Walter S. de Boef

Learning about

institutional frameworks

that support farmer management of

agro-biodiversity,

Tales of the unpredictable

Stellingen (propositions)

1. This dissertation reflects upon a unique historic period in which research organisations, genebanks, NGOs and farmer organisations joined forces to implement the Convention on Biological Diversity.

2. Rather than a conservation strategy, "on-farm management" of agro-biodiversity is the output or an emergent property of joint activities that support farmer management *(this thesis).*

3. Because of their narrow focus on *ex situ* conservation, most National Plant Genetic Resources Programmes may be regarded national genebanks *(this thesis).*

4. Maintenance of agro-ecological resilience is a major reason for agro-biodiversity conservation *(this thesis).*

5. The relationship among management systems at various levels is critical to adaptive agro-biodiversity management *(this thesis).*

6. National Plant Genetic Resources Programmes such as CGN are faced with the paradox that promotion of PGR utilisation is included in their mandate while not accounted for in their resources *(this thesis).*

7. De terugkeer van Sunnan op de rassenlijst op verzoek van de Zeeuwse Vlegel toont aan dat de nationale rassen- en zaadregelgeving flexibeler is dan oorspronkelijk werd aangenomen door boeren, zaad- en veredelingsbedrijven en betrokken uitvoerende organisaties *(dit proefschrift).*

8. Even though the CBDC Programme and the IPGRI *in situ* project had divergent perspectives on the development of the *in situ* conservation strategy, they implement activities and develop approaches that turn out to be rather similar *(this thesis).*

9. This dissertation illustrates that the management of agro-biodiversity is a field of expertise where ß and γ sciences meet.

10. De discussies over boren op het Wad en toelating van genetische gemodificeerde organismes op de voedingsmarkt geven beiden aan dat het sociale contract van de wetenschap met de maatschappij, en dus ook met de politiek, onder een grote spanning staat.

11. De maatschappelijke discussie over biotechnologie versnelt de sociale herwaardering van de landbouw als middel om voedsel te produceren.

12. A smart shareholder is aware of a company's economic and its stakeholder value.

13. During the past decade "Wageningen" has primarily been concerned with answering the question "Are we doing things right?" rather than "Are we doing the right things?" (questions based on Gunderson *et al.*, 1995).

14. Gezien de eenzaamheid waarin het schrijven van een proefschrift plaatsvindt komt dit overeen met het zoeken naar een juiste balans tussen intellectuele zelfkastijding, zelfbevrediging en zelfverheerlijking.

Stellingen behorend bij het bij het proefschrift
(Propositions accompanying the doctoral dissertation)

Tales of the unpredictable. Learning about institutional frameworks that support farmer management of agro-biodiversity

Walter S. de Boef, Wageningen Universiteit, 27 juni 2000

Tales of the unpredictable

Learning about institutional frameworks that support farmer management of agro-biodiversity

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Tales of the unpredictable

Learning about institutional frameworks that support farmer management of agro-biodiversity

Walter S. de Boef

Proefschrift

ter verkrijging van de graad van doctor
op gezag van de rector magnificus
van Wageningen Universiteit,
dr C.M. Karssen,
in het openbaar te verdedigen
op dinsdag 27 juni 2000
des namiddags te vier uur in de Aula.

CIP-DATA KONINKLIJKE BIBLIOTHEEK, Den Haag, The Netherlands

De Boef, Walter S.

Tales of the unpredictable. Learning about institutional frameworks that support farmer management of agro-biodiversity.

Thesis Wageningen University. With references. With summaries in English and Dutch.

ISBN: 90-5808-238-5

Cover and design: © Maja Voijt, 2000.

Printed by Ponsen & Looijen BV, Wageningen.

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Preface

Old questions, few answers

Finding my way as a plant breeding student in Wageningen, I learnt about participatory research and farmers' experimentation on the one hand, while farmers were considered as passive clients by plant breeders on the other. This contradiction resulted in the following questions sticking to my memory:

> "If farmers are assumed to be passive clients of plant breeding, how would domestication of crops and landraces ever have taken place? Are not farmers experimenters? Do they not select varieties? Is there no way of linking scientific plant breeding directly to farmers' selection? Would such an effort not better serve the needs of poor farmers, than serving them from islands of science such as IRRI?"

When I put these questions to most of my fellow students in plant breeding or professors, they could not provide answers. In fact, quite a few eyebrows were raised. With an exception of Dr Jaap Hardon, a guest lecturer in a course in social, political and ethical issues of plant breeding. Dr Hardon spoke about farmers that select, develop and maintain varieties, when discussing the potential of modern plant breeding to raise production among small-scale farmers in the Third World. He challenged our plant breeding professor. Dr Hardon questioned the function of, and methods used by international plant breeding programmes. He actually referred to my questions.

In 1990, I was fortunate enough to start working at the Centre for Genetic Resources, the Netherlands (CGN), fulfilling my social service by assisting Dr Hardon in his international work. The questions were no longer imaginary; they were real. In this book, I have tried to formulate some answers to them.

Institutional environment

Centre for Genetic Resources, the Netherlands (CGN)

CGN was established in Wageningen in 1985 as the national genebank with Dr Hardon as its Director. The Centre's core programme is based on the implementation of the National Plant Genetic Resources Programme commissioned by the Ministry of Agriculture, Nature Management and Fisheries. The Centre is responsible for the conservation of collections of a range of crops. CGN operates in an international (European) network of genebanks, and works closely together with private plant breeding companies and research organisations in the Netherlands. CGN is an integral part of Plant Research International (formerly called Centre for Plant Breeding and Reproduction Research, CPRO).

Agro-biodiversity Team

In addition to managing CGN, Dr Hardon was an active player in international discussions about agricultural research and plant genetic resources. Particularly the North-South issue and global management of plant genetic resources captured much of his attention. Through his participation in the Keystone Dialogue Series on Plant Genetic Resources (1988-1991), he met a group of people with a keen interest in supporting farmer breeding and conservation of plant genetic resources. In 1991, this group took the initiative to work together in a global programme, the Community Biodiversity Development and Conservation (CBDC) Programme. Dr Hardon assumed responsibility for supporting and institutionally hosting CBDC. It was at this time that he employed me to become his assistant. We used the organisation of the "Local Knowledge and Agricultural Research" seminar in 1992 as a "bridge" between Keystone and CBDC. Wieneke van der Heide joined in; Conny Almekinders succeeded her. Gradually, we became an informal group within CGN/CPRO working with organisations in developing countries on various agro-biodiversity issues. In the book, I refer to this group as the "A-Team" ("Agro-biodiversity Team") that operated as an informal group within CGN between 1993 and 1998.

In 1995, the Directorate-General for International Co-operation (DGIS) requested Dr Hardon and the A-Team to explore ways of supporting agro-biodiversity initiatives in various regions in the world. Using the Convention on Biological Diversity (CBD) as a guiding framework, DGIS decided to give agro-biodiversity a high priority within its environment programme. However, DGIS received few good proposals addressing these issues and therefore decided to actively identify organisations working with agro-biodiversity, to support linkages between these organisations within regional programmes, and to assist them financially in formulating proposals. DGIS commissioned the A-Team to act as facilitator in some initiatives. We were asked to use the approach and experience we had developed setting up CBDC between 1992 and 1994. The A-Team started implementing activities in 1995. In addition to our work in CBDC, we became active in Southern and West Africa, Ethiopia, Southeast and South Asia, the Andean region and Central America. The backgrounds of our colleagues and partners in developing countries were much more diverse than one would expect from actors involved in plant genetic resources conservation. In addition to the CBDC and the DGIS assignments, team members undertook individual consultancies. As a team, we played active roles in participating in and organising international meetings, and compiling

and writing publications on *in situ* conservation, participatory plant breeding and local seed supply.

In 1998, Dr Hardon retired. I resigned from CGN in 1999 to take up a new position with the Royal Tropical Institute in Amsterdam. In the time that I worked with Dr Hardon at CGN, the A-Team had emerged and played a facilitating role during the fascinating and inspiring years following CBD. This period coincides with the time when agro-biodiversity was "hot" in the international arena of agricultural research and development. The A-Team, through its composition of development-oriented scientists operating in international co-operation, has contributed to a range of projects around the world, many of which are currently being implemented. Appendix I provides an overview of projects and activities implemented and initiated between 1990 and 1998. The experiences and knowledge of our extensive network of partners in the South and our personal experiences have resulted in a number of publications, including this book.

Box I Composition of the A-Team

1990-1997	Jaap Hardon (CGN)
1990-1998	Walter de Boef (CGN)
1993-1995	Wieneke van der Heide (CGN)
1995-....	Niels Louwaars (CPRO)
1995-1999	Conny Almekinders (CGN)
1996-....	Joost van der Burg (CPRO)
1996	Michiel Hoogendijk (CGN)
1997	Maurice Starren (CGN)
1997-....	Bert Visser (CGN)
1997-1998	Anne Elings (CGN)

Learning environment

Due to its growing and variable agenda, the A-Team has grown and changed continuously as far as size and composition are concerned. Box I gives an overview of team members while I worked for CGN. Other CPRO researchers joined the A-Team to assist us in performing some activities. DGIS' challenging assignment and the innovative nature of CBDC have contributed to a creative working environment. Flying around the world with a full agenda and working with many inspiring people, we became a rather chaotic group full of energy and ideas. It became clear that the nature of problems and issues we faced in various countries broadened CGN's conservation and research mandate. Gradually we became involved in participatory plant breeding and local seed supply. The formulation phase of various projects and discussions with CBDC-partners have changed our ideas about management and conservation of crop genetic diversity. Our involvement in these projects in the South has created opportunities for learning in an intensive, dynamic and challenging manner. Our informal group culture developed rather autonomously in directions not always congruent with the institutional culture and professional environment of the agricultural research establishment in the Netherlands to which we belonged. The A-Team with its partners has been the principal intellectual and learning environment in which I have been working for eight years. My colleagues in the A-Team, and the people working as our partners in the South, have become co-learners and co-researchers in the work that is reflected upon in this book. These experiences constitute the basis for the perspective on and opportunities for studying the creation of an institutional framework supporting the development and implementation of "on-farm management" of agro-biodiversity, the main subject of this book.

Learning leads to changed perspectives

Working in plant genetic resources, our original focus concerned the development of methodologies of and approaches to *in situ* conservation and "on-farm management" of agro-biodiversity. The context of the Convention of Biological Diversity made us explore ways to link conservation of agro-biodiversity with sustainable utilisation and development, thus widening our scope:

- bridging scientific disciplines, we started recruiting and working with people with a diversity of backgrounds and active in other fields than plant genetic resources and breeding (such as agronomy, farming systems research, social sciences, legal and political sciences);
- taking genetic diversity and its use as starting points, we integrated diversity and conservation aspects into plant breeding, seed supply and variety and seed legislation;
- using a "systems' perspective", we learnt to look beyond conservation, research and plant genetic resources, and link with biodiversity, product and chain development, nature management, conservation and management of livestock genetic diversity and forest biodiversity;
- realising that participatory methodologies are crucial to the implementation of "on-farm management" of agro-biodiversity", we gradually developed our expertise in participatory approaches to conservation, plant breeding and seed supply, but also in institutional aspects such as facilitating planning, organisation and implementation, and monitoring of integrated projects;
- using interactive approaches, we started working with other organisations than those directly involved in plant genetic resource conservation, such as non-governmental organisations, universities, and centres in national and international agricultural research systems;
- working in the South and being financed through development funding contributed to using a development focus in our activities and approaches instead of focusing on plant genetic resource conservation and research.

