac.	Bank fac.	Bank fac.	Bank fac.	co-op	Cover streams
Agricultural processing industries (4)						Vet.	Proc. Ind.	Fodder	Proc. Ind.	License	Co-op	Cover streams
Skilled veterinarian (4)							Vet.	Fodder	Vet.	License	Co-op	Cover streams
Air pesticide application (0)								Fodder	fuel	License	Co-op	Cover streams
Animal fodder (8)									Fodder	Fodder	Fodder	Cover streams
Fuel for agriculture machinery (1)										License	Co-op	Cover streams
Bee-keeping license (7)											License	Cover streams
Bee-keeping co-op (6)												Cover streams
Covering of streams (10)												

During the completion of the above pair-wise matrix by men farmers in Upper Peresk, their criteria for prioritization of needs turned out to be, in order of significance: (1) ‘scarcity of water sources and the need for optimal use of water’; (2) ‘importance of water for livestock and agriculture production and for staying in the village’; (3) ‘legalizing livelihood activities’ and ‘capital for agriculture’; (4) ‘improving bee-keeping’ and ‘relevance for husbandry’; and finally (5) ‘abundance of slopes’.

Table A1.3. Integrated findings from the four villages in Merek and the four in Honam.

Topic of analysis	**Significant findings relevant to livelihood resilience and water resources**	**Implications for livelihood resilience and technology search and selection for upcoming season**
MEREK		
Well-being criteria that distinguish the poorer households and farmers (from the household well-being rankings)	Lack of access to wells for agricultural purposes	
	Work as seasonal labor in other areas	This well-being criterion, as well as ‘unemployment’, cited as one of the problems in the area, testifies to the farmers’ pursuit of adding to and diversifying their sources of livelihood
	No land owned/rent land for agriculture Rainfed agriculture Lack of access to agricultural equipment and machinery	
Historical events/ seasonal trends (from the historical time lines and seasonal calendars)	Drying of river Freezing of river	The central role of a natural resource in the socio-economic livelihood of a community means that its history is important for the people
	Loss due to drought Wheat infection/pests Livestock disease and loss Chicken influenza Illness of cows Fear of “black scar” of livestock	Historical experience seems to have much impact on the needs and criteria for prioritization
	Carpet weaving training Piped water supply	
Expressed needs (from the card collections on needs)	Specific to men	
	Livestock fodder Cleaning of qanats	
	Common to men and women	
	Loans for employment and husbandry/ banking facilities Agricultural training/training in vegetables/livestock training Repair of agricultural water pools/ temporary flood barriers	

Table A1.3. (continued).

Topic of analysis	Significant findings relevant to livelihood resilience and water resources	Implications for livelihood resilience and technology search and selection for upcoming season
	Specific to women	
	Livestock Mushroom growing Expansion of tree planting Weeding tools Handicraft Land consolidation Transforming rainfed to irrigated land Chickpea tools Veterinarian Health training	Ideally, in the search for potential ideas and technologies, we would be looking for options that combine farmers' needs and their criteria. In this respect, mushroom and saffron growing were two ideas presented that responded to needs while also satisfying local criteria for prioritization. In fact, mushroom and saffron growing were relevant to other farmer priorities and problems as well, such as 'learning new activities', 'lack of diversity', and requiring relatively less 'land, capital, technical expertise, and outside equipment'
Criteria for prioritization of needs (from the matrices on needs)	Specific to men	
	Yield increase Ease of movement in fields Increase of fertilizer portion Transforming rainfed land to irrigated Improved cultivation More agricultural water	Ideas such as Azetobacter, pea and bean inoculants, and integrated wheat pest management, were all ideas that had the potential for this particular need while conserving the natural resources and protecting the environment at the same time
	Common to men and women	
	Reducing agricultural losses Employment generation Health	Ideas such as walnut blight control were very much in line with this concern
	Commonality	Contrary to the general belief in economic circles that farmers' priorities, especially the poorer ones, are always guided by immediate personal benefits, farmers will usually value and have time for what is best for the whole community
	Learning new activities	It seems that local farmers have recognized the need to learn and develop new skills and capacities to be able to change aspects of their livelihood. This is a rich potential source of motivation to participate in experimentations with new ideas

Table A1.3. (continued).

Topic of analysis	Significant findings relevant to livelihood resilience and water resources	Implications for livelihood resilience and technology search and selection for upcoming season
	Specific to women	
	Hope for future Family use and consumption Easing of work Independent/direct income for women Filling leisure and idle time Specific need of women Indoor nature of activity	Many of the criteria are not necessarily of an economic nature, and some of them are definitely not immediate short term. In fact, many of the ranking matrices showed that non-material and non-economic criteria and concerns had priority over material and economic items. The criteria also show a holistic outlook towards their livelihood and living environment
Raised issues and problems (from the card collections and matrices on problems)	Specific to men	
	Loss of fisheries in river Destruction of rangeland	Again contrary to widespread belief, even poorer farmers can be concerned about the environment on a wider scale. This concern was the motivation behind pursuing the idea of planting fruitf trees on slopes, even though we missed the cultivation period by a few days
	Diminishing of irrigated land Wheat pests Illnesses and hunger Loss of grains Unemployment	
	Inadequate fertilizer portions	This problem emphasized the need for ideas that either reduce the need for chemical fertilizers, or at least make their use more optimal. Again Azetobacter had characteristics that satisfied this concern. Another relevant option was the application of fertilizers based on soil testing
	Lack of water for agriculture	Thus the need for ideas that are more sparing on water resources. Probably the technology most relevant to this observation was the autumn chickpea
	Lack of capital Lack of orchards	

Table A1.3. (continued).

Topic of analysis	Significant findings relevant to livelihood resilience and water resources	Implications for livelihood resilience and technology search and selection for upcoming season
	Lack of diversity of agricultural products	It seems the farmers are well aware of the risk of concentrating on one or two products, and of the value that diversification of farming activities can add to their livelihood resilience. This was definitely one of the incentives for the 22 farmers in Merek who pursued the idea of substituting sugar beet with potato cultivation for the first time in their area
	Specific to women	
	Lack of money in costly months and seasons	
Possible root causes of the problems (from the problem tree analyses)	Specific to men	
	Lack of access to agricultural equipment and machinery Lack of technical skills Lack of land Lack of owned land Lack of money Illiteracy	Such realities emphasize the importance of seeking ideas and options that require little land and capital, are simple to implement, and do not require much equipment or machinery. At the same time, for farmers who do not own land and work on other farmers' land, there is a need for options that can show returns in a shorter time span. The criteria by which the local people classified the households in terms of their socio-economic well-being support these arguments
HONAM		
Well-being criteria that distinguish the poorer households and farmers (from the household well-being rankings)	Temporary labor No second employment or source of livelihood Work on other people's land No fixed salary or income	Like Merek, a more secure or a second source of income can be invaluable for poorer farmers
	Little land Rents agricultural land No fruitful orchard	Any new technology or activity taken up by the poorer farmers would have to be implemented and be effective on relatively smaller plots. It might be difficult for the poorer farmers to take up activities or ideas that require more than one season to show significant results

Table A1.3. (continued).

Topic of analysis	Significant findings relevant to livelihood resilience and water resources	Implications for livelihood resilience and technology search and selection for upcoming season
Historical and seasonal trends, and daily routines (from the historical time lines, seasonal calendars and the daily activities analyses)	Specific to men	
	Land reform Flood and loss of livestock, crops and human lives Abandoning of the traditional alternate cultivation of land, and consequently a decrease in productivity	This is credible evidence of farmers' endogenous mechanisms for the management of their local natural resources. Given their analysis of the consequences with a sense of regret is further reason to acknowledge local people's awareness of the inter-linkages affecting their long-term livelihood
	Arrival of new and high-yield crops in the village	
	Vaccination of livestock Feeding livestock on anti-parasites	
	Specific to women	
	Weeding and helping out with pesticide application Clearing land of stones Growing vegetables Processing dairy Collective collection of medicinal herbs from rangeland Hand-picking rainfed harvest Collecting harvest and sieving Traditional poultry	
Expressed needs (from the card collections on needs)	Specific to men	
	Quick growing seeds Planting fruit trees on slopes Fertilizers Agriculture equipment Fuel for machinery	The idea of planting fruit trees was introduced in the spring fair, but we missed the planting period by a few days The importance of fertilizers amongst farmers encouraged the introduction of various ideas in the fairs, including pea and bean inoculants, Azetobacter inoculant, and urea and phosphor fertilizers
	Covering of streams Deep wells Access to water	
	Livestock and livestock hygiene training Veterinarian Enriching fodder	

Table A1.3. (continued).

Topic of analysis	Significant findings relevant to livelihood resilience and water resources	Implications for livelihood resilience and technology search and selection for upcoming season
	Composting animal manure Beekeepers' co-operative Beekeeping license Processing industries	These are either secondary or post-production needs, and they were mainly raised by farmers from Chahartakhte and Siahpoosh, which were the more resource rich of the four villages. We could perhaps conclude that post-production issues surface more in communities where primary production issues are relatively secure
	Banking facilities Loans	
	Specific to women	
	Domestic mushroom growing Dams Pesticides for stables Bakery Milking tools Loans for small and milk livestock	
Criteria for prioritization of needs (from the matrices on needs)	Specific to men	
	Preventing losses Safeguarding family production resources Purchasing power Increased livestock Increase livestock production Optimal use of water Easing of work A lot of slopes Legalizing beekeeping	
	Common to men and women	
	TImpact on resources of majority of community Source of production/ diversifying agricultural production/ diversifying income sources Vaccination of birds/livestock health and hygiene	

Table A1.3. (continued).

Topic of analysis	Significant findings relevant to livelihood resilience and water resources	Implications for livelihood resilience and technology search and selection for upcoming season
	Specific to women	
	Cost effectiveness Financial independence Learning specialized skills For future security Low cost of milk Insurance Handicraft and training Training on livestock, agriculture and natural resources Living environment hygiene	
Raised issues and problems (from the card collections and matrices on problems)	Specific to men	
	Loss of livestock Inequitable distribution of fertilizers Natural Resource Dept.'s prevention of cultivation on slopes Wheat pests Lack of coordination between bee-keeping and pesticide application Lack of water Fruit tree diseases High cost of livestock production	
	Specific to women	
	Unemployment High cost of pesticides Traditional irrigation Unemployment of children Livestock and household litter	
Possible root causes of the problems (from the problem tree analyses)	Specific to men	
	Improper application of pesticides	This and some of the problems and issues raised in relation to pesticide application were some of the main incentives for introducing simultaneous wheat and barley pesticide application in the spring technology fairs, particularly that the daily routine analyses show that this has traditionally been an activity carried out by women

Table A1.3. (continued).

Topic of analysis	Significant findings relevant to livelihood resilience and water resources	Implications for livelihood resilience and technology search and selection for upcoming season
	Destruction of rangeland crops Not maintaining cultivation and barren alternation Unsuitable soil Lack of a deep well Lack of coverage of streams Lack of access to hygiene equipment Improper feeding of livestock	
	Uncontrolled picking of shallot	Introducing farm cultivation of shallot was meant to address the conflict between the Natural Resource Dept. and the farmers regarding shallot collection from the rangelands. Collaboration with the Dept. could also have a positive impact in other areas of the farmers' livelihood, such as the issue of cultivating on slopes (see problems and issues raised above)
	Lack of marketing No access to honey market Lack of capital	
	Specific to women	
	Rainfed agriculture Lack of capital Always been viewed as help Low income of agriculture work Hardship of agriculture work Lack of land Rented agriculture land Lack of medicine Inability to store rainwater Soil streams and canals Breaking up of land	

Appendix 2

PTD Characteristics of the Experiment Process

Apart from the anticipated and actual technical value of the experiments, and the holistic, multi-dimensional evaluations of the farmers, the whole process of the experiments can be assessed in terms of characteristics that distinguish a participatory research and technology development process from a conventional approach. Some distinctions that were actually observed in the various technology experiments in this project are summarized in the table below.

Table A2.1. Insights from the experimentation process from a PTD perspective.

Experiment	Main features from a PTD perspective
Replacing sugar beet with potato cultivation (for the first time in Merek, Kermanshah)	• The experiment was suggested and requested by farmers • Farmers have invested in seeds on their own initiative • Farmers have used different planting and irrigation methods • New irrigation methods (sprinkling) have been introduced • The expert revised his view regarding the impact of the technology to take a more holistic view after understanding the influence of outside factors such as market fluctuations
Azetobacter inoculation of wheat and barley	The experiment was repeated over three consecutive years, which allowed for a more valid assessment of the impact and of some of the changes: • The socio-economic range of farmers involved, and how they were approached and selected: a rather top-down selection in the first season changed towards a much more voluntary and participatory involvement in the third season • The direct and indirect impact – on the quantity of yield (see evaluation results in Chapter 6) and on the quality of soil (more moisture retained in dry seasons). Unexpectedly, the farmers observed that after the drought season, the soil where Azetobacter had been applied was much softer and more fertile • National-local expert, and expert-PTD team interaction – from non-communication and misunderstandings to more coordinated decision-making and division of roles
Autumn chickpea	There were also experiments for three consecutive years for this technology: • Field days were conducted in an open manner. The harvest day, in particular, was, in the words of one team member, “a glorious day” where around 100 farmers gathered to witness the results and use the occasion to discuss among themselves the pros and cons of the technology • PTD team and expert were on the alert throughout the three seasons for cases that could provide a cross-visit opportunity

Table A2.1. (continued).

Experiment	Main features from a PTD perspective
Urea and phosphor fertilizer application	• Experts 'screened' varieties based on nutrient demands derived from tests conducted on the composure and quality of soil • The expert also showed a willingness to change from a standard recommendation of fertilizers towards a site-specific application depending on nutrient requirements. This contrasted greatly with the usual excessive and unorganized distribution and application of fertilizers
	• The local experts spent a lot of time discussing experiment stages and requirements with the PTD team members and the farmers
Inoculation of chickpea and beans	The local expert coordinated with the national expert through the PTD team before presenting the technology in the fair, and the national expert merely mediated access to the required material. As these were the same actors involved with the Azetobacter technology, it was encouraging to see better coordination and collaboration initiated by the local expert
Walnut trees pest management	• A traditional indifference was tackled patiently, rather than insisting on what the farmers do • Female household members were gradually involved in the cross-visits and subsequently in the evaluations as they became more aware of the relevance of this experiment to their livelihood • Towards the latter stages of the experiment – when the farmers were participating more actively in the cross visits and evaluations, and were providing more insights on the range of different problems they were facing with their walnut trees, the experts expressed their regret at not having seen their pest topic in relation with other diseases and influencing factors. This, they claimed, would have increased the impact of their blight control actions
Mushroom growing	• The intention of this idea was to add value to the household economy, without imposing too much extra workload on the household members • The experimenters utilized unused space within the premises of their own houses • The basics of the technology were easy to grasp and monitor • The experts visited the growers (all women) frequently – and suggestions were made based on the available resources. This is particularly important for a process that claims to be participatory. One of the main tasks of a PTD process is to look into the obstacles that limit farmers' participation and seek ways of removing the obstacles if possible, especially those hindering the involvement of the poorer farmers • The management and growing environment of each experiment was unique and totally according to the resources available to them
Shallot growing	• There was very little need for outside expertise as this was a traditional activity and source of livelihood • The local Natural Resources Dept. collaborated by providing the seeds for the 2007 season

Appendix 3

Qualitative and Quantitative Evaluations of the Experiments

The farmers' assessments of the strengths and weaknesses, as well as their suggestions and recommendations, are shown under the heading of each of the technologies below, along with a brief description of the context in which the experiment has been implemented. It is worth comparing the qualitative results of these evaluations with the anticipated changes of the technologies before implementation (see Table 4.2 in Chapter 4).

Rain-fed autumn chickpeas (Merek)

At present, 700,000 hectares of land are under chickpea cultivation in Iran, of which 95% is under dry farming. The global average yield of chickpea is 820 kg/ha, whereas the average yield in Iran is 400 kg/ha. There are two explanations for such a low output: (1) local varieties are easily affected by leaf and pod spot of pea (*Ascochyta* blight); and (2) farmers tend to cultivate chickpeas in spring. Spring cultivation of chickpeas causes 'terminal drought stress' to plants during their flowering and growing pods and seeds phases. This is due to the fact that rainfall stops in early May. Chickpea plants have to cope with arid tension, which results in low yield at the end of the farming season. This major constraint can be overcome by cultivating in autumn, as this would allow the seeds to benefit from the proceeding rainy season. Therefore, rain-fed autumn chickpea has water use efficiency.