The orientations described above have motivated the team and its partners to use alternative approaches to conservation, research and development. Through this diversity, our professionalism has been challenged to work with multiple realities. With our changed professionalism, our research paradigm has changed as well. We started using a constructivist instead of a positivist approach to research, although we had been trained to use the latter. We pursued process approaches to development-oriented and participatory research, facilitated social learning and pursued actor-oriented approaches to research. Taking into account our "hard-science" training and background, the change had been made intuitively, learning by experience. I realise that the change in paradigm has not been unique but could be considered part of a general trend in development-oriented research. The shift has forced us to widen our perspective, by which we became even more estranged from our conservationist and positivist professional environments. We have explored alternative frameworks in which utilisation, development and conservation had been integrated. I consider this book a conclusion to this joint and personal exploration.

Acknowledgement

I would like to thank all those people who have contributed to and supported me in writing this book.

Dr Niels Röling has been of great inspiration to me. He has guided me to study and learn about some exciting perspectives that I used to reflect upon my experiences. He has supported me in the challenge to write a thesis based on eight years' experience. His questions have been crucial to shape and structure my perspectives on "on-farm management". Niels thanks for your views and guidance. Through interesting discussions with Dr Jan Engels, I could sharpen my ideas and draft chapters, and get direct feedback from a person with an extensive knowledge and expertise in plant genetic resources management and conservation. Jan Engels has encouraged me to develop rather unconventional perspectives within a PGR context. In addition, he has provided considerable inputs for this book. I would like to thank Jan and his wife Eimelt for their support and the pleasant "study-weekends" in Rome and Umbria. The activities that I reflect upon are based on the eight years I worked for the CGN. Dr Jaap Hardon has introduced me to, and stimulated me in operating in field of agro-biodiversity conservation and international co-operation. Jaap thanks for your inspiring guidance.

In this book, I call my closest colleagues at CGN and CPRO, the A-team. It formed an inspiring and pleasant working and learning environment. I would like to express my gratitude to Conny Almekinders, Wieneke van der Heide, Michiel Hoogendijk, Maurice Starren, Niels Louwaars, Joost van der Burg and Anne Elings for the inspiring team spirit and friendship. I want to thank my CGN colleagues for their interest and support. Special thanks to Helga for her friendship and support, and Liesbeth for her never ending interest. I would like to thank Ton, Leny, Rini, Bertha and other CPRO colleagues for supporting me in a friendly manner in the administration of often complex matters relating to co-operation with organisations in the South. I would like to express my gratitude to Dr Nic Hogenboom, who made the suggestion to ask Niels Röling to act as my supervisor in my PhD-study. I guess I am one of the first from his institute who has completed a social science PhD thesis.

Partners in the various projects in the South have been my overseas colleagues. I thank them for their friendship and sharing with me many lessons that have been crucial to my study. In the book, I reflect on activities that have been financially supported by a range of donors, in

particular DGIS. I want to mention SIDA in Sweden and IDRC in Canada. They have been supporting various CGN activities in which I have been involved.

At the Chair Group Communication and Innovation Studies of Wageningen University, I have found a very pleasant place to study. For three years, I have been coming and going. I want to thank Joke and Sjoukje for their support. I enjoyed the special spirit of being one of many other PhD students walking around at the Chair Group and the University. I want to thank Marleen for the comradeship and wish her good luck with the final pages, my "buurman" Dominique for his friendship and the introduction of the "cradle", and. Julio and his wife Martha for their "amizade".

Simone Kortbeek of the Royal Tropical Institute (KIT) provided me with an opportunity to plan a study leave before my start in Amsterdam. I would like to thank Anne Stanneveld for creating room for completing the study while working at KIT. I would like to thank my colleagues for their interest and support.

When I decided to write the case study chapter based on some projects, it was clear that I wanted to write these chapters with inputs of various people directly involved. I would like to thank Joost, Karma and Dr Asibey. Special thanks to Devra Jarvis for her open and constructive position towards me studying her project. Anke, thanks for being my Roman landlady. Various persons have read drafts of one or more chapters. I would like to thank them for their inputs: Conny Almekinders, Niels Louwaars, Chris Enthoven, Jan Koeman, Guido Ruivenkamp, Loek van Soest, Bert Visser, Trygve Berg and Camila Montecinos.

I would also like to thank those, who have directly contributed to this book. Maja Voijt has designed the cover and supported me in the design of the layout. Arnoud Budelman made final checks on details and mistakes I could no longer find. Ilonka Barsony of KIT has translated my Dunglish into English. Ilonka, during the final months while completing this book, we became a wonderful team. Sorry for my preference to writing in the present and my use of metaphors. Thanks "for your hand in almost every sentence of this book".

My friends have encouraged and supported in their own ways. Thanks to Ria (for maintaining a hotline), Joyce (rebuilding me while travelling) and Thies (for keeping your promise), Jan, Renate, Ellen, Hans, Monique, Anneke, Anita, Jos en mijn cluster. I thank my parents for their encouragement during the long path of a "promotion" and listening to my stories. Gerth-Jan & Linde thanks for your interest. Finally, I would like to thank Paul for his patience and for remaining truthful to himself.

Walter de Boef
Wageningen, 14 May 2000.

Part I

Introduction

1

Research framework

Attempts to develop and implement *in situ* conservation and "on-farm management" of agro-biodiversity have been initiated since 1990. They have resulted from a growing attention to local management of biodiversity and have been strongly supported by the Convention on Biological Diversity (CBD). Increased recognition of the importance "on-farm management" to sustainable agricultural development has contributed to this interest. Biodiversity is considered an important component that increases "ecological resilience" of agriculture. With a higher degree of agro-biodiversity, agro-ecosystems are assumed to be better able to respond to unpredictable ecological, social and economic "surprises". Conservation organisations and many other actors involved in crop development (such as plant breeding and seed production) have started activities that aim to support and strengthen farmer agro-biodiversity management. The scope of this book is to study the social construction of a conservation strategy referred to as "on-farm management" of agro-biodiversity. Other elements of the book include the study and elaboration of institutional frameworks that encourage farmer management of agro-biodiversity. This chapter presents the research framework; it introduces the objectives and research questions, the research process and the outline.

1.1 Objective

The objective of the book is to construct a socio-ecological perspective on "on-farm management" as a conservation strategy to assist actors involved in crop development in supporting farmer agro-biodiversity management. Herewith, I aim to develop a theory that can inform the practice of actors involved in crop development and conservation. I use two socio-ecological perspectives to systematically develop a praxeology.

1.2 Scope, case studies and perspectives

Scope: institutions and "on-farm management"

Activities of conservation organisations to support "on-farm management" of agro-biodiversity as a means to implement the strategy differ from "normal" conservation practices (primarily *ex situ* conservation). Conservation organisations "control and freeze" ecological and genetic processes in genebanks in order to maintain the germplasm. An objective of "on-farm management" is the continuation of social and ecological processes, within which farmers are key players. A new relationship emerges between farmers and conservationists. Development objectives need to be integrated within conservationists' activities. Such a shift has implications for the conservationists' professionalism and the institutional framework in which they operate. Existing technical agronomic and genetic expertise is complemented by skills in participatory and interactive research, and expertise in facilitation in the establishment of platforms for joint agro-biodiversity management and social learning. Conservation organisations link with other crop development actors; their mandate is revised because development goals are added. With my focus on the social organisation of "on-farm management" of agro-biodiversity, I concentrate on changes in professionalism and institutional frameworks, rather than on the strategy's practical and technical implementation.

The focus of the book is the social organisation of "on-farm management" as a conservation strategy. Structures and dynamics of organisations that may be expected to contribute to agro-biodiversity conservation have been examined. Hence, I focus on organisations and to a lesser extent on the key players in "on-farm management", the farmers. With respect to farmers' knowledge, practices and management of agro-biodiversity, I draw on a large number of detailed sociological, anthropological, agronomic and genetic studies that describe and analyse farmer agro-biodiversity management. Van der Heide *et al.* (1996) reviewed and compiled a bibliography that covers many of these studies.

A-Team, agro-biodiversity projects and case studies

The Agro-biodiversity Team (A-Team) at the Centre for Genetic Resources, the Netherlands (CGN) via a range of activities contributed to the development and implementation of the "on-farm management" strategy. The A-Team encountered a major barrier that it tried to bridge. Actors involved in crop development and conservation have diverse and often conflicting perspectives on how "on-farm management" may be achieved. This barrier needs to be bridged for "on-farm management" as a strategy to become effective. The strategy of the A-team was to bring together various actors in what were called "agro-biodiversity projects". "Partners in the projects" engaged themselves in the interactive design and implementation of biodiversity conservation and development strategies. Experiences of actors and processes of social learning in these platforms are reflected upon in the book.

In the case studies, I particularly refer to interactions between organisations involved in these projects. Writing these case studies, I have drawn on experiences shared with other members of the A-team and with people working in various partner organisations between 1990 and 1998. Appendix I provides the list of the team's agro-biodiversity projects, workshops and books published. The "tales" are illustrations of experiences of people and professionals in conservation and plant breeding programmes in international and national agricultural research centres, and non-governmental and farmer organisations.

Socio-ecological perspectives

In the past decade, interest in "on-farm management" of agro-biodiversity has grown. However, its practical implementation has lagged behind. Many people involved in conservation, research and development have questioned "on-farm management" as a conservation strategy. Practitioners have been faced with professional and institutional barriers. This book responds to these questions and barriers using two socio-ecological perspectives. They have been developed in applied social sciences and ecosystem management. These perspectives place organisations in a flexible and learning environment that encourages sustainable agricultural development and natural resource management. As "normative perspectives", they have assisted me in the design of the structure of the case studies.

The first perspective is based on "adaptive management". This perspective contributes to management of complex situations where human and ecological processes are interwoven, where society and nature cannot be separated. It is a perspective that may be used to design human institutions that are better capable of responding to ecological uncertainty and surprise. It has been developed in response to current environmental problems that in most cases are human induced. Adaptive management emphasises ecological functions and structures, rather than social and economic forces. Facilitation of social learning and the creation of flexible management institutions are inherent to the approach. The perspective has successfully guided change in and renewal of the management of large-scale ecosystems (Gunderson *et al.,* 1995a; Berkes *et al.*, 1998). It is currently used as a new paradigm to respond to social and ecological crises in agriculture, natural resource and nature management. I use the perspective to address ecological, social and institutional dynamics in agro-biodiversity management.

The "ecological knowledge system" perspective has been developed to emphasise social and institutional aspects ("socio-sphere") of ecologically sound agriculture (Röling & Jiggins, 1998). Five dimensions form the ecological knowledge system: (i) ecologically sound practices, (ii) learning, (iii) facilitation, (iv) supportive institutions and networks and (v) conducive policies. A soft system approach has been used for its development. Social actors form a soft system to the extent that they become collectively engaged to form a system through jointly agreed and negotiated goals and activities. Such a soft system facilitates processes of social construction and learning (Checkland & Scholes, 1990). Attributes of the soft system approach are used to further develop a perspective on "on-farm management" of agro-biodiversity and elaborate strategies for its further development and implementation. This second socio-ecological perspective has particularly guided me to focus on identification of social actors, flows of knowledge and information between various actors and the formation of platforms for resource use negotiation. It has particularly drawn my attention to processes of social learning within the projects and organisations described. Social learning draws attention to procedures and incentives that encourage people to learn together (Röling & Jiggins, 2000) and join in agro-biodiversity management.

1.3 Research questions

The book is guided by four research questions. The first two questions focus on the social construction and social organisation of the "on-farm management" strategy. The third question links these questions with the socio-ecological perspective. The fourth question reflects upon the perspectives used in this book (Box 1.1). In the research process covered in the book, I return regularly to the box with research questions and gradually refine them to the research questions answered in the concluding chapters.