Farmers' recommendations

- The government should guarantee that it will purchase the winter tillage crop.
- Regular field visits of expert(s) should be ensured during all stages of planting, nursing plants to maturity, and harvesting.
- Farmers should be provided with relevant training.

Table A3.1. Merek farmers' assessment of weaknesses and strengths of autumn chickpea experiment.

Weaknesses	Strengths
• When chickpeas are cultivated by mechanical tools in spring, many more weeds grow in our land • Hashem and Arman varieties, which have medium size seeds, are less accepted in Kermanshah and Lorestan markets than Gerit varieties that produce larger seeds. (It should be noted that Azad variety has seeds that are as large as those of Gerit varieties.)	• Spring cultivation is not possible in boggy soil most of the years. Hence, it can be replaced by mechanical cultivation of improved seeds • When farmers can afford supplementary irrigation during phases of flowering and pod setting, they get a high yield • It is easily possible to harvest chickpeas gained from improved varieties of Hashem, Arman, and Azad in winter by mechanical tools • Harvesting of improved chickpea varieties of Hashem, Arman and Azad (mechanized cultivation) coincides with wheat harvesting. Therefore, farmers do not face any difficulty in using the available combine harvesters in the area

- The procedure to select only the larger seeds for the following year should be done accordingly.

(For quantitative findings related to this technology, see Sabbaghpoor *et al*. (2008).

Azetobacter bio-fertilizer inoculant (Honam)

Azetobacter inoculation liquid contains useful bacteria. This liquid causes plants to grow and, through various mechanisms such as biological nitrogen fixation and expansion of the plant's root system, increases the yield of garden and farming crops, especially wheat, up to 20%.

The evaluation sessions were held in each of the villages separately – late May 2008 in Chahartakhte and Upper Peresk, and early June in Siahpoosh, and were attended by Aghajan Haji, Rahim Poorhaji, Seyed Roohoddin Hosseini

Table A3.2. Results of sampling in Honam region.

Performance in control plot (kg/ha)	Performance in testing plot (kg/ha)	Increase in performance (%)	
3450	4067	+18	Irrigated wheat
1578	1895	+17	Rain-fed wheat
1099	1308	+16	Rain-fed barley

Table A3.3. Honam farmers' assessment of weaknesses and strengths of Azetobacter experiment.

Weaknesses/disadvantages	**Strengths/advantages**
• This technology is less effective during drought, but the difference is remarkable when it is applied in normal conditions • Its effect on rain-fed farming depends on the rainfall • A drought occurred in the year we started the project	• The performance of the testing plot is about 50% more than the control plot • The stalk of plants in the testing plot was taller • There was more straw and hay in the testing plot • The ears were richer and heavier in the testing plot • Grains from the testing plots were heavier • It is not a complicated technology and can be easily applied • The crop harvested from the rain-fed testing plots was so good in quality that people thought it was irrigated • Grains from testing plots were harder, taller and bigger just like grains produced in irrigated farms • Compared with control plots, less grains had fallen out of the plant • The use of Azetobacter inoculation affected rainfed farming more positively than irrigation farming. • The effect of Azetobacter on barley was more visible than on wheat • It was low cost • It causes the roots to expand • It prevents the plant being nipped by frost because using the liquid strengthens its root and fortifies the plant • Azetobacter inoculation liquid speeds up the growth of plants and accelerates the sprouting process, and therefore increases the yield

Box A3.1. Mr. Younes' experience

"I had used Azetobacter inoculation liquid last year. Since the rainfall was sufficient, the root of the plants in the test plot had grown 10 cm deeper into the soil than the ones in the control plot. The difference was significant. However, there was not much difference this year, due to the existing drought."

Fard, Khodad Hajari, Kamran Dervikian (Upper Peresk); Mirza Ali Naderi, Younes Kheirollahi, Habat Kheirollahi (Chahartakhte); and Ali Morovvat Seyfi and Noorkhoda Tavakkoli (Siahpoosh). It is worth noting that the Upper Peresk farmers took part in the evaluation session even though they had lost their crop entirely to drought, emphasizing once again that even if a particular experiment does not reach its anticipated technical results, the process can still be evaluated.

Farmers' recommendations

- Azetobacter liquid should be offered to farmers at a suitable price;
- Farmers should be provided with the liquid prior to cultivating time; the same process should be repeated so that its effect on plants under normal conditions can be assessed too.

Eight of the farmers applied the technology for rainfed barley, two for rainfed wheat, two for irrigated wheat. Six had planted chickpea the previous year, one fodder, two barley, (i.e. consecutive years), three fodder, and one had left the land idle.

The farmers also concluded that the effect was more significant with rainfall compared to drought, on rain-fed compared to irrigated crops, and on barley compared to wheat.

Vetch (Honam)

Vetch is typically a one-year plant. It may sometimes extend its life cycle into the second year, but it rarely grows for several years. Among plants that are used to feed cattle, vetch is significantly more important because of its nutritious value for livestock, its role in maintaining soil fertility, and its ability to grow on less fertile soils.

Separate evaluation sessions were held in the different villages, for the two experimenters from Chahartakhte, the one from Siahpoosh, and for 6 of the

Table A3.4. Honam farmers' assessment of weaknesses and strengths of vetch experiment.

Weaknesses	Strengths
• The assessment was difficult because there were not adequate seeds to have several plots • The drought destroyed much of the crop. Therefore, we cannot make sensible comparisons	• It is tasty fodder for livestock • Despite the drought, the plants grew as high as 20-25 cm. They will certainly grow better in rainy years • Given that we lack water and irrigated land, and vetch is a rain-fed crop, it is an appropriate replacement for alfalfa and clover • There is no need for spraying plants with insecticides • Vetch is blight resistant • Due to dry-farming, vetch cultivation is done more easily than alfalfa and clover cultivation

8 from Upper Peresk, all in mid-July 2008 (the other two in Peresk were visited individually). Mirza Morad Moradi (Chahartakhte); Noor Khoda Tavakkoli (Siahpoosh); and Khodadad Hajari, Agha Morad Haji, Aghajan Haji, Mohammad Bagher Dervekian, Vali Morad Haji, Mohammad Karam Haji, Sheikh Reza Haji, and Mohammad Ali Hajari (Upper Peresk) were the farmers who took part in the evaluations.

Farmers' ecommendations

- The technology should also be tested in a year with heavy rainfall;
- Farmers should be provided with more seeds.

Shallot (Honam)

Shallot grows on the rangeland as a wild plant. Its bulb is one of the most favorite spices, due to its taste and aroma. For the sake of conservation of natural resources, it is prohibited to collect wild shallots from the rangelands. Some villagers have started experimental cultivation of shallots in Honam, Lorestan Province, which is one of the natural habitats of this plant.

Separate evaluation sessions were held for the three experimenters from Chahartakhte, and 11 of the the 18 from Upper Peresk on two days in the first ten days of June 2008. Mohammad Vali Hosseini, Mohammad Asadollahi, Parviz Moradi (Chahartakhte); and Abed Kheirollahi, Kamran Dervekian, Ali Karam Haji, Norooz Ali Haji, Rabi'e Haji, Saman Kheirollahi, Ahmad Reza Asadinejad, Ali Hojjat Rezaei, Khodadad Hajari, Nasser Dervekian, and Adel Hajari (Upper Peresk).

Farmers' recommendations

- The plots should be watered two or three times (in spring) in places like Peresk village, where the soil is not so deep and loses its dampness quite soon;
- As long as the plant is green, you

Table A3.5. Honam farmers' assessment of weaknesses and strengths of shallot experiment.

Weaknesses / disadvantages	**Strengths / advantages**
• It takes several years to reach an economic harvesting • Sowing is done by hand, which is hard • Being a perennial plant, tenant farmers do not find it useful • It costs too much to buy the bulbs (and seeds) from the free market	• There is a good market for shallots and the price for them is high • Its sowing process is gradual and does not interfere with our other cultivating activities • Harvesting can be done during a long period (from May to November) • Nursing is not difficult • Compared with wild shallots, improved varieties have high bulb weights (up to 180 g under suitable c onditions) • Shallots do not rot and can be kept for a long time (from spring until the beginning of winter) before being marketed gradually • Blights cannot affect shallots • The livestock ca not harm the bushes, on the contrary, eating the leaves and branches may increase the size of bulbs • This plant also benefits bee-keepers because it produces into flowers and attracts bees

should continue watering, but when the leaves turn yellow, stop watering, otherwise the bulbs start rotting;

- Farmers should remove the shallots from the soil and plant them before it gets cold and they start growing. However, it is possible to plant dry shallots (i.e. harvested ones) anytime.
- You should avoid planting shallots in the shade;
- You can plant shallots together with wheat and barley in the first year, when the harvesting is almost impossible or the yield is low;
- Farmers should keep the harvested shallots in the shade;
- When the plant has rooted firmly, removing some of its branches and leaves causes the bulbs to grow better;
- We were wrong to plant the shallot bulbs close to each other. They should be planted 35-40 cm apart from each other;
- It is recommended that the management of shallots on the common range lands, be handed over to the farmers so that they can make use of lands while taking care of them;
- The most pressing problem is accessing shallot onions, which the Natural Resources Department can provide from those it confiscates from illegal collectors from rangelands;
- Can avoid weeding, which saves a lot of time;
- Should not be planted on the northern skirts of the mountains where there is no adequate sunlight.
- After a certain level of growth when the plant is firmly based, the leaves and branches can be eliminated; this will strengthen the growth of the seeds.
- Animal manure is good for shallots – where the crop was planted on land where previously livestock was kept, growth has been better.

Upper Peresk farmers have traditionally been collecting shallot from pastures and rangelands, averaging about 40-50 kg per farmer, but still 18 farmers volunteered to participate in experimenting with planting shallot on private land, eight of which ultimately completed the experiment. In fact, these farmers were also the ones who contributed the most recommendations for future developments.

It was concluded that shallot cultivation on private land could be a viable option for farmers and substitute the rangeland collection However, for poorer farmers, picking shallot from rangelands is still the more attractive option. Therefore, rather than insisting on viewing it as illegal, it might be worth investing in negotiations with farmers on optimized and sustainable collections from rangelands, and eventually stripping the activity of its illegal status.

Saffron (Honam)

Saffron has traditionally been an important agricultural export commodity of Iran, as well as being an expensive spice across the world.

The group evaluations were carried out in two afternoons in the space of 12 days in October 2008: in Chahartakhte and Saihpoosh villages, separately, in the first, and in Upper Peresk in the second.

Farmer-experimenters who participated in evaluation (village): Mohammad Asadollahi, Parviz Moradi (Chaharthkhte); Yarollah Hemmati (Kolahool Hossein Beygi); Noor Khoda Tavakkoli, Ali Morovvat Seyfi (Siahpoosh); Ali Hojjat Rezaei, Sarfgoli Haji (female), Ali Haji, Mohammad Karam Haji, Khodadad Hajari, Adel Haji, Ali Karam Haji, Mohammad Ali Haji (Upper Peresk).

Table A3.6. Honam farmers' assessment of weaknesses and strengths of saffron experiment.

Weaknesses / disadvantages	Strengths / advantages
• The training should have been offered visually along with a copy of it in CD format so that we could refresh our learning. We had already forgotten some of the points that we were instructed before planting, such as irrigation time or harvesting time • The expert we were in touch with could not pass on the knowledge on methodology and technology as precisely as required • In Siah-poosh village, most of the land needs irrigation so we had better planted colza and alfalfa, instead of waiting for three years until we can harvest saffron • Since it is a new crop we feel inexperienced and do not know much about it • Farmers would like to gain immediate profit out of their cultivation. The act of harvesting that is not economical in the first and second year may discourage farmers • The irrigated farms are full of weeds • Planting is done by hand which is very difficult • In Peresk village, hedgehogs ate the saffron bulbs	• The quality of the crop was excellent • Nursing is a bit difficult • The harvesting time coincides with the time that farmers are not busy with other agricultural activities • Saffron breeding in large scale fits the big size families because women and children can also help with its planting and harvesting • Harvesting is easy since there are no weeds on the land in November • No blight or disease can harm the plant • Cultivating saffron results in high income • Saffron can be planted on uncultivated/barren land • Irrigation happens when other crops do not need water • Harvesting is easy and no tool is needed • Saffron can be utilized for seven years, therefore planting is only necessary every seven years

Of the 16 Upper Peresk farmers who had opted for the experiment, only eight had planted the saffron seeds and these eight had lost their crop to hedgehogs after the first harvest.

It is worth noting that Yarollah Hemmati of Kolahool Hossein Betygi village had participated in the experiment at his own insistence even though his village was not one of the project sites. He was also approached to take part in the evaluations.

Farmers' recommendations

- If we cultivate saffron in barren/ uncultivated lands we will have an increased income;
- It is recommended to train farmers on additional skills and knowledge about this crop;
- We need to know how to control hedgehogs.

Mushroom (Merek)

Growing mushrooms is currently developing widely in the country, due to its low risk, little need for investment, and profitability. Due to the fact that all stages of cultivation are done in a closed place and other necessities such as light, humidity, and heat are provided artificially, this vocation can be developed anywhere in the country with minimum facilities.

The group evaluation took place in the garden of one of the farmer-experimenters' father in July 2008, and was attended by Farzaneh Mohammadi (female) along with her husband and children (Tahne Olya village), Mehri

Table A3.7. Merek farmers' assessment of weaknesses and strengths of mushroom experiment.

Weaknesses	Strengths
• 'Button' mushrooms did not sell • There was no organization to help with the marketing • Harmful insects affected the compost • We were lacking in required water and electricity • Our crops were not insured • Since cultivation is done on the floor, it is easily infected by pests	• Food for our families • It was a new type of food • Mushrooms contain a lot of protein, which is a suitable source of food for our families, specially for children • We are happy to have a job • It was the first time that such a plant was cultivated, and the people welcomed it • We were pleased with the income we earned • Women could earn income directly. They were also able to help their family economically • We learned "how to do something new" • We learned some new recipes for cooking mushrooms

Ahmadi (female) (Kolah Joob), family members (mother, sister and sister-in-law) of Fereydoon Mohammadi, and Shamsi Ahmadi (female) on behalf of her mother-in-law (Mehdi Abad Sofla).

The four farmers harvested 124, 60, 100 and 40 kg respectively. Their harvest did not sell too well in the market because the mushrooms were big. The produce was either used for household consumption, sold in own or neighboring villages or in nearby town, or given to neighbors and relatives.

Mushroom growers' recommendations

- Providing places (markets/*bazaars*) for sale;
- Growing button mushrooms in a bigger place;
- Getting more information and training

Table A3.8. Some quotes from the mushroom farmer-experimenters and what they could imply.

Weaknesses/disadvantages	Strengths/advantages
"I was nervous at first, until I gradually learned the controlling methods. Now I like this activity very much and I am keen to continue"	It is very possible, and even likely, that meaningful and sustained farmer participation in new processes will not occur immediately. People take to an idea and process gradually, but when they do, actions and activities also gather momentum
"The women in the village were not very optimistic, but I was very keen to learn something new." *"Some relatives were encouraging me throughout the experiment"*	Real pioneers are those who, even in spite of relatively less resources, are motivated to try something new or to contemplate change. Also, such expressions show that the incentive is not always material. On the other hand, one community member's experiment can be significant for many others in the community
"Some women have since approached us and have said they are keen to try it as well"	Again, this is evidence of one of the most effective ways for spread and outscaling in a participatory process of change: farmer to farmer

on how to control pests;

- Requiring more and stronger facilities such as coolers and electricity power;
- Insuring crops so that the business keeps on;
- Learning different cultivating methodologies.

Replacing sugar beet with potato (Merek)

According to the 4th National Development Plan of Iran, the annual consumption of potato is estimated at 100 kg/person per year. Potatoes can be cultivated three times per year in cold and mild areas of Kermanshah Province. At the same time, the farmers have been facing difficulties in delivering their traditional crop, sugar beet, to the companies that have the mandate to purchase farmers' products. This experiment was the first time potato was tried out in Merek.

Eight of the 19 potato experimenters from Kolah Joob participated in the evaluation session in September 2008: Heshmat Azizi, Noor Khoda Beygi, Majid Mohammadi, Ayat Ahmadi, Gholam Ali Mohammadi, Gholam Khazaei, Kamran Gholami, and Yazdan Nazari.
Farmers' recommendations

Table A3.9. Merek farmers' assessment of weaknesses and strengths of potato experiment.

Weaknesses	**Strengths**
• Prices were not fixed • Specific tools for sowing and harvesting were needed • A special place for storing the crops was required • The crop was affected by the arid climate • Expensive tubers, especially considering farmers' weak financial base • Shallow planting of tuber prevented the moisture adequately reaching it • Purchase of tubers from suspect sources showed their effect in the field • Distance from reliable sources of planting material • Lack of cash available when purchasing tubers • Contamination of land due to suspect tubers • Some mistakes are irreparable (this was mentioned in reference to the purchase of potato tubers from unreliable sources despite the technology scientist's advice) • The expert was not present at the time of planting • Not possible to plant potatoes two consecutive years • Lack of attention of some farmers to expert's advice • Weak market in the region government's policy to import this year and set low price • No guarantee purchase of produce • Not dealt with honestly by the village co-operative department	• Learning how to plant a new crop, and practical training on methods of preparation, planting and irrigation • Advice on tubers and how to get hold of good quality at reasonable prices • Making use of experience of farmers from other parts of the country • Provision of planter • Visits to other farmers' plots – "we understood the problems and weaknesses better" • Earning more income than sugar beet (the previous harvested crop) • Getting cash from selling much sooner than the previous cultivation, which took several months • Adaptability to different ways of irrigation, including rain-fed and customary ways • Providing the families of farmers with required portions of potato • Co-operation of technology expert and PTD team – "the expert (technology scientist) invested a lot of time in the visits" • Constant phone contact with other farmers

- The government should guarantee that it will purchase the crop even if its price increases;
- Building a cold storage should be taken into account;
- Farmers should be provided with loans for purchasing required equipment for cultivation and harvesting.
- Support is required from village co-operatives department to access required tools.
- Night irrigation increases yield.

Walnut blight control (Honam)

'Xalthomonaus axalopodis pv.juglandis' is locally known as 'bacteria burn', 'decomposition of walnut kernel', and 'walnut bacteriose'. Bacteria are the main sources of causing this disease. Once organs of a tree are affected, other trees will be in danger of infection too. Bacteria may contaminate any part of a leaf. Walnut trees are usually contaminated by bacteria in a short period in spring. No variety of walnut trees is resistant to this blight.

Tests were carried out on a total of 80 trees in varying agro-ecological conditions in Honam.

Table A3.10. Results of sampling in Chartakhteh and Upper Peresk villages.

	Infection (%)	**Weight of each fruit (g)**
Not sprayed with insecticide (control trees)	*29.3*	*40.2*
Sprayed with insecticide (test trees)	*15.9*	*42.4*

Table A3.11. Honam farmers' assessment of weaknesses and strengths of walnut blight control experiment.

Weaknesses	**Strengths**
• The positive impact of the project might be undermined by other harmful threats, such as cold weather and other blights • We lack the sufficient skills to prepare the insecticide and for the spraying • Due to unexpected cold weather in spring, spraying insecticide was delayed	• Trees sprayed with insecticide suffered less from fruit dropping • Test trees seemed greener and fresher • Less symptoms of blight (contaminated branches and dried and blackened fruit) are observed in trees sprayed with insecticide • The kernel of fruit grown on sprayed trees are healthy and white • The kernel of fruit grown on sprayed trees are white and all the same size, which will satisfy market demands • Trees sprayed with insecticide have heavier fruit, with full proper kernel • The project could change the wrong views of farmers on garden management and bring into light the problems caused by walnut blight • In addition to men, women could also apply this technology • The insecticide was cheap and accessible for farmers • The project made use of the villagers' labor force for applying this technology

Farmers' recommendations

- Beware that walnut blight is not removed with one-time spaying of insecticide. It should be repeated the following year.
- The Ministry of Agricultural Jihad should provide gardeners with garden sprayer on hiring basis.
- Gardeners should avoid dropping the skin of infected fruits under trees because, as a result, the blight will be spread.

Simultaneous wheat pesticide application (Honam)

Of the 51 farmers directly involved in the experiment 27 were from the project villages of Chahartakhte (24) and Bardbal (3), and the other 24 were from the neighboring villages of Yari Abad, Khosro Abad and Jahan Abad. All the farmers had planted 'Alvand' type wheat.
The group evaluation was conducted in two sittings on consecutive days in August 2008. On the first day 10 farmers from Chahartakhte and Bardbal took part, and on the second day, separate sessions were held in the two villages, with six taking part in the Chahartakhte gathering and two in Bardbal. Therefore, overall 18 of the 27 farmers from the project villages participated in the evaluations: Mirzabak Moradi, Mirzavali Hosseini, Parviz Moradi, Bakhtiar Moradi and Reza Azizi jointly, Esmatollah Azizi, Mirzamorad Moradi, Mohammad Asadollahi, Alireza Moradi, Hajar Moradi, Habat Moradi, Ismail Kheirollahi, Yarollah Moradi, Masood Asadollahi, Ali Mohammad Khan Sabzevari, Shah Mohammad Rahimi (all from Chahartakhte); Fereydoon Nazari, Qobad Nazari, Vali Bag Rahimi (Bardbal).

Note: 'appropriate' pest control implies *simultaneous* and *timely* application of wheat pesticide, that is, farmers cultivating on bordering plots on one strip of land all applying the pesticide at the same time and according to scientists' advice. In contrast, 'inappropriate' pest control refers to farmers applying pesticides individually and according to their own convenience.

As can be observed, the rate of infection in Peresk and Sarab-e Honam villages were seven times higher than Chahar-takhteh Village. Even allowing for differences in soil, and slightly in rainfall, this is significant. According to the sampling of summer and winter locations of cereal bugs, their average number under each plant was 21.5 in 2006-2007, but the number reduced to 0.81 after pest control was introduced to the whole region in 2007-2008.

Farmers' recommendations

- The integrated pest control should start on time, when cereal bugs are mature;
- Due to the fact that farmers lack the required machinery, the relevant departments of the Ministry of

Table A3.12. Comparison between irrigated fields with appropriate and inappropriate application of pesticides.

Village	Pest controlled / uncontrolled	Yield (kg / ha)	Rate of infection
Chahar-takhteh	Appropriate pest control	3550	0.2%
Sarab-e Honam	Uncontrolled or inappropriate pest control	2961	1.4%←
Upper Peresk	Uncontrolled or inappropriate pest control	2500	1.5%←

Table A3.13. Honam farmers' assessment of weaknesses and strengths of simultaneous wheat pesticide application experiment.

Strengths	Weaknesses
• The integration and coordination of the process was so great that all the pests were destroyed • The yield was very satisfactory in terms of quantity and quality. There were neither meagre nor wrinkled seeds this year • The end result of pest control in the whole region was much more satisfactory compared with the way we used to spray pesticides in previous years • The hay of wheat/barley that is pest-stricken smells badly and our livestock would not eat it. We did not have such a problem this year • Due to the fact that the rate of pest-stricken yield was very low, the crops were easily delivered to silos	• Due to the delay in spraying pesticide, cereal bugs damaged the fields to some extent • Procurement of the unimac machine requires the co-operation of government bodies

Box A3.2. Whose joy counts?

After witnessing the impact of simultaneous pesticide application for all neighboring wheat and barley plots, the farmers were visibly delighted. From a technical point of view, this experiment and its results may have been relatively simple, obvious and predictable, as compared to some of the more complicated technologies. However, this simple innovation seemed to have been able to solve fundamental problems related to the farmers' main source of livelihood. In a participatory mode of work, the local people's joy at the outcome of a process would have to count more than the outsiders' satisfaction with the results.

Agricultural Jihad should provide them with fertilizer, pesticide, tractors, and reaping machines;
- The integrated pest control should be repeated in subsequent years;
- An agricultural engineer is needed to co-operate with farmers in Honam region;
- Farmers should be informed about the most suitable time of spraying pesticide by local media.

Double queen bee-keeping (Honam)

Is it possible to keep two queens in one hive? Nowadays, keeping two queens in one hive is a common way of breeding honey bees. Naturally, two queens can lay more eggs, which results in a stronger bee population. The objective of doubling the number of queens in a beehive is to have a more populated colony of bees, in order to make optimal use of natural nectar resources. Benefits could include:

- Gradual replacement of old queens with younger ones without the colonies being divided or weakened;
- Increase in honey production and pollen/pollination;
- Easier management of beehives.

Three out of the four experimenters participated in the evaluation session in Upper Peresk at the beginning of June 2008.

Farmers' recommendations

- It will be very helpful if bee-keepers are provided with good quality and various races of queens;
- It is essential to establish a bee-

Table A3.14. Honam farmers' assessment of weaknesses and strengths of double queen bee experiment.

Weaknesses	Strengths
• It is a difficult task • It is time consuming • Before succeeding in this project, we may lose several queens • Mating might not be done properly • Due to the increase in the number of trays, the hive becomes too heavy to move	• Usually bees take care of a young strong queen and exterminate the old queen • Bees increase in numbers • Honey production becomes substantial • It becomes possible to expand one hive to two, each with a separate queen, hence the bee-keeping business is developed

Table A3.15. Honam farmers' assessment of weaknesses and strengths of bean inoculation experiment.

Weaknesses / disadvantages	Strengths / advantages
• Beans were affected by blight. The new technology was expected to be helpful, but no positive result was observed	• In fact, there was no remarkable advantage

Table A3.16. Results of sampling in Siah-poosh and Chahar-takhteh villages for pea inoculants.

	Average number of pea pods per m^2	Average biological performance
Seeds not mixed with inoculation liquid control plot	598.5	451
Seeds mixed with inoculation liquid treatment plot	983	656.5

Table A3.17. Honam farmers' assessment of weaknesses and strengths of pea inoculants experiment.

Weaknesses / disadvantages	Strengths / advantages
• Expanded and deeper roots makes harvesting more difficult	• The technical scientists(s) provided farmers with follow-up and training sessions • The pea inoculants were distributed in a timely way • Farmers got more yields • Farmers could harvest more and bigger peas • There were less empty pods • There were more two-pod plants • Farmers got more straw and hay since the bushes had grown bigger and higher. • The plant grew better, due to its more expanded and deeper roots

keepers' co-op in Peresk Village, given that there are many bee-keepers in this area with lots of beehives;
- It is required to provide bee-keepers with training on sanitary packaging and marketing of honey.

Bean (Rhizobium legominozarum) *and pea* (*rhizo-chickpea*) *inoculation* (*Honam*)

Although most pulses are planted without the use of inoculation, research studies have shown that inoculation increases the yield of beans and peas by 20-40%.

Farmers' recommendations

- The expert(s) should be in closer touch with farmers to get to know problems and help to resolve them.

Farmers' recommendations

- When the pea inoculation is used in rich (fertile) soil, the result will be much better. (Note: It would depend on what is implied by 'rich'. If the soil contains high levels of N, biological N fixation will be reduced and the N absorbed by the plant comes rather from the soil. If the soil contains higher levels of P compared to other locations with low levels, then N fixation will be increased, resulting in higher N levels and therefore, higher yields.
- Due to the current drought, the testing will be repeated next year to get a more concise assessment.
- It is fruitful if the relevant government bodies, such as the Center for Agricultural Extension Services, promote the use of pea inoculation liquid.

Urea fertilizer application based on soil tests (Honam)

Nitrogen, next to water, is the second most important factor for increasing yield, especially of wheat. One source of nitrogen is urea fertilizer. However, farmers usually do not apply chemical nitrogen fertilizers (such as urea fertilizer) to plants adequately or at

Table A3.18. Honam farmers' assessment of weaknesses and strengths of urea fertilizer application experiment.

Weaknesses	**Strengths**
• The test plot was suffering from cereal eyespot • Spraying started later than expected • It is imperative to have a sprayer, whereas some farmers did not own one • We did not observe any difference. We believe there was no impact	• Branches and leaves grown on the sprayed parts of plants were greener and larger (as large as the leaves of green corn) • The plants in the test plots grew taller, while the amount of straw collected from control plots was doubled • The yield of test plots was 300 kg more than control plots, despite the fact that the seeds sown in the test plots • We did not observe any weighed 30 kg less than the ones in control plots • In the test plots, ears of wheat grew taller and bigger and had 20% more seeds than the ears of wheat in control plots • Seeds from the test plots were bigger • The liquid used for spraying is cost effective (in terms of the consumed fertilizer and the time spent on spraying) • It was easy to prepare and to spray the liquid • It can be applied to the plants along with herbicides and other fertilizers hence farmers can save time and energy doing two things at the same time

Table A3.19. Honam farmers' assessment of weaknesses and strengths of thyme experiment.

Weaknesses / disadvantages	Strengths / advantages
• Planting seedlings, is time-consuming and hard • It lacks definite marketing opportunities, therefore farmers cannot count on its income • Being a wild plant growing in mountain slopes, women collect it, as a natural resource, with no cultivation and harvesting costs for domestic use and/or sale • Being a multiple-year plant, it does not fit the lands that are rented out to farmers for one or two years	• Nursing young plants is not labor intensive • Cattle and domestic birds do not feed on thyme therefore less protection is needed • Harvesting is easy and all family members, including children, can take part in it • It can be grown in small size plots, at the side of gardens or other plantations • It is not labor-intensive • Being a multiple-year plant there are no annual cultivating costs after the first year

Table A3.20. Merek farmers' assessment of weaknesses and strengths of poplar tree experiment.

Weaknesses	Strengths
• It is required to make appropriate preparations • It is quite important to comply with the irrigation cycle	• The yield is high, compared with other varieties • The growth of the plant is fast • The quality of produced wood is good

appropriate times. It should be noted that N fertilizers are easily washed out by water and, therefore, do not reach the roots of plants. It is observed that significant amounts of such fertilizers are lost by evaporation too. In other words, many plants suffer from nitrogen deficit, which results in the reduction of the yield as well as its quality.

Foliar application of N fertilizers on branches and leaves can solve the problem. In addition, this technology prevents excess consumption of chemical fertilizers. The objective of this technology is to increase the yield of wheat and the percentage of its protein in a very cheap and simple way.

Farmers' recommendations

- Given that the price of chemical fertilizers will probably increase next year, because of the removal of subsidies, this technology is cost effective.
- Considering the fact that the price of straw will rise, especially when droughts occur, this technology, (even when it only affects branches positively) is cost effective for farmers.

Thyme (Honam)

Thyme is a herbal bush-like plant that grows on mountain slopes, grasslands, stony or sandy soil, natural forests, or thinly forested areas. Thyme can be cultivated in the rain-fed areas of Lorestan with its semi-arid climate.

Poplar tree cultivation (Merek)

Farmers' recommendations

Farmers should
- be provided with training on the way this kind of poplar grows;
- be provided with timely inputs;
- be given the opportunity to visit each other's farms.

Appendix 4
Technology Flyers

Rain-fed Winter Tillage of Chickpeas (Azad Variety) 2008

At present, 700,000 hectares of land is under chickpea cultivation in Iran, of which 95% is dry farming. The global average yield of chickpea is 820 kilograms per hectare, whereas the average yield in Iran is 400. There are two reasons for such a low output:

1. Local varieties are easily affected by leaf and pod spot of pea;
2. Farmers tend to cultivate chickpeas in spring.

Spring cultivation of chickpeas causes harm to plants during their flowering and growing pods and seeds phases. This is due to the fact that rainfall stops in early May. Chickpea plants have to cope with arid tension, which results in low yield at the end of the farming season.

PREPARATIONS

- First, an arrish of cereals should be collected.
- Then, plots should be plowed by a plow or a wheat tractor.
- Last, seeds are sowed either by line planters or pneumatics.

TIMING

Planting: November 6th to December 6th
Nursing plants to maturity: Narrow-leaf weeds and wide-leaf weeds should be controlled consecutively from January until March and from April to May.
Harvesting: Chickpeas are ready for harvesting right after collecting the previous crop (i.e. wheat or barley).

METHODOLOGY

- First, farmers should turn over the plots deeply using a plow;
- They should plow the plots once again in fall after it rains sufficiently;
- Farmers are expected to make the land even;
- If farmers are growing peas in small plots, they can sow seeds by hand in irregular rows;
- However, seeds should be sowed by machines in regular rows when plots are large;
- To control weeds, farmers should apply super galante herbicide to narrow-leaf weeds and lintagran herbicide to wide-leaf weeds. Moreover, the growth of weeds can be controlled by mechanical tools. To be exact, farmers should apply herbicides after they make rows 50 cm from each other by using a narrow-wheeled tractor and a cultivator.