Box 1.1 Key research questions (I)

i. In what way is "on-farm management" of agro-biodiversity as strategy constructed?

ii. What is the social organisation for the development of the "on-farm management" strategy?

iii. What are the implications of using a socio-ecological perspective for the institutional crop development and conservation frameworks?

iv. What can be learnt about the socio-ecological perspectives while using them in the study of institutional aspects of agro-biodiversity management ?

1.4 Research process

The research process involves four steps:

i) Institutional aspects of the social construction and organisation of "on-farm management" of agro-biodiversity are identified to define the problem being addressed;

ii) Research methodologies and socio-ecological perspectives are identified and elaborated. The perspectives increase understanding of the problem and provide tools for development of a theory that can inform practice (praxeology);

iii) Case studies are presented that describe and analyse processes of social construction and the social organisation of "on-farm management";

iv) Based on the socio-ecological perspectives and the case studies, a praxeology is developed in which the creation of an institutional framework that supports farmer management of agro-biodiversity is addressed.

These four steps correspond with the four parts of the book (I) introduction, (II) socio-ecological perspectives, (III) case studies and (IV) conclusions.

1.5 Outline of the book

Part I contains four chapters including the current chapter on the book's research framework. Chapter 2 provides a general introduction to "on-farm management" of agro-biodiversity. Literature and current trends with respect to farmer management, agro-biodiversity, and loss and conservation of agro-biodiversity are reviewed. Conservation strategies are classified using a range of criteria. Actors involved in crop conservation and development are described. Current interactions between these actors in crop development are described. In Chapter 3, the problem being addressed in this book is elaborated in a description of the social organisation and construction of "on-farm management". Chapter 4 introduces the methodologies used in the book.

Part II includes three chapters that introduce the two socio-ecological perspectives and introduces the use of perspectives to organise and structure information in the case studies. The

"adaptive management" and "ecological knowledge system" perspectives are introduced in Chapters 5 and 6. The perspectives provide inputs for the development of "windows of reflection" that structure and focus the case studies (Chapter 7).

Part III presents five case studies. Chapter 6 provides an introduction to the projects and organisations described in the case studies. The case studies provide stories about attempts to construct the "on-farm management" as conservation strategy and to link conservation and utilisation. They also reflect on the social organisation of the development of the approach or development of the link. Chapters 9, 10 and 11 are based on projects, organisations and experiences in the Netherlands, Bhutan and Ghana. Chapters 12 and 13 are based on the IPGRI *in situ* project and the Community Biodiversity Development and Conservation (CBDC) programme.

Part IV contains two chapters that synthesise the book's outcomes. In Chapter 14, I aim to contribute to the utilisation and development of the two socio-ecological perspectives. In Chapter 15, a praxeology is developed that addresses the social construction of strategy to support farmer management of agro-biodiversity and the social organisation of the strategy's development. This chapter concludes with a theoretical elaboration on the development of an enabling institutional framework that supports farmer management of agro-biodiversity.

2

Farmers and conservation of agro-biodiversity

This chapter gives a general introduction to "on-farm management" of agro-biodiversity. In the first section, I describe farmers and their management and utilisation of local varieties on the basis of three stories told by farmers whom I met in Brazil, the Philippines and Belgium. These stories serve to illustrate farmer management of crop genetic diversity. In the following section, I introduce terminology used in the book. A distinction is made in terminology between agro-biodiversity, crop genetic diversity and plant genetic resources. A historic overview is given of the development of *ex situ*, *in situ* and on-farm conservation strategies. These strategies are analysed, and a framework for their classification is provided. In the final section of this chapter, I use a systems perspective to describe the activities of farmers and organisations in crop development, and elaborate on the interactions between various actors in crop development systems. This perspective illustrates the position of farmers and conservation organisations located at the two ends of a linear flow of germplasm, knowledge and information. On the one hand genebanks collect from farmers, whereas farmers obtain seeds of improved varieties at the end of the chain. In the final section, I briefly describe the various levels and domains at which actors involved in agro-biodiversity management operate.

2.1 Farmers and their varieties

Oscar and his maize varieties in the Colônia (Rio Grando do Sul, South Brazil)
Oscar lives in Rio Grande do Sul in the South of Brazil in an area with small-scale farmers. I met Oscar in 1995 during fieldwork for an ICRA-study. Oscar is in his mid-forties and has two children. Oscar's grandparents had been immigrants from Italy. Oscar and his wife own a small farm in the hills; their cash crops include peaches and some vegetable crops. In addition, they cultivate many other crops and have some livestock and pigs for home consump-

tion. His farm and the agro-biodiversity used are quite typical of the region in Southern Brazil. Oscar cultivates maize as a cash crop, as animal feed and for home consumption. He plants hybrid maize varieties at approximately half his maize fields. The hybrids are released by Agro-Ceres, a Brazilian subsidiary of Monsanto. In "good" years, the yield of these hybrids is high. He grows them on fertile soils that have a good access to irrigation or that are relatively wet. He applies inorganic fertiliser to increase yields. He thinks the expected high yield is worth the risk. Oscar realises that in years of drought, the economic balance may turn negative, because hybrids produce very little to nothing in those years. He therefore plants four "criollo" varieties on his drought prone fields. In good years, they produce less than half of what the hybrids yield. The "criollos" are more drought tolerant, store better and possess other qualities. Even pigs seem to appreciate one of the "criollos" more. He primarily uses the local varieties for home consumption. He uses three local varieties as animal feed; the other one is excellent for preparing "polenta", a traditional Italian dish. Oscar describes the "criollos" as robust. He inherited them from his grandfather; he took the varieties with him on his trip from Italy to Brazil. In addition to appreciating them for their robustness, Oscar takes pride in keeping his grandfather's varieties alive. He has started to teach his youngest son how to maintain the "criollos" pure, and not mix them with other varieties through separate cultivation and seed selection. Some of the other farmers in the community consider Oscar old-fashioned because he spends much time on keeping the varieties alive. Oscar considers maintaining the varieties his duty while they help him in avoiding risk in farming.

Immaya and her rice varieties in the Ifugao (Northern Luzon, the Philippines)

Mrs Immaya is a rice farmer in the Ifugao. I met her in 1989 during fieldwork for my studies at Wageningen University. When we met her, Mrs Immaya was about 60 years old; she owned a few rice paddies on which she cultivated eight rice varieties. The rice she grew was intended for home consumption. She belongs to the Ifugao peoples, who are famous for their rice terraces. Up until the 1950s, the Ifugao had been a rather closed society. Management of the terraces, rice and rice landraces was and to a large extent still is interwoven in Ifugao culture and society. The rice crop and its traditional varieties are believed to link living generations to their ancestors. As a consequence, Ifugao farmers are reluctant to change crops and varieties. Mrs Immaya cultivated two types of rice, one for staple food, the other for making traditional rice wine. She cultivated five "food" varieties. Three of them included traditional *tinawon* landraces. She grew two more recently introduced varieties called *pinidua*. The variety she likes most was an introduced variety called *Palawan*. Years earlier, she had obtained it from a relative living in a lower area. She experimented with *Palawan*; it performed well and became her highest yielding variety. She provided many of her neighbours with *Palawan* seeds. Generally, *Palawan* performed well; it has a good food quality and is resistant to some of the major diseases. Mrs Immaya believes *tinawons* will gradually be replaced by *pinidua*-like varieties. She indicated that many of her neighbours were reluctant to plant new varieties because tradition would not allow such change. Immaya believed that in the end "new" diseases and pests would destroy local varieties. In addition to the food types, Mrs Immaya grew three rice wine varieties, including two traditional Ifugao landraces and an introduced variety. She introduced the new variety some years ago. Her daughter's mother in law had given it to her. She tried it on one of her small paddies; the yield was really high. Again she shared seeds with her neighbours. Even though this variety's wine gave a headache she liked its high yield. Brewing rice wine, she mixed it with grains of traditional landraces. Mrs Immaya indicated that she could

not conserve all her mother's rice varieties, she has lost one. She pointed out that even though her ancestors would be angry, she did not regret losing this one. It was extremely vulnerable to rice weevils. As insects destroyed the landrace, she did not consider the loss her fault. She has been able to conserve all other varieties, in fact she had identified two new and popular varieties for her community (Osman, 1990).

Frans Bergen and his traditionally grown Brussels endive varieties (Belgium)

Frans Bergen is a traditional "witloof" (endive) farmer in the neighbourhood of Brussels. I met him in Antwerp in 1999 during a seminar on seeds, culture and sustainable agriculture. The "witloof" crop was developed in his region in the late 19th century. Its scientific name is *Cichorium intibus* L. The English name "Brussels endive" is based on this origin. The crop produces buds that grow on replanted chicory roots of which the original leaves have been removed. The heads grow in the dark, resulting in the production of white leaves. The Flemish name of "witloof" refers to these white leaves. Frans belongs to a group of farmers engaged in traditional "witloof" cultivation. Instead of producing the buds in a completely controlled and industrial aquaculture system, they grow them in the soil. The production system is referred to in the name of their product, "Brussels Grondwitloof". No pesticides are applied; in fact its cultivation has not changed since the 1880s with the exception of an increased level of farm mechanisation. In the Brussels area, "witloof", produced by Frans and his colleagues, is considered of superior quality; the price is about 25% higher than "aquaculture witloof". In Western Europe traditional cultivation practices have almost completely disappeared. With this change, old varieties have almost entirely disappeared; modern farmers use a limited set of varieties developed by Dutch and French breeding companies. Modern varieties cannot be used in traditional cultivation. Traditional farmers have maintained and still maintain their own selections. Frans uses five selections that correspond to five growing seasons. He selects roots that perform well and grows them in the field for seed production. His father has passed on selection and seed production techniques and now he passes them on to his son. Through use, Frans maintains his grandfather's selections. He indicates that over the years these selections have changed. Farmers who produce traditional "witloof" have formed a group to improve marketing opportunities. With the growing markets for ecological and regional products in Europe, he hopes his son will carry on his grandfather's tradition and if no alternatives are available will keep using his "witloof" selections.

Farmers and "on-farm management" of local varieties

Farmers are key players in conservation strategy referred to as "on-farm management" of agro-biodiversity. In this book I concentrate on institutions and organisations. In one way or another, these organisations work with and for farmers such as Oscar, Immaya and Frans. They are examples of farmers I have met over the years. Talking about varieties always leads to interesting stories, each telling a specific history and details, teaching me, a stranger, some lessons about farmers' management and use of crop genetic diversity. The three short stories are illustrations of farmers and their varieties. For years scientists have been working with single groups of farmers, studying their management of crop varieties in detail. I build upon these studies and experiences. In 1995, the A-team compiled an annotated bibliography on local crop development. It contains 90 papers that describe farmers' practices and related knowledge of agro-biodiversity management and crop development (Van der Heide *et al.*, 1996). Almekinders & de Boef (2000) provide a more recent collection of papers by various

authors on farmers' management and utilisation of agro-biodiversity, which includes cases from various countries around the world and Prain & Hagmann (2000) describe some general trends. This book will neither discuss agro-biodiversity management at farmer nor at the community levels. These are not the levels at which I have gained experiences. Instead, the book refers to institutions that support and organisations that work with farmers in "on-farm management". The book focuses on the creation of institutional frameworks that serve as enabling environments to the development and implementation of "on-farm management" as a conservation strategy.