WATER REQUIREMENTS

Supplementary irrigation is done during flowering and growing of pods phases, if possible.

HARVESTING

Tall varieties of chickpeas such as Hashem, Arman, and Azad are harvested using a typical wheat tractor or a wheat tractor with a transformed head fixed to it.

Strengths

- Spring cultivation is not possible in boggy soil most of the years. Hence, it can be replaced by mechanical cultivation of improved seeds;
- When farmers can afford supplementary irrigation during phases of flowering and growing pods, they get a high yield;
- It is easily possible to harvest winter tillage of chickpeas gained from improved varieties of Hashem, Arman, and Azad by mechanical tools;
- Wheat is ready for harvesting just at the same time that the chickpeas from mechanical cultivation of improved varieties of Hashem, Arman, and Azad are to be collected. Therefore, farmers do not face any difficulty in using the available combine harvesters in the area.

Weaknesses

- When chickpeas are cultivated by mechanical tools in spring, much more weeds grow in our land;
- Hashem and Arman varieties that have medium size chickpeas are less welcome in Kermanshah and Lorestan markets than Gerit varieties that grow large chickpeas. (It should be noted that Azad variety has got chickpeas that are as large as Gerit varieties.)

FARMERS' RECOMMENDATIONS

- The state should guarantee that it will purchase the winter tillage crop.
- Regular field visits of expert(s) should be ensured during all stages of planting, nursing plants to maturity, and harvesting.
- Farmers should be provided with relevant training.
- The act of rating seeds and selecting the large ones for the following year should be done accordingly.

It should be noted that the above sections of “Recommendations” and “Strengths/Weaknesses” are based on the findings of a participatory evaluation of the Autumn Chickpea Experiment (as one component of the PTD Project).

Farmers who participated in the PTD project

Mohamad Rahimi, Bizhan Saati, Madjid Mohamadi, Mohamad-reza Mohseni

Contact details of expert(s)

Name: Dr. Seyyed Hossein Sabbaghpour
Position: Head of Legumes Department of Dry Agriculture Research Institute
Duty Station: Sar-Arood Research Station
Contact Number: 0918 331 2500

Facilitators:
Hamid Azizi, Mohamad-Reza Farhadi, Masoumeh Fakhri

Azetobacter Nitro-bacteria Inoculation 2008-2009

A number of farmers showed interest to take part in the Participatory Technology Development (PTD) Project on a volunteer basis, to test various technologies. The information in this sheet only refers to the joint experience of farmers and experts engaged in the PTD Project. The views, advantages, disadvantages and suggestions reported here are based on this experience. It is recommended that the farmers interested in using such technologies in the future contact the relevant experts and experienced farmers directly.

AZETOBACTER NITRO-BACTERIA INOCULATION LIQUID

Azetobacter inoculation liquid contains some incredibly useful bacteria. It is manufactured and offered in 1000 ml packages. This liquid causes plants to grow and through various mechanisms, such as nitrogen biological fixation and expansion of the plant's root system, increases the yield of garden and farming crops, especially wheat, up to 20%.

PREPARATIONS:

- Authorized centers provide farmers with the azetobacter inoculation liquid;
- Farmers are trained with relevant skills;
- Farming lands will be divided into two pieces of testing and control plots.

TIMING:

Azetobacter liquid is mixed with seeds on the same day of plantation; therefore the timing depends on the planting season of the plant (being wheat or barley). Moreover, the timing varies if it is rainfed or irrigation farming.

IMPLEMENTATION:

- Mixing the liquid with seeds - One 1000 ml package of Azetobacter is enough for 75-80 kg of wheat or barley seeds. Farmers should mix the seeds with the liquid in the shade and turn the seeds over and over until they are assured that the seeds and the liquid have been completely blended;
- Drying seeds - The mix should be kept in the shade for 4-5 hours to become dry;
- Sowing dried seeds in testing and control plots - To examine the impact of Azetobacter on the plant, the land is divided into two plots. The seeds mixed with the liquid will be sowed in one plot, called treatment or testing plot. Another plot, called the control plot, will be planted as usual.
- Monitoring visits of expert(s) - Expert(s) will be in touch with farmers to discuss relevant issues. Moreover, farmers can collectively accompany the expert(s) in his visits to other farms to exchange views and share information with each other.
- Harvesting and sampling - Expert(s) will get a sample of products from both plots to examine and will share the results with farmers.

WATER REQUIREMENTS:

There is no specific requirement in applying this technology to rainfed or irrigation farming.

HARVESTING

Farmers harvest the crop routinely. They can compare the samples taken from testing and control plots with each other to observe the impact of azetobacter inoculation liquid on the plant, in terms of ears, height of stalk, and expansion of roots.

Results of Sampling in Honam Region

	Percentage of Increase in Performance	Performance in Testing Plot (kg/ hectare)	Performance in Control Plot (kg/ hectare)
Irrigated Wheat	+18	4067	3450
Rain-fed Wheat	+17	1895	1578
Rain-fed Barley	+16	1308	1099

Strengths /Advantages

- The performance of testing plot is about 50% more than control plot;
- The stalk of plants in the testing plot was taller
- There were more straw and hay in the testing plot;
- The ears was richer and heavier in the testing plot;
- Grains from the testing plots weighed more heavily;
- It is not a complicated technology and can be easily applied, involving no hardship;
- The crop harvested from the rain-fed testing plots was so good in quality that people thought it was irrigated;
- Grains from testing plots were harder, taller and bigger just like grains produced in irrigated farms;
- Compared with control plots, less grains had fallen out of the plant;
- The use of azetobacter inoculation liquid affected rainfed farming more positively than irrigation farming.
- The effect of azetobacter inoculation liquid on barley was more visible than on wheat;
- It requires low-budget;
- It causes the roots to expand;
- It prevents the plant to be nipped by frost because using the liquid strengthens its root and fortifies the plant;
- azetobacter inoculation liquid speeds up the growth of plants and accelerates the sprouting process, and therefore, increases the yield.

Weaknesses/Disadvantages

- This technology is less effective during drought, but the difference is remarkable when it is applied in normal conditions;
- Its effect on rainfed farming depends on the rainfall;
- A drought occurred in the year we started the project.

Mr. Younes' Experience

I had used azetobacter inoculation liquid last year. Since the rainfall was sufficient, the root of the plants in the testing plot had grown 10 cm deeper into the soil than the ones in the control plots. The difference was significant. However, there was not much difference this year, due to the existing drought.

RECOMMENDATIONS:

- Azetobacter liquid should be offered to farmers at a suitable price;
- Farmers should be provided with the liquid prior to cultivating time;
- The same process should be repeated so that its effect on plants under normal conditions can be assessed too.

Farmers who participated in the PTD project

Ali -morovat Saifee, Sufi-reza Balvasi, Nourkhoda Tavakoli, Younes Khairollahi, Mirza-ali Naderi, Abbas Mirzapour, Yarollah Hemati, Mohamad-bagher Drowkiyan, Agha-jan Hadji, Rahim (Kaveh) Pourhadji, Khodadad Hajari, Mohamad-ali Hajari, Ali-karam Hadji, Ali Hojat-rezayee, Seyed Rooheddin Hosainee-fard

Contact details of expert(s)

Parviz Mohajer Milani
Position: Senior Expert on Soil
Duty Station: Institute of Water and Soil - Tehran
Contact Number: 0912-3130281

Manoochehr Kalhor
Position: Senior Expert on Soil
Duty Station: Agricultural and Natural Resources Research Center- Lorestan
Contact Number: 0661-2202136

Vetch Dry-farming 2008-2009

A number of farmers showed interest to take part in the Participatory Technology Development (PTD) Project on a volunteer basis, to test various technologies. The information in this sheet only refers to the joint experience of farmers and experts engaged in the PTD Project. The views, advantages, disadvantages and suggestions reported here are based on this experience. It is recommended that the farmers interested in using such technologies in the future contact the relevant experts and experienced farmers directly.

Vetch Dry-farming:

Vetch is typically a one-year plant. It may sometimes grow in two years, but it rarely grows in several years. Among plants that are used to feed cattle, vetch is significantly important because of its nutritious value for livestock, its role in soil fertility, and the fact that it can be cultivated on low-yield land. Vetch grows more or less on the surface, though its weak upright branches can grow as high as 20 to 200 cm, based on its type and on the climate conditions. Only one type of this plant, called horse bean and grows upright, is used by people.

Preparations:

Vetch does not require any specific soil to grow. Some types of vetch can be easily bred in sandy and poor soil. Seeds can be just sown in lines by hand or by machines. In case of sowing by hand, seeds should be, then, pressed into the soil with a disc.

Timing:

Vetch is not resistant against cold weather. As a result, it should be cultivated as a one-year plant in cold regions though it can be planted in fall in warmer places.

Due to the drought, dry-farming of vetch did not succeed in Honam Region. In its early stages of growth, all test plots were destroyed.

Implementation:

This particular type of vetch (which is used to feed cattle) should be planted at the presence of a technical expert and under his supervision. The following steps are taken:

- Farmers are provided with seeds;
- Farmers and the technical expert come to an agreement that the seeds provided by certified centers are planted on a small test plot;
- Seeds are planted according to the technical expert's instructions;
- It is agreed that farmers and the technical expert compare the result of cultivating vetch with clover, which is routinely planted as fodder in this region.

Water Requirement:

The growth of vetch depends on the rainfall. However, the crop will severely be damaged if the rainfall is less than 350 mm. All types of vetch are vulnerable to dry weather. Dry-farming of vetch will succeed in Honam region (with average rainfall of 480 mm) provided that no drought occurs.

Harvesting:

- Vetch is used in different ways: stored as fodder, used as a green fertilizer, and grazed by cattle. Besides, its seeds make up part of birds' foodstuff;

- If vetch is planted as a green fertilizer, plowing should start before the plants grow fully. Otherwise, the decomposition of vetch in the soil will take longer and cause problems;
- If vetch is planted for the grazing of livestock, then animals should not be allowed into the plots while the soil is damp. Otherwise, they will suffer from stomach gas generated by wet vetch. Besides, the soil will get hardened when livestock hoofs on wet land.
- The best time for harvesting the vetch that will be used for birds' foodstuff is when the seeds in the lower pods of the plant are fully ripe. Any delay will cause the seeds in the lower parts to start rotting. By this time, the pods in the upper parts of the plant have been formed too.

Strengths:

- It is tasty fodder for livestock;
- Despite the drought, the plants grew as high as 20-25 cm. They will certainly grow more in rainy years.
- Given that we lack in water and irrigated land, and vetch is a rain-fed crop, it is an appropriate replacement for alfalfa and clover;
- There is no need for spraying plants with insecticide;
- Vetch is blight resistant;
- Due to dry-framing, vetch cultivation is done more easily than alfalfa and clover cultivation.

Weaknesses:

- The assessment was difficult because there were not adequate seeds and land plots.
- The drought destroyed much of the crop. Therefore, we can not make sensible comparisons.

Recommendations:

- The process should also be tested in a year with heavy rainfall;
- Farmers should be provided with more seeds.

It should be noted that the above sections of "Recommendations" and "Strengths/Weaknesses" are based on the findings of a participatory evaluation of Walnut Blight Management Project (as one component of the PTD Project), with the participation of gardeners.

Farmers who participated in the PTD project:

Abed Khairollahi, Vali Morad Hadji, Mohammad Bagher Darookian, Aziz Khan Hadji, Agha-jan Hadji, Aziz Morad Hadji, Mohammad Karam Hadji, Rahim (Kaveh) Pourhadji, Agha-morad Hadji, Nour-khoda Tavakolli, Shir-mohammad Siyahpush, Sufi Reza Balvasi, Khodadad Hajari, Mohammad Ali Hajari, Ali Karam Hadji, Sheikh Reza Hadji, Seyed Abbas Mirzapour, Mirza Morad Moradi. Mohammad Hosseini.

Contact details of expert(s):

Name: Karim Khademi
Position: Senior Expert on Plant and Sapling Breeding
Duty Station: Agricultural and Natural Resource Research Center, Lorestan
Contact Number: 0661-2202080

BREEDING SHALLOTS 2009

A number of farmers showed interest to take part in the Participatory Technology Development (PTD) Project on a volunteer basis, to test various technologies. The information in this sheet only refers to the joint experience of farmers and experts engaged in the PTD Project. The views, advantages, disadvantages and suggestions reported here are based on this experience. It is recommended that the farmers interested in using such technologies in the future contact the relevant experts and experienced farmers directly.

SHALLOT:

Shallot grows in the grasslands as a wild plant. Its bulb is one of the most favorite spices, due to its taste and aroma. For sake of conservation of natural resources, it is not allowed to collect wild grown shallots. At present, breeding shallots is considered a new promising technology. Some villagers have started experimental cultivation of shallots in Honam, Lorestan Province, which is one of the natural habitats of this plant.

PREPARATIONS:

- First add three to four kg of totally rotted animal manure to each square meter of the plot;
- Plow the soil as deep as 30 cm. If you have plowed the soil previously, turn it over with a spade after fertilizing process is complete;
- Get the bulbs from the relevant expert(s);

ATTENTION:

If you cannot plow the soil, dig holes that are away from each other 40 cm horizontally and 10 cm vertically. Then put one bulb in each hole and cover it with the softened soil.

TIMING:

Shallot bulbs are planted at the end of fall, at the beginning of the rainy season. Villagers in Honam started the cultivation on 12/10/09. Shallot seeds can be planted in winter.

IMPLEMENTATION:

- Turn over the land with a spade and make furrows as deep as 20 cm and 40 cm far from each other;
- Put the bulbs one by one inside the furrows in an upright position with 10 cm distant from each other. Then, cover the bulbs with soft soil;
- Water the land, at least two times in spring, after the rainy season is over;
- Remove weeds regularly;
- Discuss the relevant issues with the expert(s) in a group, exchange views, and share information with other farmers when PTD Project staff visit to monitor the growth of shallots;
- As the experts recommend, no harvesting is done in the first year so that the bulbs can be multiplied and cultivation is expanded.

WATER REQUIREMENTS:

Shallots are grown by dry farming. To get a better yield, they only need two to three times irrigation in spring. Compared with other agricultural products of the region (such as onion, beans, and clover), shallots need much less water.

HARVESTING:

People use the bulb of shallots, which grows in the soil. To harvest them, farmers turn over the soil with a spade or a similar tool and collect the bulbs afterward. When the area under the cultivation is large a three-furrow plow is used. After plowing, the bulbs are collected from the ground.

REMINDER:

Be careful to collect only the bulbs that are big enough with an appropriate weight. Leave the small bulbs in the soil so that they fully grow for future use.

MARKETING:

In Peresk village, shallots are sold in two ways; either the farmers start the process collectively, i.e. appoint one person as their representative to take their products to the neighboring provinces of Hamadan and Isfahan for sale, or sell them as wholesale to some other villagers.

Strengths/Advantages:

- There is a good market for shallots and the price for them is fine;
- Its sowing process is gradual and does not interfere with our other cultivating activities;
- The act of harvesting can be done during a long period (from May to November);
- The act of nursing involves no hardship;
- Compared with wild shallots, bred ones enjoy a high quality (with each bulb weighing up to 180g under suitable conditions);
- Shallots do not rot and can be kept for a long time (from spring until the beginning of winter) before being marketed gradually;
- Blights cannot affect shallots;
- The livestock can not harm the bushes, on the contrary, eating the leaves and branches may increase the size of bulbs;
- This plant also benefits bee-keepers because it grows into flowers and attracts bees.

Weaknesses/Disadvantages:

- It takes several years to reach an economical harvesting;
- The act of sowing is done by hand, which is hard;
- Being a multiple year plant, farmers that rent lands do not find it fit.
- It costs too much to buy the bulbs (and seeds) from the free market.

FARMERS' RECOMMENDATIONS:

- The plots should be watered two or three times (in spring) in places like Peresk village, where the soil is not so deep and loses its dampness quite soon;
- As long as the plant is green, you should continue watering, but when the leaves turn yellow, stop watering, otherwise the bulbs start rotting;
- Farmers should remove the shallots from the soil and plant them before it gets cold and they start growing. However, it is possible to plant dry shallots (i.e. harvested ones) anytime.
- You should avoid planting shallows in shady lands;
- You can plant shallows along with wheat and barley in the first year, when the harvesting is almost impossible or the yield is low;
- Farmers should keep the harvested shallots in the shade;
- When the plant is rooted firmly, removing some of its branches and leaves causes the bulbs to grow more;
- We were wrong to plant the shallot bulbs close to each other. They should be planted 35-40 cm far from each other;
- It is recommended that the management of shallots, as natural resources growing in grazing lands, be handed over to the farmers so that they can make use of lands while taking care of them;
- It is recommended that the Bureau of Natural Resources distributes the shallots confiscated from smugglers among farmers that breed shallots;
- The yield increases as much as the lands are watered.
- It should be noted that the above section is the findings of a

participatory evaluation, regarding the shallot breeding, with the participation of farmers involved in the PTD Project.

Farmers who participated in the PTD project

Mohammad Asadollahi, Parviz Moradi, Vahid Hossaini, Yarollah Hemmati, Mohammad Karam-hadji, Rahim(Kaveh) Poor-hadji, Khoda-dad Hajari, Ali Karam-hadji, Ali Hojat Rezayee, Alireza (Ali) Rezayee, Adel Hadji, Nasser Drowkiyan, Norooz-ali Hadji, Rabi Hadji, Saman Khairollahi, Kamran Drowkiyan,, Ahmad Reza Asadi-nejad, Arsalan Hadji, Sattar Hashemi, Hamzeh Hashemi, Ali (Alireza) Hadji, Abed Khairollahi.

Contact details of expert(s)

Ali Sepahvand
Position: Senior Expert of Plant Breeding
Duty Station: Agricultural and Natural Resources Research Center
Contact Number: 0661-2202080

Growing Button Mushrooms 2008

Currently, one of the most significant activities in the food industry is the provision of protein for family food baskets. In this regard, growing mushrooms is developing widely in the country, due to its low risk vulnerability, little need for investment and profitability. Furthermore, graduates from agricultural universities and other interested people can look at this activity as a successful income generating business because it has low costs and because there is a favorable climate for growing button mushrooms across most provinces. Button mushrooms are very delicious and contain many B, C and D vitamins as well as numerous minerals such as iron and calcium. It also contains as much protein as meat. For those that cannot use meat due to high cholesterol in blood, button mushrooms are a very appropriate replacement for red meat.

> Due to the fact that all stages of cultivation, nursing, and harvesting are done in a closed place and other necessities such as light, humidity, and heat are provided artificially, this vocation can be developed anywhere in the country with minimum facilities.

NECESSARY EQUIPMENT

1. Button Mushroom seeds;
2. Disinfecting liquid;
3. Thermometer;
4. Hygrometer;
5. Heating facilities, such as a kerosene stove or central heating devices;
6. Inhalation device;
7. Desert Cooler (if required).

REQUIRED SPACE

You can start button mushroom growing in an old storehouse, deserted room or any other similar space. You should cover the floor and walls with cement and build in a window for ventilation, if there is not one yet.

PREPARATIONS

1. Disinfecting the room
2. The room should be washed clean and disinfected with water and disinfecting liquid 24 hours before the process starts.
3. Preparing the bed
4. A suitable sort of bed for growing button mushrooms is compost, which is produced under complicated processes in big compost manufacturing factories and offered to growers for purchasing.
5. Stabilizing room conditions
6. To grow button mushrooms, it is required to provide a place with appropriate temperature, humidity, and ventilation. During the early stages, the temperature should be kept as high as 25 degrees centigrade. In the later stages, it should be decreased to 17-18 degrees centigrade. It is required to

keep the humidity of the cultivated area at the saturated level of 80% to 90%. Furthermore, it should be noted that a balanced flow of air will stabilize the condition of the environment.

STAGES OF GROWTH

1. Growth of seeds - It takes 14-15 days for seeds to grow (provided that the temperature is as high as 25 degrees centigrade and the humidity is 80% to 85%.
2. Earth/Soil shoveling - On the 15th day, mushroom growers shovel earth on to the floor.
3. Bottom pin stage - Seven to ten days

after earth shoveling, mushrooms appear, although they are as small as the bottom of a pin.
4. Button stage - This period, which requires proper watering and ventilating of the cultivated area, usually takes as long as seven to eight days.
5. Harvesting stage - The act of harvesting is done in three phases. The most appropriate time for harvesting the mushrooms is before their cap/ top opens out. Each phase takes seven to ten days. It is required to stop harvesting for four to six days between phases.

Strengths

- Food was provided for our families;
- It was a new type of food;
- Mushrooms contain much protein, which is a suitable source of food for our families, specially for children;
- We are happy to have a job;
- It was the first time that such a plant was cultivated, and the people welcomed it;
- We were pleased with the income we earned;
- Women could earn income directly. They were also able to help their family economically;
- We learned "how to do something new";
- We learned some new recipes for cooking mushrooms.

Weaknesses

- Button mushrooms did not sell;
- There was no organization to help with the selling and supervising the marketing process;
- Harmful insects affected the compost;
- We were lacking in required water and electricity;
- Our crops were not insured
- Since cultivation is done on the floor, it is easily infected by pests.

Mushroom Growers' Recommendations:

- Providing places (markets/bazaars) for sale;
- Growing button mushrooms in a bigger place;
- Getting more information and training on how to control pests;
- Requiring more and stronger facilities such as coolers and electricity power;
- Insuring crops so that the business keeps on;
- Learning different cultivating methodologies.

It should be noted that the above sections of "Recommendations" and "Strengths/ Weaknesses" are based on the findings of a participatory evaluation of Button Mushroom Growing Experiment (as one component of the PTD Project).

Farmers who participated in the PTD project:

Mrs. Shah Tala Mohamadi;
Mrs. Farzaneh Mohamadi;
Mrs. Naz-khanom Mohamadi;
Mr. Fereydoon Mohamadi

Contact Details of Expert(s):

Name: Katayoon Moomivand
Position: Expert on Mushroom Growing
Duty Station: Private Sector
Contact Number: 0918-9322628

Name: Nargess Azimi
Position: Expert on Rural Development Planning
Duty Station: Ministry of Agricultural Jihad
Contact Number: 0918-3300357

Facilitators:

Teymoor Babayee, Hamid Azizi, Mohamad Reza Farhadi, Masoumeh Fakhri

POTATO CULTIVATION 2008

A number of farmers showed interest to take part in the Participatory Technology Development (PTD) Project on a volunteer basis, to test various technologies. The information in this sheet only refers to the joint experience of farmers and experts engaged in the PTD Project. The views, advantages, disadvantages and suggestions reported here are based on this experience. It is recommended that the farmers interested in using such technologies in the future contact the relevant experts and experienced farmers directly.

POTATO is one of the most significant agricultural products throughout the world. According to the 4th National Development Plan of Iran, the annual consumption of potato is estimated at 100 kilograms per person.

SEED POTATOES should be sowed in a period when the act of sprouting happens right afterwards. In addition, there should be an adequate number of strong sprouts among the seeds with no significant diseases. Farmers will note that their plantations are not infected by any harmful bacteria and seeds of weeds.

PREPARATIONS

Seed potatoes are ready when buds grow as long as one to two centimeters. In order to get strong and hard seeds, proper ventilation is required. Besides, farmers should not let the buds grow longer. They should place the seed potatoes on a thin layer on the floor or in specific boxes in a storehouse for five to seven days. The temperature of the room should be as high as 15-16 degrees centigrade for the first six or seven days until the buds grow as long as some millimeters. Then, the seed potatoes should be exposed to indirect light. The temperature should be reduced to 10 degrees centigrade and the humidity should be kept at as much as 80% to 85%.

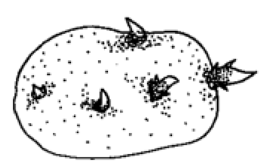
Due to the fact that cutting the seeds with a knife can transmit some sorts of diseases, the knife should be disinfected first. The seed potatoes should not be cut into very small pieces. Each piece should weigh, at least, 40-50 grams with two or three buds.

The act of cutting should be done before sowing the seeds so that the cut surface will have enough time for recovery.

The most ideal plot for sowing potato seeds is where the soil is deeply dug and drained well. Besides, farmers find sandy-clay soil quite suitable for growing potatoes. This kind of soil stores much water, without getting muddy or saturated. It is easy to work in and will result in high-quality yield.

DISINFECTING SEED POTATOES

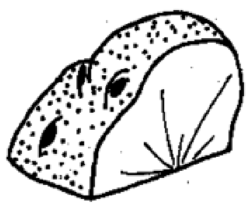
It is recommended not to plunge seeds in the fungicide liquid for disinfecting purposes. Instead, all seeds should be dry-disinfected by certified fungicide before sowing.



PREPARING BEDS

Potato growers should bear in mind two general principles. First of all, the planting process starts in spring when cows wander about in farms and the ‘traffic’ of equipment reaches its minimum. Second, given the climate of this area, there is a possibility of rain in spring. Consequently, farmers are expected to carry out the basic stages of preparations in fall.

PLANTING DEPTH usually fluctuates between 7 to 15 centimeters.



FERTILIZING

Growing potatoes requires chemical fertilizers in addition to organic fertilizers. In order to determine the amount of fertilizer, it is required that samples of the soil be taken and analyzed in a soil science laboratory. The best time for applying the chemical fertilizers that contain phosphorus, nitrogen, potassium, zinc, manganese, magnesium, and copper, is spring, before sowing the seeds. Besides, it is recommended to divide the fertilizers that contain nitrogen and potassium into several proportions and apply them to the soil in several stages.

CULTIVATION

Potato is generally cultivated by automatic and semi-automatic machines that are fastened to a tractor with narrow wheels.

TIMING

Potatoes can be cultivated three times in cold and mild areas of Kermanshah province. They can be planted in late March to early April and harvested in June to August, or planted in May and harvested in October. The latter is strongly recommended since the crop can be stored without losing its freshness until a more suitable market is found. Providing that farmers have access to rain-fed irrigation, they can plant potatoes as a secondary crop to barley right after harvesting it. In this case, potatoes are planted in mid June to be harvested in late October.

IMPLEMENTATION

There are four main activities:

- Covering the bottom of the plants with soil - Since potatoes are, actually, the stems of the plant, covering them with soil will give rise to the yield. As a result, farmers will benefit provided they can afford it. Usually, once to twice soiling with special furrow tools will do well. At the same time, farmers can also apply nitrogen and potassium fertilizers to the soil after greening.
- Pest and weed control – It is certain that farmers can gain the most output with the least costs if they comply with standards of plant breeding, frequency, and mechanical combating, and use certified herbicides for controlling weeds. For pest control, the ultimate way is using chemicals.
- Plant nutrition - To obtain high-quality yield, it is essential to spray liquid nutritious fertilizers that contain iron, zinc, manganese, magnesium etc., at least twice during the farming season.
- Watering - This plant is extremely sensitive to watering and any inconsistency in watering can create lots of problems for potato growers. Therefore, farmers should ensure that adequate water is accessible for irrigation. Furrow irrigation requires 10000 to 11000 cubic meters of water, whereas rain-fed irrigation needs 7000-8000 cubic meters.

HARVESTING

Potatoes can be harvested when 65% of the plants have turned yellow. This is the time when potatoes are ripe. However, it is recommended to pull some potatoes out of the soil and test them by peeling. If peeling happens easily, potatoes are not ripe yet. On the contrary, when they are difficult to peel, it is time to harvest. In this case, farmers should cut the branches that are close to the earth from the plants and take them away from the plots five to seven days beforehand. The soil should be damp enough (neither dry nor muddy) when the act of harvesting starts so that the machines do not harm the roots. Machines take out the potatoes, which will then be collected by farmers and transported to storages or markets immediately.

Strengths:

- Learning how to plant a new crop;
- Earning more income than sugar beet (the previous harvested crop);
- Getting cash from selling much sooner than the previous cultivation, which took several months;
- Adaptability to different ways of irrigation, including rain-fed and customary ways;
- Providing the families of farmers with required portions of potato.

Weaknesses

- Prices were not fixed;
- Specific tools for sowing and harvesting were needed;
- A special place for storing the crops was required;
- The crop was affected by the arid climate.

Famers' Recommendations:

- The state should guarantee that it will purchase the crop even if its price increases;
- Building a cold storage should be taken into account;
- Farmers should be provided with loans for purchasing required equipment for cultivation and harvesting.

It should be noted that the above sections of "Recommendations" and "Strengths/Weaknesses" are based on the findings of a participatory evaluation of Potato Cultivation Project (as one component of the PTD Project).

Farmers who participated in the PTD project:

Golam-ali Mohamadi, Madjid Mohamadi, Gholam Khazayee, Fattah Mohamadi, Baig-morad Mohamadi, Emam-ali Gheytasi, Heshamt Azizi, Karam Heydari, Hamid Azizi, Moosa Akbari, Ayat Ahmadi, Shahram Gholami, Ali Panahi, Akbar Nazari, Noor-khoda Baigi, Rasool Yari, Esmaeel Amiri, Keyhan Mohamadi, Vali Panahi, Arab-ali Panahi, Mansoor-ali Amiri.

Contact details of expert(s):

Name: Heydar Zolnourian
Position: Faculty Member of Agricultural and Natural Resources Research Center
Duty Station: Kermanshah, Agricultural and Natural Resources Research Center, Seedling and Seed Improvement Department
Contact Number: 0918 832 8717

Facilitators:

Teymoor Babayee, Hamiz Azizi, Mohamad-Reza Farhadi, Masoumeh Fakhri

MANAGEMENT OF BACTERIAL BLIGHT OF WALNUT 2009

A number of farmers showed interest to take part in the Participatory Technology Development (PTD) Project on a volunteer basis, to test various technologies. The information in this sheet only refers to the joint experience of farmers and experts engaged in the PTD Project. The views, advantages, disadvantages and suggestions reported here are based on this experience. It is recommended that the farmers interested in using such technologies in the future contact the relevant experts and experienced farmers directly.

Walnut Blight:

This disfiguration is also known as "bacteria burn", "decomposition of walnut kernel", and "walnut bacteriose". Bacteria is the main source of spread of such a disease. Once organs of a tree are affected, other trees will be in danger of infection too.

Symptoms:

LEAVES- Bacteria may contaminate any part of a leaf. First, some tiny, shiny and waterlogged stains appear on the organs. Then, the stains gradually grow bigger until they cover the leaves with dark brown stains. At this point the organs are decomposed.
MALE ORGAN- It is possible that the bacteria contaminate male organs under certain circumstances.
FRUIT- Sometimes, tiny semi-shiny stains appear on the fruit. This is when walnut blight has infected the tree.
BRANCHES- Small green branches are particularly sensitive to walnut blight. Walnut trees are usually contaminated by bacteria in a short period in spring. Dark stains, as long as several centimeters, are observed on tips of older branches which frequently leads to their dying.

REMINDER:
- No variety of walnut trees is resistant to this blight.
- To ensure the quality of product for marketing purposes, it is recommended to pack healthy and big fruits separately from infected and small ones after the harvest and offer them to the market in different packages.
- It is recommended to lop contaminated small branches off regularly, to collect and destroy plant waste totally, and to nourish plants well.

Damages:

Due to early drop of leaves and fruits and dying of tips of older branches, infected walnut trees get weakened. Besides, contaminated and stained fruit lose their quality marketing value and can not satisfy the standard market demands. Eventually, stains produced by bacteria paves the way for fungi and other diseases to attack walnut trees.

Blight Management:

The most effective ways of blight management are planting healthy certified saplings and safe-guarding young gardens by timely spraying of insecticide. Bacteria is spread along with contaminated saplings to newly esatblished gardens. The existence of even a very low percentage of disease in saplings will be threatening. Gardens that are located in regions with a humid climate in spring, with much rainfall, should be sprayed insecticide once a week during the period that new branches start growing. It is recommended to apply the mix of 1% or in the first phase. and fungicide, in ratios as instrcuted, in the second phase.

Preparations:

It is required that

- technical experts visit experiment gardens regularly and examine the situation along with farmers;
- famers and technical experts agree on the ways to manage bacterial blight of walnut'
- both farmers and technical experts do what they have agreed on;
- technical experts monitor the growth of trees and check if bacteria have spread;
- technical experts provide farmers with required training;
- farmers and technical experts maintain their relationship;
- farmers are provided with needed fungicide and bactericide from certified centers;
- farmers are provided with a 100-liter motor garden sprayer that can be fixed to a tractor

Timing

The best time to treat the blight chemically is when fruit grow as big as a pea or a peanut.