2.2 Biodiversity and agro-biodiversity

Biological diversity: three levels

Biodiversity or biological diversity refers to the variety of life forms, the genetic diversity they contain, and the assemblages they form. I follow the Convention on Biological Diversity (CBD) that distinguishes three levels: (i) genetic diversity, (ii) species diversity and (iii) ecosystem diversity (UNEP, 1992). Genetic diversity refers to the variation for the basic unit of inheritance, DNA that controls the genetic identity of all living organisms. Species diversity refers to the diversity among organisms; i.e., species of plants in forests, micro-organisms in the soil, fish in rivers and birds in gardens. Ecosystem diversity is both the sum and product of the other two diversity levels. The diversity of species and populations within species constitute an ecological community that has developed or evolved in its physical and chemical environment, with adjacent ecosystems and the atmosphere. Synergistic feedbacks between organisms and their environment sustain the structure and functions of ecosystems. Ecosystems or habitats contain thousands of species that interact with other species and the environment. Ecosystem diversity is the whole of interactions of species and genetic diversity and the surrounding environment.

Ecosystems, biodiversity and ecological services

Ecosystems play a fundamental role in supporting life on earth. This "life-support" system is essential to human existence, agriculture and economic activities. Ecosystems are essential to global material cycles (e.g., carbon, oxygen, and water); they produce ecological services and renewable resources. Barbier *et al.* (1994) define ecological services as ecosystem functions currently perceived to support and protect human activities or affect human wellbeing. They include supply of irrigation and drinking water, recycling of nutrients, maintenance of soil fertility, pollination of species and provision of food, but also aesthetic values such as conservation of scenery and landscapes. Sustenance of species and a vast genetic library of organisms by ecosystems are important ecological services. Ecosystems generate and sustain natural resources and ecological services. Biodiversity is an important property of ecosystems for a continued production of these services and resources (Costanza & Folke, 1996). Thus loss of biodiversity leads to a reduced capacity of ecosystems to continue producing ecological services and renewable natural resources. In the case of agro-ecosystems, agro-biodiversity is considered one of these ecological services.

Loss of biodiversity, resilience and ecosystems

Humankind is facing global environmental problems that are partially interrelated; they include climate change, air, water and soil pollution, limited availability of drinking and irrigation water and loss of biodiversity. The first problems feature prominently on scientific and policy agendas; loss of biodiversity features less prominently, as the impact on human's livelihood and economy seems less evident. Perrings *et al.* (1995a) provide two arguments for the conservation of genetic and species diversity: (i) genetic properties of a range of species are of direct value to human consumption and utilisation in their livelihood; and (ii) species perform ecological services and provide renewable natural resources with a direct value to human society. Genetic diversity of these species is crucial to maintain the natural capacity to respond to change. Perrings and colleagues indicate continuation of ecological functions as a major anthropocentric reason for biodiversity conservation. The resilience of ecosystems, or the capacity to continue responding to environmental surprises in a dynamic manner, is an emerging property of the whole of an ecosystem's ecological functions (Holling, 1986; 1995). Based on ecological economy, biodiversity loss is associated with depletion and/or deletion of species and genetic diversity, that may be translated into reduction of an ecosystem's (potential) economic value (Ehrlich, 1988). It is also associated with decreased ecosystem resilience or reduced sustainability of ecological services crucial to human society.

Levels of agro-biodiversity

Since CBD, biodiversity used in agriculture has been referred to as agro-biodiversity. It is defined more accurately as including all crops and livestock and their wild relatives, and all interacting species of pollinators, symbionts, pests, parasites, predators and competitors (Qualset *et al.*, 1995). For agro-biodiversity, three levels similar to biodiversity may be distinguished: (i) varietal and other genetic diversity, (ii) crop, animal and other species' diversity and (iii) farming systems or agro-ecosystems diversity. Genetic diversity in agriculture can be recognised as the crop varieties, animal breeds and diversity within species directly or indirectly used in agriculture or provide ecological services (trees, fungi and other micro-organisms). One character of agro-biodiversity distinguishes it from natural biodiversity: agriculture is a way of humankind to use natural biological and physical resources to feed itself, to cure, construct shelter, manufacture clothing, and earn income and to manage the natural environment. The role of farmers in the development of diversity in agriculture is crucial. Not only natural pro??cesses and conditions have contributed to the creation of agro-biodiversity; cultural and social diversity encountered in humankind has had a guiding hand in its creation. Farmers cultivate and use diversity for specific purposes (e.g., health) "rooted" in people's belief and knowledge systems. These systems are considered to constitute the fourth level of agro-biodiversity (WRI *et al.*, 1992; Gonese & Haverkort, 2000). With respect to biodiversity management in forests, various authors have indicated that it is an illusion that natural forests may be conserved, while ignoring local and indigenous peoples in management of natural processes (Gadgil *et al.*, 1993; Alcorn & Toledo, 1998; Begossi, 1998). These authors support the position that biodiversity management and utilisation should be considered important components of its conservation. A similar argumentation applies to agro-biodiversity management. Because of the human component of agro-biodiversity, participation of local communities in management and conservation is a condition to the continuation of agro-ecological processes.

Agro-biodiversity and plant genetic resources

In the practice of plant breeding and conservation of biodiversity in crops, the term "plant genetic resources" is used. "Plant genetic resources" are defined as all plant materials with an actual or potential value" (IBPGR, 1991: pp. 74). Wood & Lenné (1999) particularly refer to interactions of "food agro-biodiversity" with other agro-biodiversity within agro-ecosystems. The "other" includes pests, pathogens, pollinators and much else, and they are considered important in determining whether or not there will be more food or less. Based on an ecological perspective on biodiversity, "plant genetic resources" cannot be maintained as a synonym for "agro-biodiversity" or more specifically "crop genetic diversity". Instead of a resource, agro-biodiversity is considered an ecological service provided by agro-ecosystems. Plant genetic resources have a political connotation, because of its association with the potential economic value (Pistorius & van Wijk, 1999). In this book I make use of the terminology of ecologists, who generally refer to the terms "agro-biodiversity" or "crop genetic diversity". These terms refer to the ecological and social dynamics of biodiversity in the agro-ecosystem. The objective of *in situ* conservation and "on-farm management" is not only to "conserve" but also to support and strengthen these dynamics.

2.3 Loss of (agro-) biodiversity

Dynamic nature of biodiversity

The diversity of life has never been and never will be static. The structure and functioning of the various ecosystem components and the ecosystem as a whole are sustained by synergistic feedbacks between organisms and environments (Perrings *et al.*, 1995b). Diversity fluctuates in time as evolution adds and eliminates species and genetic diversity, and changes the genetic composition of species. Evolution and extinction are natural processes; they are the responses of populations of organisms to changes in their environment. Jablonski (1991) has put the dynamics rather explicit as he stated that "change is, in a very real sense, a basic fact of life".

If change is a norm, why are we concerned about the loss of biological diversity? Current losses have a different origin, order and magnitude compared to those recorded earlier. Box 2.1 presents some of the causes. Above all, independent decisions of individual users of natural and biological resources, and the environment in general, are important. Extinction of species has been the incidental and usually unanticipated consequence of an economic activity that has destroyed a habitat (Perrings *et al.*, 1995a). This is the case with thousands of species

Box 2.1 Major causes of loss of biodiversity

- direct destruction, conversion, or degradation of ecosystems; processes that result in loss of complexes of various species;
- overexploitation, habitat disturbance, pollution, and the introduction of exotic species accelerate the loss of individual species within ecosystems;
- selection pressures that arise directly and indirectly from human activities may result in loss of genetic variability;
- exploitation, the presence of chemical toxins or changes in climate may eliminate some genetically different parts of a population yet not cause extinction of the entire species;
- the accelerated rate of destruction of habitats, particularly in tropical forests.

Sources: McNeely *et al.*, 1990; Soulé, 1991

that annually become extinct due to destruction of tropical rainforests and coral reefs (Myers, 1988). Biodiversity loss is caused by changes in ecological systems, but root causes include social, economic and political processes that operate on a scale that affects the earth as a global ecosystem. These global changes are extremely complex and unpredictable. Possibilities for individual human interventions are limited. Only joint actions of people in the North and South, farmer and consumer groups, organisations and individuals may reverse this trend (Röling & Jiggins, 2000).

Genetic erosion in agriculture

In agriculture, human's leading hand in the domestication of biodiversity shapes the diversity of living forms. Agro-biodiversity, in this human-natural interaction, develops with a continuous gain and loss. However, in the 20th century the balance turned to loss. Most prominent is the "loss of crop genetic diversity" or "genetic erosion". The process of replacement of landraces by modern varieties is often equated to loss of genes, and is consequently called "genetic erosion". However, agricultural processes must also be examined beyond the loss of these landraces and pay attention to loss of genes, gene combinations, or allelic forms. The irreversible loss of genes is of major concern. Plant varieties disappear without a corresponding loss of genetic diversity, as the genes in a lost variety may continue to exist in other varieties cultivated elsewhere. With the loss of landraces, unique combinations of genes of a particular value or immediate utility may disappear.

The spread of modern agriculture is considered a major cause for genetic erosion. In the 1996 world survey on the status of plant genetic resources (FAO, 1996), replacement of landraces by modern varieties is most frequently cited causing genetic erosion. Brush (1992) indicated that the equation "introduction of varieties = loss of genetic diversity" does not capture the complex processes of varietal change. When modern varieties and landraces "compete", this could result in loss of diversity if the introduced varieties are less diverse or if they replace various landraces. Regular introduction of genetic material does not necessarily result in genetic erosion, but may increase available genetic diversity. Examples of germplasm introduction and farmers' adoption that have resulted in a higher level of genetic diversity are given for rice in Thailand (Dennis, 1987), potatoes in Peru (Brush *et al.*, 1981), maize in Mexico (Bellon & Brush, 1994; Louette *et al.*, 1997) and beans in the Great Lakes region of Central Africa (Sperling & Loevinsohn, 1993).

Landraces: their dynamic nature

Louette *et al.* (1997) studied farmers' management of maize varieties in Mexico. They describe the open and dynamic nature of local maize varieties.

> "A farmer variety is (...) mutable in terms of the number, original, and genetic composition of the seed lots that compose it. In and of themselves local varieties constitute systems that are genetically open. On the other hand, the geographical point of reference for the term "local variety" is revealed to be larger than the community itself. The genetic diversity of a variety is traceable more than the community itself, because seed lots of external original are regularly added to those of local landraces that are then locally reproduced. These practices may be a means for adding diversity to locally adapted cultivars" (*Ibid.*: pp.36).

Landraces (or local varieties) are variable populations of cultivated plants (Frankel, 1971; Frankel & Brown, 1984). Thurston *et* al. (1999) provide a broader definition for landraces as populations or races that have become adapted to farmers' conditions through natural and

artificial selection. They contrast them with modern varieties that have been selected or bred for certain traits (such as high yield, short stature, or response to fertilisers) using scientific methods. Through processes of natural and human selection, landraces are adapted to the environment in which they have evolved; they are managed and maintained by farmers. In open-pollinated crops such as maize, "creolised varieties" are improved varieties that have mixed with landraces in farmers' fields for several years. Genetic variation of landraces may be substantial but far from random. Conservationists hold a different perception of landraces compared to farmers. The farmers' dynamic and unpredictable perspectives on landraces make it rather difficult for conservationists to design strategies for conservation of these varieties.

Loss of indigenous knowledge

In addition to physical loss of allelic forms, gene combinations, genes or landraces, a similar process of erosion threatens indigenous knowledge related to a diversity of crops and varieties. This process of "knowledge erosion" includes the loss of knowledge of and practices of cultivation, use and processing (minor) crops and their specific landraces. Modernisation of agriculture and society leads to globalisation of agricultural practices. Monica Opole (personal communication) from Kenya refers to rural women's knowledge about cultivation and use of indigenous leafy vegetables. Women have started to send their daughters to school where they learn how to grow tomatoes and cabbages to become good and modern farmers. These mothers have started to realise they no longer teach their daughters aspects of collection and utilisation of indigenous leafy vegetables. Not only knowledge of species is lost but also knowledge of their medicinal and culinary properties and ways to process the vegetables.