Implementation:

- Gardeners divide the garden into test and control trees.
- For the first phase of spraying insecticide, bordofix is solved in water at a ratio of 1.5 g in 1000 cc. For the second phase, exciclor mix is solved in water at a ratio of 1.5 g in 1500 cc.
- Technical experts pay weekly visits to the gardens. (Gardeners can accompany them to other gardens in order to exchange views and share experiences with other farmers.)
- To be able to assess the impact of spraying on the plants, it is recommended that gardeners (with the help of technical experts) collect samples from test and control trees at harvest time.

Water Requirements:

To apply this technology, it is required to have adequate water to make the spraying liquid.

Harvesting:

Farmers traditionally begin harvesting in late August.

Results of Sampling in Char Takhteh and Upper Persek Villages

	Percentage of Infection	Weight of Each Fruit (g)
Not Sprayed with Insecticide (Control Trees)	29.3	40.2
Sprayed with Insecticide (Test Trees)	15.9	42.4

Recommendations:

- Beware that walnut blight is not removed with one act of spaying insecticide. The same act should be repeated the following year.
- The Ministry of Agricultural Jihad should provide gardeners with one garden sprayer on hiring basis.
- Gardeners should avoid dropping the skin of infected fruits under trees because, as a result, the blight will be spread.

Strengths:

- Trees sprayed with insecticide suffered less from dropping of fruit;
- Test trees seemed greener and fresher in terms of their leaves and branches;
- Less symptoms of blight (contaminated branches and dried and blackened fruit) are observed in trees sprayed with insecticide;
- The kernel of fruit grown on sprayed trees are healthy and white;
- The kernel of fruit grown on sprayed trees are white and all the same size, which will satisfy market demands;
- Trees sprayed with insecticide have heavier fruit, with full proper kernel;
- The project could change the wrong views of farmers on garden management and bring into light the problems caused by walnut blight;
- In addition to men, women could also apply this technology;
- The insecticide was cheap and accessible for farmers;
- The project made use of the villagers' labor force for applying this technology.

Weaknesses

- The positive impact of the project might be undermined by other harmful threats, such as cold weather and other blights;
- We lack the sufficient skills needed for preparing the insecticide liquid and also for the act of spraying;
- Due to unexpected cold weather in spring, the act of spraying insecticide was delayed and therefore walnuts had grown bigger.

It should be noted that the above sections of "Recommendations" and "Strengths/Weaknesses" are based on the findings of a participatory evaluation of Walnut Blight Management Experiment (as one component of the PTD Project), with the participation of gardeners.

Farmers who participated in the PTD project:

Kaveh Mohammadi, Ali Hojat Rezayee and Parvar Esmaelvand, Ali Khair Darookian and Sarf-Gul Hadji, Ozra Ghaitooli, Mohammad Ali Hajari, Aziz-bag Fallahnezhad and Iran Hassanzadeh, Mirza Mohammad Fattahnezhad, Khodamorad Asadinezhad and Shah-dowlat Darookian, Iran Ahmadi, Agha-morad Hadji and Fozieh Hadji, Mirza Fattahnezhad, Ali Morad Hadji, Malek Morad Hadji, Alireza Hashemi, Amin Hashemi, Parviz Moradi, Mohsen Assadallahi, Khanom-naz Assadallahi.

Contact details of expert(s):

Name: Nader Azadbakht
Position: Expert on Plant Medicine
Duty Station: Agricultural and Natural Resource Research Center, Lorestan
Contact Number: 0661- 2201005

Name: Daruish Mubaraki
Position: Plant Medicine Technician
Duty Station: Agricultural and Natural Resource Research Center, Lorestan
Contact Number: 0661-22010005

Integrated Combat against Cereal Bugs 2008-

A number of farmers showed interest to take part in the Participatory Technology Development (PTD) Project on a volunteer basis, to test various technologies. The information in this sheet only refers to the joint experience of farmers and experts engaged in the PTD Project. The views, advantages, disadvantages and suggestions reported here are based on this experience. It is recommended that the farmers interested in using such technologies in the future contact the relevant experts and experienced farmers directly.

Cereal Bugs:

Cereal bugs are one of the most harmful pests in Iran. They exist in every region where wheat is cultivated. Cereal bugs are called differently in local languages; however, they are all generically the same.

Damages:

Cereal bugs damage the wheat fields in two periods of time. One damage occurs in early spring when mature insects leave the mountains to attack the fields. During this time, they feed on the leaves and soft branches of plants. Cereal bugs suck the nectar of plants through their trunk-like mouth, and therefore, the ears of wheat get pest- stricken and hollowed before the seeds are formed. Second type of damage is caused by baby bugs, after they hatch and begin feeding on the delicate and soft seeds. As a result, seeds become meager.

Coordination:

Farmers should visit their plots every two days before mature insects attack the

field in order to determine their intensity. They should quickly start the process of chemical integrated pest control before cereal bugs lay eggs and as soon as their number increases to two or three per one square kilometer in irrigated farms and to one or two per one square kilometer in rain-fed farms. Otherwise, farmers should wait until the eggs hatch. In other words, applying pesticide to mother bugs is ineffective. Furthermore, it is required that farmers of the same region meet each other and plan together for preparing pesticide, procuring a suitable sprayer machine, and applying the technology simultaneously.

Cereal Bugs Control:

Instructions for cereal bugs control are as follows:

- The minimum infection for starting controlling is the ratio of one to two mature bugs or four to five baby bugs in every square meter;
- The amount of dassise pesticide is 500 cc per hectare for mature bugs and 300 cc per hectare for baby bugs;
- The best possible time for controlling mature cereal bugs is as soon as they

leave the mountains to attack fields and before they lay eggs;

- Due to the fact that cereal bugs are able to fly away as far as 20 to 30 km, the act of spraying pesticide should be done in all the region as a whole;
- If combat against mature pests is not possible or is not necessary, farmers should visit their fields regularly to check the situation of baby bugs. Farmers should start the act of spraying pesticide when the bugs are as old as two or 70% of them are as old as two and 30% are as old as three. Technically, it is not proper to delay sprayingto the time that baby bugs are at the age of four or five or when they become mature. This should be absolutely avoided.

Reminder:

It is required to arrange field visits and pest controls in such a way that the infected fields are sprayed only once against either mature cereal bugs or baby bugs. Twice application of pesticide should be avoided.

Due to the fact that the project will succeed only if the technology is applied to the whole region, dividing the plots into test and control ones would not make sense. Therefore, it was planned to compare the results with crops harvested from Sarab-e Honam wheat/barley fields.

Preparations

- Deciding on the limits of location for spraying pesticide - It was difficult to apply pesticide to some parts of irrigated fields using a unimac machine, therefore it was decided to use a hand-sprayer under the supervision of the technical expert;
- Collecting samples regularly to determine the intensity of pests and to decide on timing - After the technical expert provided the farmers with required training, they started the process jointly;
- Preparing appropriate pesticide - Ali-Abad Services Center provide farmers with subsidised pesticide under the supervision of the technical expert;
- Procuring a suitable sprayer machine to apply the pesticide to the whole region concurrently - Ali-Abad Services Center authorized farmers to use its unimac machine.

It took four days to spray pesticide on 101.7 hectare of wheat and barley fields of Chahar-takhteh Village with a unimac tool from 23/05/08 to 26/05/08. Due to the fact that it was impossible to use the machine in some parts of the irrigated farms, hand-sprayers were used to apply the pesticide to 31.5 hectare of plots under the supervision of the technical expert simultaneously.

Timing:

Due to the unexpected attack of cereal bugs in the fields, the first sampling to determine the intensity was done on 08/04/08. According to the technical expert, the drought had caused the bugs to leave the mountains much earlier. Consequently, there were only two or three days left to start the mature pest control. The time was not enough to apply the technology to the whole region. Therefore, it was decided to combat against the pest when the baby bugs hatched. The next sampling and determining of the intensity of bugs made it clear that the act of spraying pesticide against the bugs should start on 23/05/08.

Implementation

- A technical expert provides farmers with required training on the preparation of dassise liquid pesticide (deltametrine) and working with a unimac machine;

- Wheat and barley water-fed or irrigated fields are sprayed with dassise liquid pesticide (deltametrine) with a unimac machine at the ratio of 300 cc of pesticide in 400 liters;
- When it is impossible to spray irrigated fields with a unimac, the technical expert simultaneously trains farmers on how to use hand-sprayers;
- Two weeks after the act of spraying pesticide ends, the process of sampling starts to determine the intensity and assess the result of pest control;
- Farmers pay exchange visits to each other's farms to discuss issues relevant to the project;
- During the harvesting time, the technical expert collects samples from fields in other regions that are not sprayed with pesticide to compare the yield and percentage of pest infection.

Water Requirements:

To apply this technology to both rain-fed and irrigated fields, the amount of required water should only suffice to prepare the pesticide liquid.

Harvesting:

In 2008, the yield of wheat and barley was very little, due to the drought. In most of the fields, there was either no harvesting or the harvested wheat was used for livestock. However, the following results were derived from applying the technology:

- The maximum allowed rate of pest-stricken wheat to be delivered to silos is 2%. The crop harvested in Chahar-takhteh village suffered from much less infection after applying the pesticide to the whole region.
- According to the sampling of summer and winter locations of cereal bugs, their average number under each plant was 21.5 in 2006-2007, but the number reduced to 0.81 after the pest control was introduced to the whole region in 2007-2008.

Strengths:

- The integration and coordination of the process was so great that all the pests were destroyed;
- The yield was very satisfactory in terms of quantity and quality. There were neither meager nor wrinkled seeds this year;
- The end result of pest control in the whole region was much more satisfactory compared with the way we used to spray pesticides in previous years;
- The hay of wheat/barley that is pest-stricken smells badly and our livestock would not eat it. We did not have such

Comparison between Water-fed Fields Controlled and Uncontrolled for Pests

Name of Villages	Pest Controlled/ Uncontrolled	Kind of Cultivated Wheat	Yield (kilo gram per hectare)	Rate of Infection
Chahar-takhteh	Appropriate Pest Control	Alvand	3550	0.2 %
Sarab-e Honam	Uncontrolled or Inappropriate Pest Control	Alvand	2961	1.4 %*
Upper Peresk	Uncontrolled or Inappropriate Pest Control	Alvand	2500	1.5 %*

*As observed, the rate of infection in Peresk and Honam Villages were seven times higher than Chahar-takhteh Village.

a problem this year;
- Due to the fact that the rate of pest-stricken yield was very low, the crops were easily delivered to silos.

After harvesting, a meeting was held with farmers from Chahar-takhteh Village to discuss their views on the project. Farmers came up with the following recommendations:

- The integrated pest control should start on time, when cereal bugs are mature;
- Due to the fact that farmers lack the required machinery, the relevant departments of the Ministry of Agricultural Jihad should provide them with fertilizer, pesticide, tractors, and reaping machines;
- The integrated pest control should be repeated in subsequent years;
- An agricultural engineer is needed to cooperate with farmers in Honam region;
- Farmers should be informed about the most suitable time of spraying pesticide by local media.

It should be noted that the above sections of “Recommendations” and “Strengths/Weaknesses” are based on the findings of a participatory evaluation of Integrated Combat against Cereal Bugs Project (as one component of the PTD Project).

Weaknesses:

- Due to the delay in the act of spraying pesticide, cereal bugs damaged the fields to some extent;
- Procurement of the unimac machine requires the cooperation of government bodies.

Farmers who participated in the PTD project:

All farmers that owned a wheat/barley irrigated/rain-fed field in Chahar-takhteh Village.

Contact details of expert(s):

Name: Mir-Reza Jamshidi
Position: Expert on Pests and Plant Diseases
Duty Station: Agricultural and Natural Resources Research Center, Lorestan
Contact Number: 0661-2201005

Two-Queen Beehive to Increase Honey Production 2008-2009

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Two Queens:

A queen bee is considered as the mother of a beehive. Usually, there exists only one queen in each beehive. Is it possible to keep two queens in one hive? Nowadays, keeping two queens in one hive is a common way of breeding honey bees. Naturally, two queens can lay more eggs, which results in a stronger bee population.
The objective of doubling the number of queens in a beehive is to having a more populated colony of bees, in order to make optimal use of natural nectar resources through the expansion of the flow of nectar in the nature.

Benefits:

- Gradual replacement of old queens with younger ones without the colonies being divided or weakened;
- Increase in honey production and pollen/pollination;
- Better winters for the bees;
- Easier management of beehives.

Methodology:

- First, two layers of the selected beehive (i.e. base beehive and new beehive) should be laid on top of each other so that the population of the beehive is divided into two parts. A piece of 3-layer wood should completely separate the layers in such a way that the old queen lives in the lower layer and the new queen lives in the upper layer. After two weeks, the piece of 3-layer wood is replaced with a bee-holding net. Under these conditions, worker bees can move from one layer to another but the queens cannot pass through the metal net.
- Finally, 3-4 weeks before the process and flow of nectar in the nature is over, the net is removed and the beehive is turned into a one-queen beehive. It usually implies that the young queen survives, but the old queen dies.
- During this period, the different layers of the beehive should not be interchanged. In other words, the new queen should be kept in the upper level until this period ends.
- In more populated (stronger) beehives, winters are passed better and storing honey is done better. Therefore, there is a reduction in hand-feeding (feeding with sugar and water) expenditures.
- Population of the bees is increased by (artificial means of) capturing of swarm (due to the fact that the process is carried out under controlled conditions).

Preparations:

- A main beehive is selected (the base hive);
- A smaller tray and colony with the mated young queen is prepared;
- A bee-holding net is prepared;
- The technical expert visits to assess the flow of nectar in the region and

to advise on the appropriate time for applying the technology;

- Bee-keepers are provided with relevant training.

The start of nectar flow depends on the plant types and climatic conditions of an area. In Honam, bee-keepers make use of the nectar of various plants from mid-spring till mid-summer by replacing the hives.

Timing:

The best time for doubling the number of queens in beehives is 4-6 weeks before the process and flow of nectar starts in the nature. During this period, the net between the two beehives are removed and the two colonies are merged.

Implementation:

- Bee-keepers should prepare a base beehive, a new beehive, and a metal net in advance;
- Bee-keepers add new layers to the base beehive, under the supervision of the expert;
- The expert will pay regular weekly field visits, accompanied by the bee-keepers to make sure that the queen bees are alive, and both the base and the new beehives are in normal conditions;
- After visiting the area, the bee-keepers and the technical expert will come to an agreement on the starting time for the flow of nectar in the region;
- During the process of flow of nectar, the metal net between the layers of beehives will be removed to make it possible for the two bee communities to merge;
- As the merging takes place, one of the queens (most likely the older one) will be exterminated naturally by the other bees and the beehive will turn into a single-queen beehive;
- During the implementation phase of the project, bee-keepers can accompany the technical expert in his field visits to exchange views and share their problems with other bee-keepers;
- Bee-keepers will collect samples from the experiment beehives to compare the quality of their product with honey from the other hives.

The main source for feeding honey bees in Honam region is wild goat's thorn. Due to the fact that wild goat's thorn produces more nectar in a dry climate, the drought did not have any negative effects on bee-keeping by any means. On the contrary, bee production was much higher than previous years.

Harvest:

Collection of honey takes place in two turns, in spring and autumn. This technology is applied in early to late May. In this region, bees start using the nectar of wild goat's thorn in June to August. Hence, it is possible to evaluate the project during the autumn harvest.

Strengths:

- Usually bees take care of a young strong queen and exterminate the old queen;
- Bees increase in numbers;
- Honey production becomes substantial;
- It becomes possible to expand one hive to two, each with a separate queen; hence the bee-keeping business is developed.

Weaknesses:

- It is a difficult task;
- It is time consuming;

- Before succeeding in this project, we may lose several queens;
- Mating might not be done properly;
- Due to the increase in the number of trays, the hive becomes too heavy to move.

Recommendations:

- It will be very helpful if bee-keepers are provided with good quality and various races of queens;
- It is essential to establish a bee-keepers' co-op in Peresk Village, given that there are many bee-keepers in this area with lots of beehives;
- It is required to provide bee-keepers with training on sanitary packaging and marketing of honey.

It should be noted that the above sections of "Recommendations" and "Strengths/Weaknesses" are based on the findings of a participatory evaluation of the "Two-Queen Beehive" Technology as one component of the PTD Project and experiments with the participation of bee-keepers.

Farmers who participated in the PTD experiment:

Agha Morad Hadji, Ali Hojat Rezayee, Kamran Darookian, Ali Khair Darookian, Fereydoon Hashemi, Sobhan Rahmati.