Indigenous knowledge has a strong social context and differs from scientific knowledge in being moral, ethically based, spiritual, intuitive and holistic. Based on a large number of studies, Berkes *et al.* (1995) indicate that social relationships cannot be considered separately from relationships between human and non-human entities. They indicate that mind and matter cannot be disconnected. An important element of indigenous knowledge is its foundation in long-time series of people's observations of particular ecosystem, species or crop diversity. Berkes *et al.* (1995) refer to indigenous knowledge as complementary to scientific knowledge. However, this complementarity has remained unexplored in many efforts currently undertaken to support local management of biodiversity. Indigenous and scientific knowledge have only to a limited extent been integrated into efforts to respond to, and reverse loss of biodiversity. Indigenous knowledge of agro-biodiversity may be distinguished as the fourth level of agro-biodiversity, which because of the human-ecological interaction in the agro-ecosystem is difficult to separate from other levels of agro-biodiversity.

2.4 Conservation of agro-biodiversity

Conservation strategies

Spellerberg & Hardes (1992) define biological conservation as "the effort to maintain the diversity of living organisms, their habitats and the interrelationships between organisms and their environment". They stress that conservation does not only cover individual plant and animal species, but also includes other biodiversity levels. Conservation practices emphasise biodiversity either at the level of ecosystems or genetic diversity. Nature conservation focuses on the former, agro-biodiversity conservation on the latter.

Conservation of biodiversity in agriculture has been emphasised by the international agricultural research community. Conservation of crop genetic diversity is based on two strategies, "*ex situ* conservation" and "*in situ* conservation", which have been described in Boxes 2.2 and 2.3. CBD (UNEP, 1992) has given the following two definitions:

- *Ex situ* conservation means "the conservation of components of biological diversity outside their natural habitat".
- *In situ* conservation means "the conservation of ecosystems and natural habitats and the maintenance and recovery of viable populations of species in their natural surroundings and, in the case of domesticated and cultivated species, in the surroundings where they have developed their distinctive properties".

Box 2.2 *Ex situ* conservation

Ex situ conservation is achieved by the establishment of genebanks (seedbanks, in vitro and field genebanks), which store samples of seeds or other plant materials under controlled conditions of temperature and humidity mostly in refrigerators, deep freezers for medium (4° C) to long-term (-20° C) storage. The goal is to conserve crop genetic resources and ensure their availability for future generations. Materials are collected through expeditions; accessions are documented ("passport data"). The techniques for *ex situ* conservation are generally considered appropriate for conservation of crop genetic diversity of crop relatives and wild species.

Ex situ emphasis

The practices of and institutions for conservation of "plant genetic resources" have been established with a focus on *ex situ* conservation. Genebanks have been established following the observed genetic erosion in centres of origin of cultivated crops. Particularly in the 1970s, the collection of genetic resources was undertaken in an atmosphere of crisis (Pistorius, 1997).

> "Experts believed - with good reason - that they had very little time in which to collect and safeguard these resources from extinction in the field" (FAO, 1996: pp. 20).

For example, in many expeditions that contributed to the collection of CGN were undertaken in the 1970s. Another reason for the *ex situ* focus is that a majority of the National Plant Genetic Resource Programmes (NPGRPs) established at this time as national conservation programmes, were established within or with a strong affiliation to public breeding programmes. For example, the CGN in the Netherlands was set up as an independent organisation but on the premises and within the institutional framework of a national plant breeding research institute. In fact, CGN took over responsibility of some for the working collections of researchers and breeders within this institute. This link has had direct implications for the

Box 2.3 *In situ* conservation of wild relatives of crop species in their original habitats.

In situ conservation of crop genetic diversity has been adapted from nature conservation efforts that concentrate the maintenance of entire ecosystems. For agro-biodiversity, the strategy is particularly applied for the conservation of semi-wild and wild relatives of crop species in their original habitats. The main focus is to conserve these habitats, and to manage and monitor the wild populations of certain species. The strategy is applied in the conservation of forests, rangelands and other "human" managed ecosystems. In the case of rangelands, *in situ* conservation implies that the grazing intensity is controlled at a level at which certain populations of wild plant species are conserved. To stop grazing altogether could lead to other species starting to compete with the target species and hence result in the loss of these target species.

Table 2.1 Overview of genebanks and collections.

Region	Accessions Number (000)	%	Genebanks Number	%
Africa	354	7	124	10
Latin America & Caribbean	642	11	227	17
North America	762	13	101	8
Asia	1.534	28	293	22
Europe	1.935	35	496	38
Near East	328	6	67	5
Total	5555	100	1308	100
CGIAR-genebanks	*593*	*11*	*12*	

Source: FAO, 1996

choice of a conservation strategy, *ex situ* being much more practical than *in situ* conservation for breeders who look for material with specific traits (Pistorius, 1997). This issue of access of plant breeders to germplasm and related information promoted *ex situ* conservation efforts in the 1970s. The current global "system" of both international and national genebanks was established in the 1970s and early 1980s. Table 2.1 gives an overview of accessions maintained with in the "global system" of genebanks.

Changed interest in *in situ* strategies

Even though strategies related to *in situ* conservation were discussed in the 1960s, their use was limited in the 1970s and 1980s (Pistorius, 1997). Linkages between international arenas in which plant genetic resources, nature conservation and sustainable agricultural development were discussed in the late 1980s and early 1990s, resulted in a revived interest in *in situ* conservation (Altieri & Merrick, 1987; Oldfield & Alcorn, 1987; Brush, 1991).

Motivations to support *in situ* conservation and "on-farm management" are partly based on the disagreement on the effectiveness and success of the *ex situ* strategy. These have been particularly expressed by a selected group of NGOs active within the international biodiversity arena (Nabhan, 1985; GRAIN, 1992; Montecinos, 1992; Salazar, 1992). Compared to the *ex situ* strategy, *in situ* conservation is considered to make a more direct contribution to farmers' and communities' well-being and to ensure that adapted plant types remain readily available for use (Altieri & Merrick, 1987; Berg *et al.*, 1991; Worede & Mekbib, 1993; Damania, 1996; Bellon *et al.*, 1997). Interest in *in situ* conservation was directly associated with an international (North – South) conflict, a battle primarily fought at FAO. This conflict is primarily associated with a number of dominant changes in the agricultural sector: (i) industrialisation of agriculture, (ii) increased globalisation of markets of agricultural products, (iii) employment of intellectual property rights over living organisms and traits of crops

Box 2.4 Turkey and Ethiopia: *in situ* (habitat) conservation strategies.

A project that implements *in* situ conservation of genetic diversity of crop related species is the GEF *in situ* project in Turkey. It establishes gene management zones or genetic reserves in areas that are rich in wild species related to crops, in this case wild wheat species. Controlled grazing, mowing or fire management to discourage perennial species, especially perennial grasses, from displacing annual wild wheat relatives are part of the conservation effort.

The national coffee conservation programme of the Biodiversity Institute in Ethiopia uses *in situ* strategies to conserve semi-wild coffee species. Local partners of the project include small-scale farmers in areas, where forest coffee still emerges and grows spontaneously. This activity complements field genebank collections of cultivated coffee.

Sources: Ertug Firat & Tan, 1997; Worede, 1997a

in particular, (iv) gradual replacement of the public by the private sector, which has resulted in (v) concentration of the commercial breeding industry in a "six pack" of crop development conglomerates (Pistorius & Van Wijk, 1999; Jiggins & Röling, 2000).

Keystone Dialogue, CBD and conservation strategies

Debates on conservation strategies have emphasised the need for sharing responsibilities among actors involved. The Keystone Dialogue Series was one of the first fora in the conservation arena that recognised the on-farm/community system having an equal value as the institutional (formal) system. Keystone recognised *ex situ*, *in situ* and community/on-farm conservation as complementary strategies. It emphasised the importance of an increase in formal and informal linkages (Keystone Center, 1991). Keystone has been a milestone in that it recognised the contribution of communities and farmers to the creation of agro-biodiversity.

The outcome of the Keystone Dialogue has served as an input to discussions that have resulted in the Convention on Biological Diversity (CBD). The Convention emphasised the conservation of biodiversity, the link between conservation and utilisation (in the context of sustainable development) and the fair and equitable sharing of benefits of biodiversity. With respect to conservation strategies, the Convention endorsed both *ex situ* and *in situ* strategies. Therefore CBD resulted in the initiation of many *in situ* conservation projects. *In situ* conservation in accordance with the CBD definition aims at the maintenance of species in their natural habitats and at the continuation of their evolution and adaptation. Box 2.4 presents two examples of projects that apply this strategy to *in situ* conservation.

The Convention linked under one heading "*in situ* conservation on-farm" of landraces with *in situ* conservation of species diversity in natural habitats. Its complex definition of the strategy resulted in much discussion and confusion in the plant genetic resources arena (Engels & Wood, 1999). The merger resulted in much confusion about the terminology. Within the A-Team in Wageningen, we spent many hours on discussing the meaning of *in situ* conservation. We had similar and often confusing discussions with our partners in the South. It is clear that we were not the only ones. The term "*in situ* conservation" seemed appropriate for the conservation of species in their (semi-) wild habitats, but it gradually became clear that it could not be applied to conservation of crop genetic diversity or landraces on-farm (Hardon & de Boef, 1993; Hodgkin *et al.*, 1993; Wood & Lenné, 1993). The dynamic nature of farmers' management and utilisation of landraces did not match the perspective of conservationists in the design of on-farm conservation strategies.

The Convention emphasises in "*in situ* conservation on-farm" the agro-ecosystems as habitats where landraces have evolved "their distinctive properties". The objective of the strategy is neither to entirely preserve or "freeze" landraces on-farm nor to fix or stop the process in which this diversity has developed. It targets at dynamic landraces and the association with farmers' management and utilisation. Farmers maintain, adopt, adapt, displace and exchange landraces and their seeds in a cyclic and dynamic process. Hardon and de Boef (1993) refer to this process as "local crop development". "*In situ* conservation on-farm" thus focuses on both landraces and local crop development. Hence what needs to be "conserved" appears dynamic. If we take this notion into account, the term "*in situ* conservation on-farm" turns into an oxymoron.

With the State of World Report on Plant Genetic Resources for Food and Agriculture, FAO tried to diminish the confusion and conclude the debate on the terminology for *in situ* and on-farm conservation. FAO (1996) proposed to replace the term "*in situ* conservation on-farm" by "on-farm management" of agro-biodiversity. In line with the Convention, FAO has maintained *in situ* conservation as an "umbrella" term. They proposed the term "on-farm management" for conservation through farmer management. This term accommodates the dynamic nature of management and agro-biodiversity. The FAO terminology better integrates development aspects into conservation; it relates directly to farmer's objectives in their use of crop genetic diversity. This term also facilitates links between conservation and other crop development activities such as plant breeding and seed production. In a conclusion of the discussion within the A-Team, we agreed to use "on-farm management" of agro-biodiversity. In this book, I will use the term "on farm management" for the conservation strategy or approach that targets at farmers' continued utilisation and management of agro-biodiversity.

2.5 Conservation strategies: an overview

As indicated in the previous section, during the early 1990s much confusion existed about conservation strategies. Similar terms have been used for strategies with dissimilar or conflicting objectives. With the A-team and our project partners, I have struggled with CBD and FAO terminology for conservation strategies. In an effort to create some order in the chaos and at least avoid confusion in this book, I have developed an overview of crop genetic diversity conservation strategies. I have used the following groups of criteria:

i. conservation boundaries that emphasise (a) location, (b) type of materials, (c) actors making key decisions in management, and (d) major objectives;
ii. management styles that relate to the interaction of the conservation activity with (a) ecological and (b) social dynamics; and (c) actors responsible for major interventions;
iii. property issues that address (a) ownership of and control over, (b) access to and (c) utilisation purposes of germplasm and associated information.