Contact details of expert(s):

Name: Karim Ghorbani
Position: Senior Expert on Animal Breeding
Duty Station: Agricultural and Natural Resource Research Center, Lorestan
Contact Number: 0661-2201005

Inocculation of Bean 2009

A number of farmers showed interest to take part in the Participatory Technology Development (PTD) Project on a volunteer basis, to test various technologies. The information in this sheet only refers to the joint experience of farmers and experts engaged in the PTD Project. The views, advantages, disadvantages and suggestions reported here are based on this experience. It is recommended that the farmers interested in using such technologies in the future contact the relevant experts and experienced farmers directly.

INOCULATION OF BEAN

Although most pulses are planted without the use of inoculation liquid, an economical harvesting and saving in the consumption of nitrogenous fertilizer require farmers to mix bean seeds with the inoculation liquid before annual planting. Research studies show that the use of inoculation liquid increases the product by 20-40 percent per hectare. Mixing bean seeds with this liquid along with the use of 30kg of urea fertilizer during plantation ensures high-quality harvesting.

PREPARATIONS:

- Authorized centers provide farmers with bean inoculation liquid;
- Farmers are offered required training.
- In the first year of testing this technology, a plot of land is divided into two plots in order to compare and study the impact of the use of bean inoculation liquid. In the testing plot, bean seeds are mixed with the liquid before being planted. In the control plot, bean seeds are planted as usual.

TIMING:

Bean inoculation liquid is mixed with seeds on the same day of plantation; therefore the timing depends on the planting season of beans in each region.

When bean inoculation liquid is applied to dry soil, the number of useful bacteria in the liquid will be reduced; hence its efficiency will decrease. It is, therefore, recommended that farmers water the land lightly after the planting process is over. In contrast, heavy irrigation will wash away the bacteria and prevents the symbiosis of plant and bacteria.

IMPLEMENTATION:

One package of one kilo gram of inoculation liquid is enough for mixing with 70-80 kg bean seeds to be planted in one hectare. To get the best results, it is required to:

- First, mix 500-700 ml of water and 20% sugar with pea seeds. Then, add the inoculation liquid and mix well;
- Leave the mix in the sun to dry. This may take three to four hours;
- Sow the dried seeds in the testing plot;
- Sow bean seeds that are not mixed with inoculation liquid in the control plot as usual;
- Discuss the changes and relevant issues with the expert(s) and/or other people involved in the PTD project, when they come to assess the situation of the plantation and observe the growth of beans;
- During the harvesting time, the expert(s) will get a sample of crops from both plots to examine and will share the results with farmers.

HARVESTING:

Farmers will harvest the crop, using their customary ways.

PRESERVATION CONDITIONS:

- Avoid keeping the packages of bean inoculation liquid in temperatures higher than 10 degree centigrade for a long time;
- Plant the bean seeds mixed with the inoculation liquid after five hours, maximum;
- Keep the packages of bean inoculation liquid in dry and cool places away from the sunshine.

CAUTIONS:

- It is recommended to avoid eating, drinking, and smoking while using the bean inoculation liquid;
- Wash your hand and face with soap and water after the work is over;
- Keep the packages and dishes used for mixing away from children;
- The bean inoculation liquid does not have any harmful effect on human beings, warm-blooded animals, aquatic animals, and bees.

Strengths /Advantages

- In fact, there was no remarkable advantage.

Weaknesses/Disadvantages

- Beans were affected by blight. The new technology was expected to be helpful, but no positive result was observed.

RECOMMENDATIONS:

- The expert(s) should be in closer touch with farmers to get to know about problems and help to resolve them.

It should be noted that the above section is the findings of a participatory evaluation, regarding the inoculation of bean, with the participation of farmers involved in the PTD Project.

Farmers who participated in the PTD project

Mirza Morad Moradi, Esmael Khairollahi, and Mohamad Khairollahi.

Contact details of expert(s)

Manoochehr Kalhor
Position: Senior Expert of Soil
Duty Station: Agricultural and Natural Resources Research Center- Lorestan
Contact Number: 0661-2202136

Inocculation of Pea 2009

A number of farmers showed interest to take part in the Participatory Technology Development (PTD) Project on a volunteer basis, to test various technologies. The information in this sheet only refers to the joint experience of farmers and experts engaged in the PTD Project. The views, advantages, disadvantages and suggestions reported here are based on this experience. It is recommended that the farmers interested in using such technologies in the future contact the relevant experts and experienced farmers directly.

INOCULATION OF PEA (a kind of biological fertilizer marketed as Rizo Chickpea):

Although most pulses are planted without the use of inoculation liquid, an economical harvesting and saving in the consumption of nitrogenous fertilizer requires farmers to mix pea seeds with the inoculation liquid before planting. Research studies show that the use of inoculation liquid increases the product by 20-40 percent per hectare. Mixing pea seeds with this liquid along with the use of 30kg of urea fertilizer during plantation ensures high-quality harvesting.

PREPARATIONS:

- Authorized centers provide farmers with pea inoculation liquid;
- Farmers are offered required training.
- In the first year of testing this technology, a plot of land is divided into two plots in order to compare and study the impact of the use of pea inoculation liquid. In the testing plot, pea seeds are mixed with the liquid before being planted. In the control plot, pea seeds are planted as usual.

TIMING:

- Pea inoculation liquid is mixed with seeds on the same day of plantation; therefore the timing depends on the planting season of peas in each region.
- Planting season of peas starts in mid March and ends in late April in Honam region.

IMPLEMENTATION:

One package of one kg inoculation liquid is enough for mixing it with 70-80 kg pea seeds to be planted in one hectare. To get the best results, it is required to:

- First, mix 500-700 ml of water and 20% sugar with pea seeds. Then, add the inoculation liquid and mix well;
- Leave the mix in the sun to dry. This may take three to four hours;
- Sow the dried seeds in the testing plot;
- Sow pea seeds that are not mixed with inoculation liquid in the control plot as usual;
- Discuss the changes and relevant issues with the expert(s) and/or other relevant people when they come to assess the situation of the plantation and observe the growth of peas.

Results of Sampling in Siah-poosh and Chahar-takhteh Villages

	Average number of pea pods in one square meter	**Average biological performance**
seeds not mixed with inoculation liquid control plot	598.5	451
Seeds mixed with inoculation liquid treatment plot	983	656.5

- At the time of harvesting, the expert(s) will get a sample of products from both plots to examine and will share the results with farmers.

HARVESTING:

The act of harvesting peas starts in early June in this region. It is done by hand. The table, here, indicates the results after examining the samples that four farmers involved in the PTD Project had grown.

PRESERVATION CONDITIONS:

- Avoid keeping the packages of pea inoculation liquid in temperatures higher than 10 degrees centigrade for a long time;
- Plant the pea seeds mixed with the inoculation liquid after five hours, maximum;
- Keep the packages of pea inoculation liquid in dry and cool places away from sunshine.

CAUTIONS:

- It is recommended to avoid eating, drinking, and smoking while using the pea inoculation liquid;
- Wash your hand and face with soap and water after the work is over;
- Keep the packages and dishes used for mixing away from children;
- The pea inoculation liquid does not have any harmful effect on human beings, warm-blooded animals, aquatic animals, and bees.

Strengths /Advantages

- The technical expert(s) provided farmers with follow-up and training sessions;
- The pea inoculation liquid was distributed timely;
- Farmers got more yields;
- Farmers could grow more and bigger peas;
- There were less empty pods;
- There were more two-pod plants;
- Farmers got more straw and hay since the bushes had grown bigger and higher.
- The plant grew better, due to its more expanded and deeper roots.

Weaknesses/Disadvantages

- Expanded and deeper roots make the act of cutting the bushes harder;
- Breeding peas did not contribute to the family income, due to its limited cultivation area.

It should be noted that the above section is the findings of a participatory evaluation, regarding the inoculation of pea, with the participation of farmers involved in the PTD Project.

RECOMMENDATIONS:

- When the pea inoculation liquid is used in rich soil, the result will be much better.
- Due to the current drought, the testing will be repeated next year to get a more concise assessment.
- It is fruitful if the relevant government bodies, such as the Center for Agricultural Extension Services, promote the use of pea inoculation liquid.

Farmers who participated in the PTD project

Panj-ali Siah-poosh, Rooh-ali Nazari, Parviz Moradi, and Reza Azizi.

Contact details of expert(s)

Manoochehr Kalhor
Position: Senior Expert on Soil
Duty Station: Agricultural and Natural Resources Research Center- Lorestan
Contact Number: 0661-2202136

Application of Urea fertilizer to Irrigated Wheat Farming 2008-2009

A number of farmers showed interest to take part in the Participatory Technology Development (PTD) Project on a volunteer basis, to test various technologies. The information in this sheet only refers to the joint experience of farmers and experts engaged in the PTD Project. The views, advantages, disadvantages and suggestions reported here are based on this experience. It is recommended that the farmers interested in using such technologies in the future contact the relevant experts and experienced farmers directly.

Spraying Wheat Fields with Urea Fertilizer:

Nitrogen, preceded by water, is the second most important factor for increasing the yield of production, especially wheat. A rich source for providing plants with nitrogen is urea fertilizer or "white fertilizer". However, farmers usually do not apply chemical nitro-fertilizers (urea fertilizer or "white fertilizer") to plants adequately or at appropriate times. It should be noted that nitro-fertilizers are easily washed out by water and, therefore, do not reach the root of plants. It is observed that significant amounts of such fertilizers are wasted by evaporation too. In other words, many plants always suffer from lack of nitrogen discretely or openly, which results in the reduction of the yield as well as its quality.
Spraying nitro-fertilizers on branches and leaves can solve the problem. Application of urea fertilizer provides wheat plants with the required nitrogen adequately and at an appropriate time. This is done through the direct act of spraying on branches and leaves. In addition, this technology prevents excess consumption of chemical fertilizers. The objective of this project is to increase the yield of wheat and the percentage of its protein in a very cheap and simple way.

Preparations:

- The technical expert should visit the farms to assess the situation regarding water resources, irrigation frequency, amount of consumed fertilizer, etc;
- The technical expert and farmers should reach an agreement on dividing the lands into two plots of test and control. Famers apply urea fertilizer to control plots as usual, but they should spray urea fertilizer, as instructed, in the test plots;
- Farmers should be provided with a sprayer;
- The technical expert should keep on visiting farms regularly to assess the growth of plants and determine the spraying time;
- The technical expert should provide farmers with the required training on how to use the new technology.

Timing:

The act of spraying urea fertilizer is done in three phases of tillering, shooting, and when the seeds start getting pasty. During these periods, plants need water and urea fertilizer because they are

During the tillering phase, farmers were not ready to irrigate their lands. Due to drought, extreme heat, much transpiration, excess lack of moisture, and hence the possibility of causing damages, the act of spraying did not happen in that phase. In the shooting phase, farmers used the 2% liquid to begin the act of spraying cautiously.

growing and have extreme activities. The density of the liquid fertilizer should be 5%, i.e. 5 kg of fertilizer should be mixed with 100 liters of water.

Tillering:

Tillering starts when three or four leaves grow on the newly cultivated plants. In this phase, the first tillering nodes appear. Wheat fields look like meadows with small branches grown all over. The importance of tillering is due to its ability to generate more nodes and replace the plants that are nipped by frost.

Shooting:

In most regions of Iran, the weather starts getting warmer in March. During this period when the soil starts breathing, the hibernation of wheat plants is over. In several days, the sight of the wheat field changes because branches start growing fast. This phase is called shooting.

Seeds getting pasty:

In this phase, branches and leaves gradually turn yellow. The lower pods of plants become pale and a little wrinkled. Seeds turn yellow too. The milky liquid becomes stiff and pasty to some extent. At this time, seeds get mashed when they are pressed between two fingers.

Implementation:

Application of urea feritlizer to irrigated wheat farming should be done in the presence of a technical expert and under his supervision, as follows:

- The farmer and the technical expert agree to divide the farm into test and control plots. The farmer will cultivate the control plots as usual, while the test plot will be scheduled for three times of spraying of urea fertilizer under the supervision of the technical expert;
- The farmer will receive training from the technical expert on how to prepare the liquid fertilizer;
- The farmer and the technical expert will regularly keep in touch until the harvesting is over. Afterwards, they will review the results together. Meanwhile the farmer can exchange views, discuss issues that are relevant to the use of this technology, and share problems with the technical expert and other farmers;
- Farmers involved in the PTD experiment can visit each other's test plots and benefit from others' experiences;
- During the harvesting time, farmers will collect samples from control and test plots in the presence of the technical expert for further review of their findings. The technical expert will ensure that the results of comparison between the two plots will be shared with farmers.

Water Requirements:

There should be excess moisture when urea fertilizer is being applied to the farms, otherwise plants will burn and the urea fertilizer will destroy the crop. Therefore, this technology is not recommended for use in rain-fed farming. It can be applied only to irrigated farms.

Harvesting:

Harvesting is done customarily.

Strengths:

- Branches and leaves grown on the sprayed parts of plants were greener and larger (as large as the leaves of green corn);
- The plants in the test plots grew taller, while the amount of straw collected from control plots was doubled;
- The yield of test plots was 300 kg more than control plots, despite the fact that the seeds sown in the test

plots weighed 30 kg less than the ones in control plots;
- In the test plots, ears of wheat grew taller and bigger and had 20% more seeds than the ears of wheat in control plots;
- Seeds grow fatter in the test plots;
- The liquid used for the act of spraying is cost effective (in terms of the consumed fertilizer and the time spent on spraying);
- It was easy to prepare and spray the liquid;
- It can be applied to the plants along with herbicides and other fertilizers; hence farmers can save time and energy doing two things at the same time.

Weaknesses

- The test plot was suffering from cereal eyespot;
- The act of spraying started later than expected;
- It is imperative to have a sprayer, whereas some farmers did not own one;
- We did not observe any difference. We believe there was no impact.

It should be noted that the above sections of “Recommendations” and “Strengths/Weaknesses” are based on the findings of a participatory evaluation of Application of Urea Fertilizer to Irrigated Wheat Farming Project (as one component of the PTD Project), with the participation of farmers.

Recommendations:

- To ensure its impact, the whole process should be completed fully.
- Given that the price of chemical fertilizers will probably increase next year, because of the removal of subsidies, this technology is cost effective.

Considering the fact that the price of straw will rise, especially when droughts occur, this technology, (even when it only affects branches positively) is cost effective for farmers.

Farmers who participated in the PTD project:

Amanollah Karam-elahi, Ali Morovat Sayfi, Alireza Moradi, Parviz Moradi, Reza Azizi, Mirza Morad Moradi, Ali Khair Darookian, Ehsan Hadji, Ali Hojat Rezayee

Contact details of expert(s):

Name: Morad Sepahvand
Position: Senior Expert on Soil
Duty Station: Agricultural and Natural Resources Research Center, Lorestan
Contact Number: 0461-2202136

Breeding Thyme 2009

A number of farmers showed interest to take part in the Participatory Technology Development (PTD) Project on a volunteer basis, to test various technologies. The information in this sheet only refers to the joint experience of farmers and experts engaged in the PTD Project. The views, advantages, disadvantages and suggestions reported here are based on this experience. It is recommended that the farmers interested in using such technologies in the future contact the relevant experts and experienced farmers directly.

THYME:

Thyme is an herbal bush-like plant that grows on mountain slopes, grasslands, stony or sandy soil, natural forests, or thinly forested areas. Thyme can be bred in the rain-fed lands of Lorestan with its average rainfall of 300 ml.

PREPARATIONS:

- Thyme needs a warm climate and sufficient light to grow. It is recommended that farmers breed it in sunny areas and on the southern slopes of the hills;
- Light soil with much thickness fits the best; therefore, avoid planting it in heavy soil;
- Light plowing is recommended;
- The plantation rows should be 40-50 cm far from each other;
- Agricultural and Natural Resources Research Center provides farmers with seedlings;
- Farmers are offered required training.

TIMING:

Thyme seeds are planted in fall before the rainy season starts; while the thyme seedlings are planted in spring when winter ends, but when the weather is not warm yet.

IMPLEMENTATION:

- Planting seedlings on one line with 50 cm distance;
- Irrigating after cultivation;
- Regular monitoring of the expert and the farmer;
- Nursing the seedlings (including irrigation, weeding, etc.);
- Avoiding harvest in the first year, for sake of enrichment of the plant, according to the expert's recommendation.