I used these criteria to classify conservation strategies into seven groups presented in Table 2.2. With this matrix in hand, I have reviewed literature on "*in situ* conservation" and "on-farm management" published since the 1970s. The references have been classified for the type of *in situ* conservation strategies (Table 2.3). I have not included references that refer to projects that are discussed in the case studies (Part III).

Early literature on *in situ* conservation is less explicit; I therefore classified most references from that time into group III. A distinct group of people with a conservationist background use *in situ* conservation primarily for the conservation of crop related species in (semi-) wild habitats (group IV). NGOs specifically involved in community conservation activities implement conservation activities with the objective to conserve landraces in community genebanks; I refer to their activities as "*ex situ* conservation on-farm" (group II). "On-farm management"-activities refer to activities characterised by limited interventions in local crop development. Many authors use this strategy to strengthen dynamic social and ecological processes. They emphasise farmers' continued utilisation of crop genetic diversity (groups VI and VII). The difference between these two is based on property aspects. Group VI addresses "on-farm management" with a public and "open" perspective, whereas group VII maintains a strong civil, protective and "closed" perspective. "On-farm managed" germplasm and infor-

Table 2.2 Conservation practices; an overview of characteristics

	group of conservation strategies	boundaries				management style			property			synonyms
		location where?	manager who manages?	main objective why & what for?	material what accessions?	ecological dynamics what happens?	social dynamics what happens?	intervention what happens?	ownership who?	access & control who?	utilisation purpose what for?	
I	*ex situ* conservation	genebank	conservationist	conservation & use	PGR	frozen	frozen	storage	public/ state	bona fide user	research & breeding	
II	*ex situ* conservation on-farm	on-farm	farmer curators	conservation & control	landraces	frozen	frozen	storage & cultivation	community/ farmer - civil - NGO	community members	cultivation	community conservation
III	*in situ* conservation (general)			conservation & use	PGR	continued & managed	continued & managed	monitoring & enhancement	civil - public			(overall term)
IV	*in situ* conservation (habitat)	semi-natural-habitat	conservationist	continued evolution & conservation	semi wild crop relatives	managed	frozen	monitoring & management	public/ state	bona fide user	research & breeding	genetic reserve
V	on-farm conservation	on-farm	conservationist	continued evolution	landraces	continued	frozen	subsidised cultivation	public/ state	bona fide user	research & breeding	
VI	"on-farm management" (open)	on-farm dynamic	farmer - *in situ* manager	continued processes	landraces	continued	continued	monitoring, enhancement & collection	civil - public	farmer - bona fide user	cultivation research & breeding	*in situ* conservation on-farm
VII	"on-farm management" (closed)	on-farm dynamic	farmer	control access & continued pro??cesses	landraces	continued	continued	community monitoring	civil - NGO	civil - community	community seed and genebanks	

Table 2.3 Literature review based on a classification for the terminology used for *in situ* and on-farm conservation.

Conservation group		References
II	*ex situ* conservation on-farm	Berg & Alcid, 1994; Bertuso *et al.*, 2000; Burgess, 1994; Fofana, 1997; GRAIN, 1992; Magnifico, 1996; Mekbib *et al.*, 1993; Montecinos, 1992; Montecinos & Altieri, 1992; Nabhan, 1985; Salazar, 1992; Teekens, 2000; Vijayalakshmi & Nambi, 1996.
III	*in situ* conservation general	Altieri & Merrick, 1987; Altieri & Montecinos, 1993; Brush, 1991; Cohen *et al.*, 1991; Damania, 1996; Dennis, 1987; Oldfield & Alcorn, 1987.
IV	*in situ* conservation habitat	Damania, 1996, Engels & Wood, 1999; Ertug Firat & Tan, 1997; Frankel, 1974; Prescott-Allen & Prescott-Allen, 1982; Wilkes, 1991.
V	on-farm conservation conservationist managed	Allard, 1990; 1992; Bellon *et al.*, 1997; le Boulc'h *et al.*, 1994; Brush, 1991; 1992; 1995a; 1999; Cromwell & van Oosterhout, 1999; Demissie, 1999; Dinoor & Eshed, 1997; Henry *et al.*, 1991; Iltis, 1974; Maxted, *et al.*, 1997a, 1997b; Meng, *et al.*, 1998; Ortega, 1997; Pham *et al.*, 2000; Qualset *et al.*, 1997; Vaughan & Chang, 1992; Wilkes, 1971; Worede, 1997a; 1997b; Worede & Mekbib, 1993; Worede *et al.*, 1999; Zeven, 1996; Zimmerer, 1991a; Zimmerer & Douches, 1991.
VI	"on-farm management" (open)	Appa Rao, 1993; Begemann *et al.*, 2000; Bellon, 1995; Bellon *et al.*, 1997; 1998; Benzing, 1989; Berg, 1992; Berg *et al.*, 1991; Berthaud, 1997; de Boef *et al.*, 1996; 1997b; 2000b; Campolino Soares *et al.*, 1998; Cordeiro, 1993; Cromwell & van Oosterhout, 1999; Dennis, 1987; Engels & Wood, 1999; Hardon & de Boef, 1993; Hardon *et al.*, 2000; Hodgkin *et al.*, 1993; Louette, 1997; Louette *et al.*, 1997; Maxted *et al.*, 1997c; Mushita, 1992; van Oosterhout, 1993; 1996; Perales *et al.*, 1998; Pittenger, 2000; Sanchés & Pompeyo, 2000; Shiget, 1990; Singh, 1998; Smale, *et al.*, 1998a; 1998b; Soleri & Cleveland, 1993; Sperling & Loevinsohn, 1993; Sthapit & Joshi, 1998; Tapia & Rosas, 1993; Terrazas *et al.*, 1999; Teshome *et al.*, 1999; Witcombe *et al.*, 1996; Wood & Lenné 1993; 1995; Zimmerer, 1991b.
VII	"on-farm management" (closed)	Altieri & Montecinos, 1993; Bertuso *et al.*, 2000; Khedkar, 1996; Mazhar, 1996; Montecinos & Altieri, 1992; Satheesh, 1996.

Conservation groups based on Table 2.2

mation remain in civil society. The germplasm and information are not accessible to crop development actors that operate in public (government) and private (agribusiness) domains (Section 2.7). Conservationists who practise "on-farm management" (group VI) consider agro-biodiversity managed by local people and farmers a public and commonly accessible good.

2.6 Local and institutional crop development systems

Crop development has been conceptualised as the complex of maintenance, utilisation and improvement of crop genetic diversity. Crop development actors interact in various ways; their interactions may be illustrated by drawing flows of knowledge and information, germplasm, varieties and seeds among actors. I use the soft system perspective (Section 6.2) to describe the current social organisation of crop development, and illustrate how germplasm

and information flow between farmers and organisations involved in crop development (e.g., genebanks, plant breeding organisations and seed production and dissemination agencies). Two systems may be identified the local and institutional system of crop development (De Boef & Almekinders, 2000).

The local system

The term "local crop development" is used to cover the continuous and dynamic cycle in which farmers manage crop diversity within specific agro-ecological and socio-economic environments (Hardon & de Boef, 1993). Farmers maintain, adopt, adapt, displace and exchange varieties and their seeds in a cyclic and dynamic process. This process is built on farmers' knowledge and ability to experiment with and select crop genetic diversity (Figure 2.1). Before cultivation, farmers choose varieties or landraces from their own stock or through variety exchange mechanisms (e.g. local stores, neighbours or relatives). An adequate quantity of seeds is selected from a season's harvest for next season's crop. The variety exchange component is an "entry" and "exit point" of the local system. This component places the local system beyond geographic and social boundaries of farmers' households or communities. Some farmers are involved in commercial seed production; they sell their seeds to others or to agricultural stores and middlemen, independent from seeds' regulatory frameworks. In many developing countries the local system is the dominant model of experimentation, seed supply and dissemination of modern and local varieties (Almekinders & Louwaars, 1999).

The institutional system

Development of plant breeding has resulted in the establishment of an institutional crop development system. Independent organisations or programmes are responsible for conservation, breeding, seed multiplication and marketing. A chain of actors has developed through which a linear flow of germplasm and information may be distinguished (Figure 2.2). Germplasm, the source material for crop development is collected from local systems across the

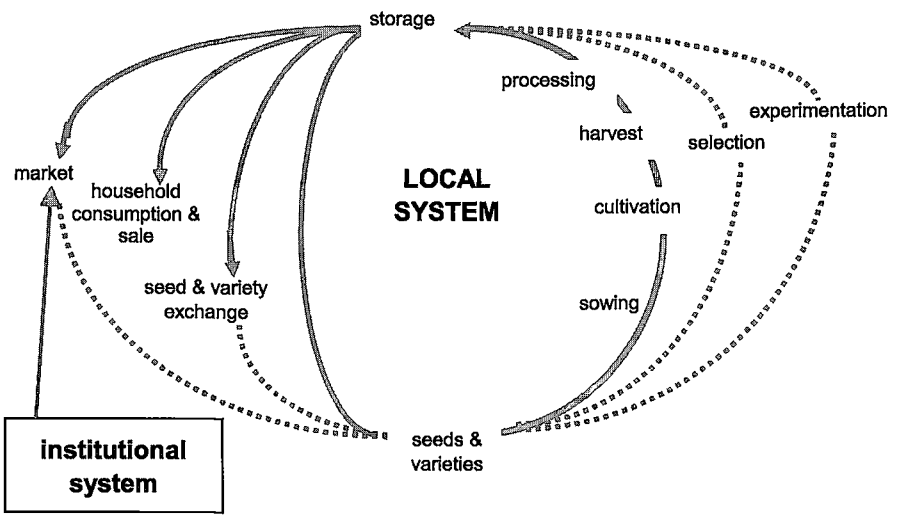

Figure 2.1 Local system of crop development
Adapted from: De Boef *et al.*, 1997b; De Boef & Almekinders, 2000

world. Genebanks store and provide plant breeders with access to germplasm. Breeders set their breeding objectives, select their germplasm, recombine it and select their materials in various production environments. Breeding objectives may be recommended by marketing channels, or based on policy maker's or breeder's judgement of farmer's needs. Products of crop development - improved or modern varieties - are multiplied in seed programmes or seed companies and distributed to farmers through rural stores, agricultural extension offices or NGOs. The institutional system is regulated by procedures with respect to seed quality control, variety testing and registration. The regulatory framework is a subsystem that organises flows of information and germplasm among institutional actors (breeders' rights and seed quality control) and between the two systems (Louwaars & van Marrewijk, 1997; Tripp, 1997). The current system perspective on crop development illustrates the position of farmers at the two ends of a linear flow of germplasm, knowledge and information. Genebanks or conservation programmes collect germplasm from farmers in the local system to be stored in genebanks and made available to breeding at the start of the chain. The only interaction between farmers and genebanks concerns the collection of germplasm. At the end of the chain, seed marketing and dissemination agencies supply seeds of improved varieties to farmers in the local system (De Boef *et al.*, 1997a).

Current trends in crop development

The institutional crop development system has strong roots in the "transfer-of-technology" paradigm that results in a linear process of variety development and dissemination. Hybrid varieties secure such linear flows of germplasm from the institutional into the local system. In industrialised countries and high-potential areas in developing countries farmers are forced to purchase varieties, particularly for crops such as maize, if they want to gain access to modern varieties. A majority of farmers in China, many Latin American and African countries prefer

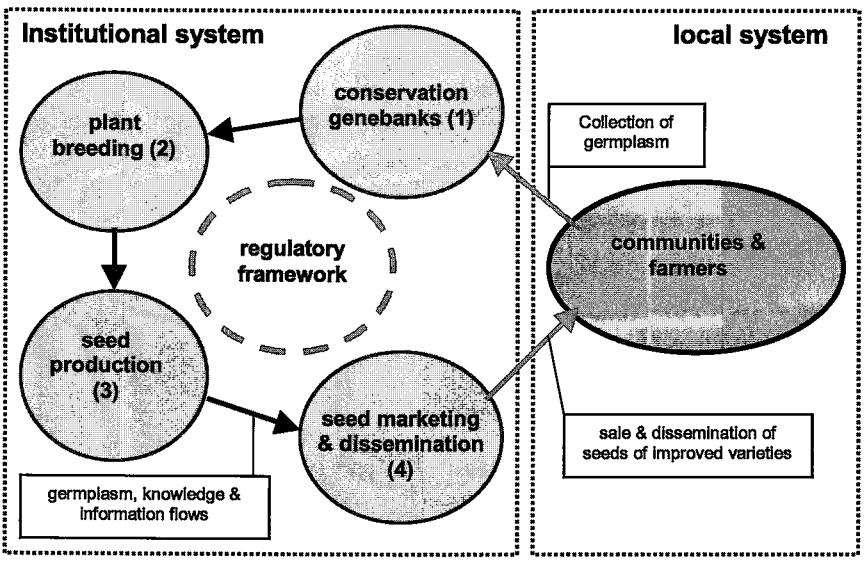

Figure 2.2
Local and institutional crop development systems: linear organisation
Adapted from De Boef *et al.*, 1997b; De Boef & Almekinders, 2000

open pollinated instead of hybrid maize varieties (Maredia *et al.*, 1998; Perales *et al.*, 1998; Song, 1998). For vegetatively propagated crops (potatoes), phytosanitary regulations compel farmers to purchase "seeds". In many countries in the South, the formal seed sector for these crops is either ineffective or non-existent. Informal channels of seed supply of vegetatively propagated crops are important (Scheidegger and Prain, 2000).

For decades, a majority of cereal farmers in Western Europe and North America has annually purchased seeds. With profits in grain production declining, farmers started reducing costs using "farm-saved-seeds". They purchase seeds when shifting to another variety or when the variety "in farmers' hands" started to lose its characteristics and uniformity. The regulatory framework permits on-farm multiplication ("farmers exemption"); it "fixes" seed production to the farm. It is illegal to sell or provide other farmers with seeds of modern varieties (Mercer & Wainwright, 2000; Wiskerke, 2000). Through the eyes of developing country seed professionals, this "normal" situation appears unnatural and abnormal; at their homes local seed supply and exchange of seeds are dominant models of variety dissemination.

An even more rigid organisation of crop development has developed in the United States. Breeding companies force farmers to sign contracts in which they commit themselves to annually purchase seeds from a specific company or pay royalties for the varieties used. The contract appears the only way to access varieties that have been genetically modified (herbicide-tolerant and/or resistant to certain pests and diseases). Farmers who ignore such contracts are prosecuted and forced to pay high penalties. "Gene-detectives" inspect farmers' fields taking DNA samples of crops. "On-farm" seed supply and local crop development have been abolished in this extreme situation that is increasingly rejected and opposed to by many farmers and other actors.

I have not yet encountered such extreme situations in developing countries. Farmers purchase or obtain improved varieties mainly through informal channels; they replace them when a better variety becomes available or when the seed stock is insufficient. Most developing countries lack an effective seed sector and guiding seed and variety regulatory frameworks. The local seed supply system has proved to be a very effective mechanism of variety dissemination. However, it is barely recognised or completely ignored by institutional actors (Louwaars & van Marrewijk, 1993; Almekinders *et al.*, 1994). Alternative institutional seed systems building on and strengthening local supply systems are currently seen as options to enhance local seed supply and dissemination of improved varieties (Song, 1998; Almekinders & Louwaars, 1999).

Effectiveness of the institutional system

The institutional system has proven successful for developing modern varieties of major cereal crops such as rice, maize and wheat. In Asia and Latin America, relatively high adoption rates have demonstrated this success (Table 2.4). Modern varieties are quickly adopted once they demonstrate to have a higher yield and possess qualitative traits that are valued by farmers (resistance; early maturity) and users (cooking quality; storability). However, less success has been obtained with other food crops (sorghum, millets, and various root crops) and minor crops cultivated and used in complex, diverse and risk-prone production environments. Table 2.5 illustrates the low adoption rates for modern varieties of sorghum and millets in some African countries. In these cropping systems, farmers continue to use landraces. The international and national crop development sectors have been ineffective in

Table 2.4 Regional estimates for areas (%) planted with modern varieties (MV) of rice and maize.

	Irrigated rice Proportion area planted to MVs		Maize Proportion area planted to MVs hybrids	OPVs	
Region	%	year	%	%	year
Sub-Saharan Africa	15	'83	36	14	'92
West Asia – North Africa	11	'83	22	7	'92
Asia (excluding China)	67	'91	10	29	'92
China	100	'91	90	7	'92
Latin America	58	'91	37	13	'92
All developing counties	74	'91	45	15	'92
Industrialised countries	78	'91	99	0	'92
World	74	'91	63	10	'92

Source: Morris & Heisey, 1998: pp. 220

the development of improved varieties suitable to these conditions. At the same time, it should be realised that the public and commercial seed agencies have been ineffective in disseminating improved varieties in these areas. Maredia *et al.*, 1998 illustrate that only a relatively small area in Sub-Saharan Africa has been planted with modern varieties. The institutional system could only to a very limited extent breed varieties adapted to the most marginal conditions on this continent, and if so has been ineffective to disseminate seeds of these modern varieties.

Trends similar to those described for cereal farmers in the North have been observed among cereal farmers in high-potential areas in the South. Some farmers have started to change their variety preference, cultivating local instead of modern varieties. Examples from the Philippines and Brazil demonstrated how "second-generation-green-revolution-farmers" started to cultivate local rice and maize varieties once cultivated by their parents or grandparents. Changing cultivation practices (such as integrated pest management) increased fertiliser and pesticide prices and price differentiation for rice varieties (Philippines) have encouraged this trend. The shift is driven by a revised economic balance of lower yields, higher prices for products of specific varieties and reduced use of inputs (Bertuso *et al.*, 2000; Campolina Soares *et al.*, 1998). The trend is discouraged by institutional frameworks (e.g. credit systems) and marketing and processing chains that favour a fixed set of modern varieties (Cordeiro, 1993; Basilio & Razon, 2000).

Efforts to strengthen the link between the local and institutional system

Various approaches strengthen links between institutional and local crop development systems. Building a synthesis of a range of experiences linking crop conservation and development, Almekinders *et al.* (2000) concluded that integrated approaches strengthen local management and encourage utilisation of crop genetic diversity. Boundaries between organisations and professionals involved in conservation, plant breeding and seed supply, and between institutional and local systems become more diffuse.

Table 2.5 Adoption of modern varieties of sorghum and millets in some Eastern & Southern African countries (1996).

	Country estimates of area planted with modern varieties (%)	
Country	Sorghum	Millets
Botswana	24	17
Ethiopia	3	--
Kenya	8	--
Mozambique	4	23
South Africa	77	0
Sudan	< 1	--
Tanzania	2	<1
Uganda	8	--
Zambia	36	63
Zimbabwe	30	25

Source Maredia *et al.*, 1998

Despite an institutional and a policy framework that often support an opposite development, many groups both in the North and in the South have started to encourage utilisation and strengthening of local management of crop genetic diversity (De Boef *et al.,* 2000b). Conservation organisations recognise *in situ* conservation and "on farm management" to complement *ex situ* strategies (FAO, 1996; Cooper *et al.,* 1994; Berthaud, 1997; Smale *et al.,* 1998a; Almekinders *et al.,* 2000). An increasing number of international and national breeding programmes have started to involve farmers in various stages of the breeding cycle (Eyzaguirre & Iwanaga, 1996; Witcombe *et al.,* 1996; Sthapit *et al.,* 1996; CIAT, 1997; Campolina Soares *et al.,* 1998; Cárdenas & Almekinders, 1998; Smith & Weltzien, 2000). Integrated seed supply systems have been proposed to optimise interactions between formal and local seed supply systems. The decline of formal seed systems in developing countries results in local systems being increasingly recognised as more effective ways of disseminating improved varieties (Almekinders *et al.,* 1994; Almekinders & Louwaars, 1999; Song, 1998). In some countries, alternative frameworks for seed quality control, variety testing and regulation have been developed that aim to strengthen local seed supply systems and support integrated approaches (Louwaars & Ghijsen, 1996; Tripp & Louwaars, 1997; Leskien & Flitner, 1997; Louwaars & Engels, 2000).

These examples of alternative approaches link various components of the institutional system with the local system. Figure 2.3 illustrates the integrated organisation of local and institutional crop development systems. Most approaches increase farmers' access to and utilisation of crop genetic diversity. Strong linkages have been established between conservationists that aim to implement the "on-farm management" strategy and other institutional actors that are involved in integrated and participatory approaches to crop development. As a result, conservation and diversity aspects have been incorporated in other activities of institutional actors. The major objective of such activities is to contribute to and strengthen the local farming system's sustainability.

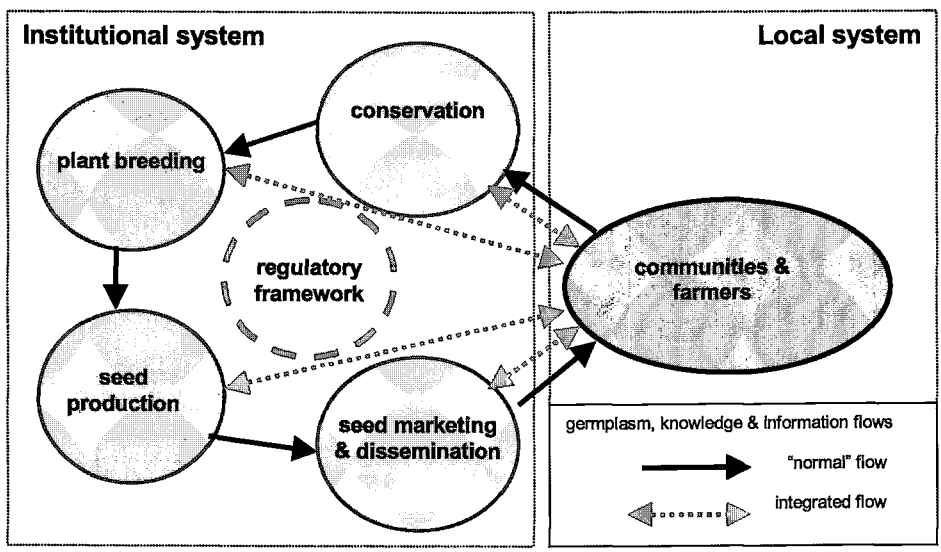

Figure 2.3
Local and institutional crop development systems: integrated organisation

2.7 Levels and domains of agro-biodiversity management

Global, national and local levels

The group of institutional crop development actors includes a diversity of individuals, organisations and institutions responsible for conservation, research and agricultural and rural development. These crop development actors operate at local, national and international levels. Because of seeds' reproductive capacity and thus varieties' mobile nature, interactions among these levels exist; these interactions result in flows of germplasm and associated knowledge and information. Biotechnological tools in modern plant breeding have made it easier to trace and transfer unique genetic information of a certain genotype to another, thereby stimulating gene flows around the world, but also within and between species. Substantial investments in genetic research have resulted in crop genetic diversity acquiring economic value at global level. In other words, various crop development actors appropriate crop genetic diversity previously considered a "common" ecological service.