How to Plant Thyme Seeds:
The seeds should be sowed directly in the main land in rows that are 40-50 cm away from each other. The depth of the seeds should not exceed 0.5 cm. The best time for plantation is mid fall.

WATER REQUIREMENTS:

- Thyme tolerates arid climate quite easily;
- It is extremely sensitive to basin irrigation;
- Too much humidity and irrigation not only harm the plant, but also reduce its aroma qualitatively and quantitatively.

HARVESTING:

Thyme flowers from May to September. The first harvesting can be done in mid spring, in May. In the first year, it is recommended to harvest once. However, in the following years two or three times harvesting is possible. The act of harvesting can be easily done by hand, and no specific tool is needed.

MARKETING:

There is a demand for thyme in the market; shops that sell herbal plants in cities and/or factories that produce herbal drinks and beverages are routine customers. Farmers can offer their products to different places that use this medicinal plant.

PROCUREMENT OF SEEDLINGS AND SEEDS:

Seeds of this medicinal plant are available in agricultural shops. There is no limitation to offer thyme seeds, though the seedlings are just available in research centers. In case farmers are willing to use seedlings for breeding thyme, they can get them through the relevant expert.

Strengths/Advantages:

- The act of nursing young plants to maturity requires less hardship;
- Cattles and domestic birds do not feed on thyme; therefore less protection is needed;
- The act of harvesting is easy and all family members, including children, can take part in it;
- It can be bred in small size plots of land, at the side of gardens or other plantations;

- It is not labor-intensive;
- Being a multiple year plant; there is no need for an annual cultivating cost after the first year.

Weaknesses/Disadvantages:

- The act of sowing, which is done by using seedlings, is time-consuming and hard;
- It lacks definite marketing opportunities, therefore farmers cannot count on its income;
- Being a wild plant growing in mountain slopes, women collect it, as a natural resource, with no cultivation and harvesting costs for domestic use and/or sale;
- Being a multiple year plant, it does not fit the lands that are rented out to farmers for one or two years.

It should be noted that the above section is the findings of a participatory evaluation, regarding the thyme breeding, with the participation of farmers involved in the PTD Project.

Farmers who participated in the PTD project

Serf Gul-Hadji

Contact details of expert(s)

Ali Sepahvand
Position: Senior Expert of Plant Breeding
Duty Station: Agricultural and Natural Resources Research Center
Contact Number: 0661-2202080

Black Poplar 2008

BACKGROUND:

After a comprehensive survey of local and non-local varieties, two species were selected from six top colonies of 'open crown' and 'closed crown' black poplars. The specifications of these species are as follows:

SPECIES	DISTANCE BETWEEN TREES	AVERAGE ANNUAL WOOD PRODUCTIVITY
'open crown'	4m*4m	$38m^3$
'closed crown'	3m*3m	$42m^3$

PREPARATIONS:

Gardeners should ensure that the plantation benefits from a consistent irrigation system so that all saplings can be watered uniformly. To prepare the land, it should be deeply plowed, at least once, in summer. This is vital, especially if the land is covered with weeds.
As soon as the planting phase starts, gardeners should come to accurate decisions on the locations of holes, their distances and their size, as recommended.

TIMING:

In Kermanshah province, the saplings can be planted during the period between 20th of February and 4th of April at the latest. However, the most suitable time for planting is from March 1st to March 11th, before there is an increase in the number of sprouts.

METHODOLOGY:

First, some holes, as big as 4m*4m, are dug and filled with 50% degenerated manure. Next, some soil is placed at the bottom of holes. Last, a sapling is placed in every hole. The holes should be filled in with soil up to the root collar of saplings.

IRRIGATION:

As soon as planting is over, irrigation starts. It is required to water the trees once a week in spring and fall and twice a week in summer.

CHEMICAL FERTILIZERS:

Farmers can use chemical fertilizers that contain nitrogen, phosphorus, and tiny nutritives as liquid. Fertilizers can be applied in a period of four to ten years, depending on the kind of product (paper, wood scraps, nopan wood, wooden planks, matchsticks, etc.) black poplar will be used for.

HARVESTING:

The best time for harvesting is at the end of proliferation and vegetation of trees, when they begin shedding their leaves in fall. During this period the sap stops flowing. If the conditions allow, this is the proper time for cutting down the trees. However, a number of points should be taken into account, such as estimating the direction the trees will be felled. Gardeners should also plan for cutting the top of the branches, chopping the trunk of trees into preferred sizes, sorting them, and storing the pieces in proper places. The storehouses should be provided with a ventilation system to ensure that chopped trees will be protected against degeneration and fungus infections. The last thing to do is clean up the plantation from unused pieces of timber and to cut the top of the branches to make it ready for the following cycle of proliferation and also to make growth possible.

STRENGTHS:

- The yield is high, compared with other varieties;
- The growth of the plant is fast;
- The quality of produced wood is good.

WEAKNESSES:

- It is required to make appropriate preparations;
- It is quite important to comply with the irrigation cycle.

FARMERS' RECOMMENDATIONS:

Farmers should

- be provided with training on the way this kind of poplar grows;
- be provided with timely inputs;
- be given the opportunity to visit each other's farms.

It should be noted that the above sections of "Recommendations" and "Strengths/Weaknesses" are based on the findings of a participatory evaluation of the Poplar Tree Experiment (as one component of the PTD Project).

Farmers who participated in the PTD project

About 51 farmers from Lower Mehdi-abad, Bagh-e Karam-baig, and Sokhor Villages

Contact details of expert(s)

Name: Yahya Khoda Karami
Position: Senior Expert on Forestry and Forest Ecology
Duty Station: Agricultural and Natural Resources Research Center, Kermanshah
Contact Number: 0918 831 5183

Facilitators:

Teymoor Babayee, Hamid Azizi, Mohamad-Reza Farhadi, Masoumeh Fakhri

Breeding Saffron 2009

A number of farmers showed interest to take part in the Participatory Technology Development (PTD) Project on a volunteer basis, to test various technologies. The information in this sheet only refers to the joint experience of farmers and experts engaged in the PTD Project. The views, advantages, disadvantages and suggestions reported here are based on this experience. It is recommended that the farmers interested in using such technologies in the future contact the relevant experts and experienced farmers directly.

SAFFRON:

Saffron is one of the most significant exports of Iran and the most expensive spice in the world. The stages of its development are as follows:

- Flowering - This is the most important stage of the growth of saffron, according to farmers. As soon as the weather gets cold in fall and the rainy season starts (or the irrigation takes place), the plant begins flowering. After 15 to 25 days, the plant stops flowering.
- Proliferation - During this period, which starts in November and ends in late May, leaves begin sprouting out of the soil along with flowering.
- Summer lethargy - This stage begins in spring when leaves turn yellow and ends in fall with the first irrigation or rainfall. It is recommended to weed the plot out of the wild unwanted summer plants in fall so that the saffron plant is fortified and grows into flowers better. Besides, farmers should avoid irrigating the plots during this period.

PREPARATIONS:

- Farmers get healthy strong bulbs from the authorized centers that send their experts for field visits and follow up;
- Required training on cultivation, nursing and harvesting is offered to farmers;
- Rotted manure is added to the soil as much as three kilo grams for every square meter of the plot;
- Farmers should plow the land as deep as 30 cm;
- Before planting starts, farmers should select the bulbs that weigh more than eight kilo grams and disinfect them with the recommended fungicide.

Summer lethargy is a part of the natural growth of saffron. It is signified with leaves turning yellow. You should not consider it as a disease or as a sign of drying out.

TIMING:

The bulb of saffron can be planted between late May and early October, when leaves start turning yellow. However, the best time is as early as June. In Honam region, farmers start planting the bulbs in November.

REMINDER:

It is recommended to avoid planting saffron in late July because the weather and the soil are, both, too hot. This may cause the bulbs to lose their dampness and get hurt when they are put in the soil.

IMPLEMENTATION:

All the following actions are taken under the supervision of the relevant expert(s).

- First, prepare the land, and then dig furrows, as deep as 15 cm, that are 30 cm apart;

- Sow the bulbs in upright positions in the deepest part of the furrow. Make sure that the bulbs are placed five centimeters away from each other;
- Start irrigation if there is a delay in the rainfall;
- Discuss and exchange views with the experts(s) and other farmers on the growth of the plants, relevant issues and problems. You can accompany the expert(s) in a group to other farms during his monitoring field visits;
- Visit the field in the third week of November to check up the flowering process and to determine the harvesting time;
- Combat against the unwanted wild plants by hand weeding and, if required, use herbicide under the supervision of the expert(s).

WATER REQUIREMENTS:

- Saffron does not need irrigation or rainfall in summer, due to its summer lethargy phase of growth;
- Dry farming of this plant is possible in Lorestan, due to the usual available rainwater in fall;
- In case there is a drought, one-time irrigation in late September helps the plant flower.

HARVESTING:

The act of harvesting begins in November and takes about one month, when the plant is flowering. Observing the subsequent points ensures a high quality crop.

- Early mornings are the best harvesting time because the temperature is low and the flowers are still closed. At this time, it is less likely to harm the flowers unconsciously. Besides, they are less exposed to the danger of infection. As a result, the quality of the crop increases;
- It is recommended to collect the flowers in baskets that can ventilate (such as baskets made of net or straw). Avoid putting flowers on top of each other and heaping them for a long time;
- Farmers should start separating stigmas as soon as flowers are collected. The shorter this interval is, the better the result will be. Otherwise, the quality of the crop will decrease and the possibility of mycosis increases;
- Stigmas should be kept in piles in dry, cool and shady places.
- The refrigerator temperature fits the best for keeping stigmas until the drying process starts;
- Farmers should avoid drying saffron on metal and unhygienic surfaces;
- Dried saffron should be preserved under hygienic conditions and appropriate temperature and humidity in the shade.

MARKETING:

In Peresk village, shallot breeders have decided to sell their crop collectively. They have appointed one person as their representative to take the crops to the neighboring provinces and sell them at a profitable price. Saffron breeders forecast that they will do the same when their crops reach the point that can be marketed.

Strengths/Advantages:

- The quality of the crop was excellent;
- The act of nursing involves a little hardship;
- The harvesting time coincides with the time that farmers are not busy with other agricultural activities;
- Saffron breeding in large scale fits the big size families because women and children can also help with its planting and harvesting;

- The act of harvesting is easy since there are no weeds in the lands in November;
- No blight or disease can harm the plant;
- Breeding saffron brings in high income;
- Saffron can be planted in uncultivated/barren lands;
- Irrigation happens when other crops do not need water;
- The act of harvesting is easy and no tool is needed;
- Saffron bulbs remain in the soil for seven years; therefore, the act of planting happens once in seven years.

Weaknesses/Disadvantages:

- The training should have been offered visually along with a copy of it in CD format so that we could refresh our learning. We had already forgot some of the points that we were instructed before planting, such as irrigation time or harvesting time;
- The expert, we were in touch with, could not pass on the knowledge on methodology and technology as delicately and precisely as required;
- In Siah-poosh village, most of the lands need irrigation; so we had better plant colza and alfalfa, instead of waiting for three years until we can harvest saffron;
- Since it is a new crop we feel inexperienced and do not know much about it;
- Farmers would like to gain immediate profit out of their cultivation. The act of harvesting that is not economical in the first and second year may discourage farmers;
- The irrigated farms are full of weeds;
- The act of planting is done by hand and involves hardship;
- In Peresk village, hedgehogs eat the saffron bulbs.

It should be noted that the above section is the findings of a participatory evaluation, regarding the saffron breeding, with the participation of farmers involved in the PTD Project.

FARMERS' RECOMMENDATIONS:

- If we breed saffron in barren/uncultivated lands we will get an increase in our income;
- It is recommended to train farmers on more skills and knowledge about this crop;
- We need to know how to control hedgehogs.

Farmers who participated in the PTD project

Ali Morovat and Elham Saifee, Noorkhoda Tavakoli, Abdolmohamad Khosravi, Mohamad Asadollahi, Rahman Mirzayee, Parviz Moradi and Parvaneh Khairollahi, Yarollah Hemati and Fereshteh Dowlat-shah, Mohamad-karam Hadji and Soudabeh Mohamadi, Khoda-dad Hajari and Parvaneh Asadi-nejad, Ali-karam Hadji, Shaikh-reza Hadji, Ali-hojat Rezayee and Parvar Esmaelvand, Adel Hadji and Laila Esmaelvand, Seyed Rooheddin Hossaini-fard and Zarifeh Falah-nejad, Rabi Hadji and Atr Gheytooli, Kamram Dowrkiyan and Mahin Esmaelvand, Sattar Hashemi, Ali Hadji, Mohamad-ali Hadji, Naser Fatah-nejad, Shirmorad Hadji, Ali-khair Dowrkiyan and Serf Gul-hadji

Contact details of expert(s)

Karim Khadem
Position: Senior Expert of Arable Planting
Duty Station: Agricultural and Natural Resources Research Center, Lorestan
Contact Number: 0661-2202080

Appendix 5

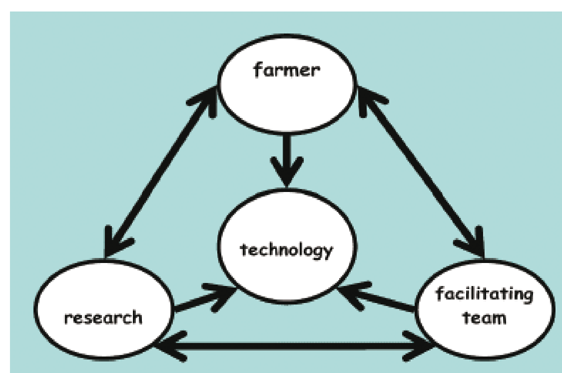
Policy Action 4

For discussion at the policy workshop of the KRB. March 4th 2009 in Tehran, Iran

Transform supply-driven agricultural research to demand-driven research and technology development by enabling farmer participation

Rationale

Participatory research in Honam and Merek watersheds (such as Participatory Technology Development and Participatory Plant Breeding) revealed great response of both male and female farmers to work with researchers on the adaptation of technologies that could solve their own problems. The linear process of development of technologies by researchers and transfer of results by extension staff to farmers has not been able to adequately respond to complex development challenges, especially in marginal environments. A more integrated and participatory approach that involves local communities and their indigenous knowledge can more efficiently contribute to the improvement of productivity and income of farming communities. This implies inter-disciplinary interaction between research, extension and farmers.



Proposed policy measures

1. Institutionalize **farmer-participatory approaches** in agricultural research and extension programs by mainstreaming PTD and inter-institutional cooperation.
2. Create mechanisms for **cooperation** between researchers, extension staff and farming communities.
3. Involve male and female farmers in setting the **research agenda**.
4. Provide appropriate **incentives** for participatory research for researchers, such as adjustment of promotion criteria.

5. Enhance allocation of **resources for provincial research** centers to support participatory technology development.
6. Mainstream **Participatory Plant Breeding** to improve production in marginal lands and cope with climate change.
7. Increase the number of **female research and extension staff** and start up a participatory research program specifically targeted to **women farmers**.
8. Improve **agricultural micro-credit** systems that support investment of both male and female farmers in promising and sustainable income-generating technologies.

CGIAR Challenge Program on
WATER & FOOD

Benchmark river basins

The CP Water & Food is a research, extension and capacity building program aims at increasing the productivity of water used for agriculture. The CP Water & Food is managed by an 18-member consortium, composed of five CGIAR/Future Harvest Centres, six National Agricultural Research and Extension Systems (NARES) institutions, four Advanced Research Institutes (ARIs) and three international NGOs. The project is implemented at nine river basins (shown above) across the developing world. The Karkheh River Basin (KRB) in western Iran is one of the selected basins. The program's interlocking goals are to allow more food to be produced with the same amount of water that is used in agriculture today, as populations expand over the coming twenty years. And, do this in a way that decreases malnourishment and rural poverty, improves people's health and maintains environmental sustainability.

Strengthening Livelihood Resilience in Upper Catchments of Dry Areas by Integrated NRM (CPWF PN 24)

Project partner institutions and contacts
Website: http://www.karkheh-cp.icarda.org/karkheh-cp/default.asp

ICARDA
Theib Oweis and Adriana Bruggeman
P.O. Box 5466, Aleppo, Syria

AEERO (AERI, SCWMRI, NSRC, DARI, SWRI, RIFR, RRC)

FRWO
Forests, Range and Watershed Management Organization

Catholic University of Leuven
Jean Poesen