With this trend of global research and utilisation of germplasm in breeding and genetic research, the link with genetic diversity in agro-ecosystems has "eroded". Products of science and the global germplasm pool have replaced locally developed varieties. Varieties and seeds have become inputs to agro-ecosystems rather than integral components. This trend has created an environment in which economic dynamics at global level are dominant to local levels of social and ecological dynamics. Conflicts have emerged among social actors who operate at various levels of agro-biodiversity management and utilisation. These conflicts particularly refer to the organisation of germplasm flows among actors who operate at different levels of agro-biodiversity management. The "on-farm management" strategy has been an important issue in discussions on germplasm flows; it may be considered a local reaction to trends of globalisation of management and appropriation of crop genetic diversity.

Public, private and civil domains

Crop genetic diversity is utilised and managed by actors who operate in what may be described as three domains. By referring to public, private and civil domains, I place these actors in society and economy. Associated institutional frameworks reveal actors' objectives and strategies. Consequently, domains are attributes to analyse interactions between various actors. Government organisations responsible for conservation, plant breeding and seed production operate within the public domain. The position of the public sector has weakened as financial resources allocated by governments to public services have decreased dramatically under structural adjustment policies (Tripp, 1997). Actors in the private domain are increasingly taking up dominant positions in society and economy. They provide services previously provided by public organisations. Policies supporting privatisation and liberalisation of public services support the public – private trend. Actors operating in the civil domain have responded to this trend. Farmers and consumers, rural and urban people, individuals and groups (NGOs) constitute the actors in what I call the civil domain. In many cases, they operate as representatives of some groups within civil society. NGOs may represent civil interest; in global and national arenas they play important advocacy and lobbying roles influencing policy makers. Examples include consumer organisations that influence the European debate on genetically modified organisms (GMOs) and Indian NGOs that influenced policies regarding plant variety protection. Their actions have resulted in including farmers' rights mechanisms in national variety legislation (Swaminathan, 1995).

3

Problem definition:
Social organisation and social construction of "on-farm management" of agro-biodiversity

In coming to the core issue of the book, the hesitant attitude among conservationists and their limited capacity to develop the strategy to "on-farm management" of agro-biodiversity are described. To better understand the situation, I present a "blueprint" and "process" conservation paradigm. In the first section, I elaborate on some of the initial efforts of conservationists and conservation organisations to implement "on-farm management" of agrobiodiversity. The two paradigms will explain to what extent the current social organisation of conservation programmes, the institutional frameworks and types of professionalism pose barriers to conservationists in addressing the dynamic and unpredictable aspects of farmers' management of agro-biodiversity. In the second section I use "system thinking" to unravel institutional and professional barriers to the development and implementation of "on-farm management". This perspective is used to introduce the process of the conservation strategy's social construction. This introduction of the social organisation and social construction of the strategy facilitates the definition of the problem addressed in this book and facilitates elaboration of this book's research questions.

3.1 Social organisation

Conservation paradigms and strategies

Since the 1970s, people working in conservation organisations and National Plant Genetic Resources Programmes (NPGRPs) have developed a specific type of professionalism and associated paradigm. In discussions on conservation strategies described in the previous chapter, conservationists demonstrated to have a perspective with a strong bias towards *ex*

situ conservation in their science and practice, and social organisation. Accordingly, conservationists who have proposed or started *in situ* and on-farm conservation activities have indicated limitations in their ability to deal with human and ecological dynamics of crop genetic diversity. It is clear that for the implementation of "on-farm management" of agro-biodiversity conservationists and conservation organisations need to cross professional and institutional boundaries.

Two conservation paradigms

Based on a study of nature conservation and development programmes, Pimbert & Pretty (1997) typify two conservation paradigms. They describe the conventional approach pursuing "blueprint" approaches to nature conservation, whereas the alternative approach pursues "process" approaches linking nature conservation and rural development (Table 3.1). "Blueprint" conservation science operates on an intellectual basis that emphasises categories, criteria, knowledge and procedures that promote professional control over natural processes and assumes universal applicability of "blueprint" procedures. It is based on positivism and reductionism; it unravels and predicts natural processes with the objective to achieve control for the sake of conservation. In a socio-political and ethical context, actors pursuing such an

Table 3.1 Conservation paradigms: blueprint and process approaches.

Characteristic	Blue print	Process
Point of departure	Nature's diversity and its potential commercial values	The diversity of both people and nature's values
First steps	Data collection and planning	Awareness and action
Design	Static, by experts	Evolving, people involved
Main resources	Central funds and technicians	Local people and their assets
Method, rules	Standardised, universal, fixed package	Diverse, local, varied package of choices
Analytical assumptions	Reductionism (natural science bias)	Systemic, holistic
Management focus	Spending budgets, completing projects on time	Sustained improvement and performance
Communication	Vertical: orders down, reports up	Lateral: mutual learning and sharing experience
Evaluation	External, intermittent	Internal, continuous
Error	Buried	Embraced
Relationship between professionals and local people	Controlling, policing, inducing, motivating, dependency-creating; people seen as "beneficiaries"	Enabling, supporting, empowering; people seen as actors
View on relationship between people and nature	People are "masters" or "guardians" of nature	People are "partners" with or "participants" in nature
Associated with	"Normal" professionalism	"New" professionalism
Diversity output	Diversity in conservation, and uniformity in production (agriculture, forestry, etc.)	Diversity as a principle of production and conservation
Associated conservation strategy	Nature reserves or parks; *ex situ* conservation (genebanks)	ICDPs, *in situ* conservation and "on-farm management"
Empowerment output	Empowerment of professionals	Empowerment of rural people

Adapted form Pimbert & Pretty (1997 and Korten (1984)

approach are referred to as "normal professionals" whose thinking, values, methods and behaviour are assumed constant (Chambers, 1993). Pimbert and Pretty emphasise that major reasons for the failure of many nature conservation programmes to include development components are "normal" conservationists' norms and practices. Above all the perspective illustrates that local communities are not accepted as basic elements of natural systems. "Normal" professionals disconnect local people's livelihood and development aspirations from the natural environment.

"Blue print" conservation programmes often turn out to be inappropriate and ineffective, resulting in conservation actions being rejected or undermined by development organisations, local communities, foresters and farmers. Conservation technologies or incentives appear to result in non-sustainable or inequitable situations. Because of their foundation in positivism (Section 4.1), the scientific basis that forms and legitimises conservation practices is assumed to be valid for all people, all places and all times. In addition it should be realised that the positivist paradigm by its very nature is pervasive in its processes of construction. People operating with this paradigm are unaware of possible alternatives. The absolutist position of positivism excludes other possibilities; it thus designs fixed and rigid boundaries to understanding nature and people. This contrasts with constructivist perspectives, where positivism is considered one of many ways to understanding nature and its people. The positivist perspective results in a conservation ethic and attitude that leaves limited room for people with other perspectives to participate in discussions on and management of conservation programmes.

The above picture of nature conservation programmes is rather negative; "it paints a black and white picture". Nature conservation programmes have been initiated in which local people have been recognised as partners in conservation. Pimbert and Pretty conclude that the development of such new more people-oriented conservation programmes entails a complete reversal of the conservation paradigm and associated professionalism. They refer to the paradigm taking up a "process approach" as a "new" professionalism for conservation. The two paradigms are illustrative as they may also be used to characterise the paradigm shift necessary to change from *ex situ* to *in situ* and on-farm strategies in agro-biodiversity conservation.

Two paradigms in the context of agro-biodiversity conservation

In an agricultural context, the science of conservation has been associated with and has resulted in the construction of *ex situ* strategies. NPGRPs or genebanks are integrated into the top-down and linear organisation of the institutional crop development system. The dominant paradigm for agro-biodiversity conservation is similar to the "blueprint" approach to nature conservation. This has resulted in *in situ* and on-farm strategies being proposed, where conservationists are still in control or managing the germplasm (Table 2.2). Similar to *ex situ* conservation, conservation scientists tend to control natural (and social) pro??cesses, while constructing *in situ* and on-farm strategies and designing frameworks for their implementation. The link with farmers' management of agro-biodiversity and integration of conservation efforts into people's development aspirations has been described by various conservation professionals as a rather problematic component of the development of *in situ*/on-farm strategies (Maxted *et al.*, 1997c; Lenné & Wood, 1999). The problem may be that they construct the strategy using a conservation paradigm that is incapable of dealing with the un-

predictable and dynamic nature of farmers' management. The "process" paradigm elaborated in Table 3.1 appears to be more open in linking conservation with these dynamics. Through its emphasis on local people as partners, joint learning and empowerment of local people, conservation and development are interwoven.

Empirical evidence from various areas in agricultural research and natural resource management (forestry, agriculture, soil and water conservation) have highlighted conflicts or misfits between the reality of "normal" professionals and rural people. The professional challenge for conservationists involved in the *in situ* conservation and "on-farm management" strategies is to engage in learning processes that may result in the necessary paradigm shift. Such a change in professionalism reverses conservation activities to a diversity of options, more democracy and decentralisation. These elements are part of a process approach to conservation (Table 3.1).

Relationship between people and nature, and local people and conservationists

Looking with a constructivist perspective at conservation suggests that conservation of natural and agricultural biodiversity require a far more subtle appreciation of both human and natural dynamics. People are no longer separated from nature (Gadgil *et al.*, 1993). In the context of the relationship between people and nature, the paradigms illustrate two major differences. With the "blueprint" perspective people are "masters of nature" or "guardians of nature". Following the "process" paradigm to conservation, people are considered "partners to nature" or "participants in nature" (De Groot, 1992). For the relationship between people and their landraces (agro-biodiversity), the latter "people–nature" perspective is significant. This relationship has direct implications for the type of contributions conservationists can make in their activities to conserve agro-biodiversity, thus to sustain or strengthen this relationship. This means a complete reversal to *ex situ* strategies, in which human elements of diversity are ignored and eliminated in conservation activities. In the *in situ* conservation and "on-farm management" strategies, it is accepted that farmers are nature's "partners" or "participants". Therefore the characteristics of the strategy are enabling, involving and above all strengthening farmers' capacity of managing biodiversity, thus recognising local people as key actors in the strategy (Table 3.1). Because they are basic "partners" or "participants" in agro-biodiversity, local people instead of conservationists are empowered to achieve conservation.

***In situ* and on-farm conservation: initial efforts**

Since the early 1990s, PGR-conservationists have proposed a wide range of *in situ* and on-farm projects. These projects are implemented within a farmer's context of development and utilisation instead of conservation. This context is new to most conservationists, who used to operate in a rather closed network of conservation with strong links with breeders and genetic researchers. New partners such as development and farmers' organisations emerge to implement local strategies. For the "on-farm management" strategy, conservation organisations and NPGRPs need to establish linkages with farmers and local (development-oriented) organisations, with direct implications for the type of activities implemented "on-farm". Some conservationists have taken up a rather defensive position and opposed this development link and have warned that funds originally allocated to (*ex situ*) conservation would be shifted towards rural development. They have argued that political rather than

technical or scientific arguments are used to justify this shift (Wood & Lenné, 1995; Zeven, 1996).

Other conservationists have proposed "on-farm conservation" projects that so far have barely materialised because they are considered rather unpractical by development organisations and institutionally unsustainable by donors. "On-farm reserves" and "conservation subsidies" for farmers for continued on-farm cultivation of landraces have been proposed and elaborated (Wilkes, 1971; Iltis, 1974; Cooper & Cromwell, 1994; Qualset *et al.,* 1997; Maxted *et al.,* 1997c; Worede *et al.,* 1999). According to the classification presented in Table 2.2, these strategies are referred to as "*ex situ* conservation on-farm" (Group II). The strategies are characterised by the fact that conservationists take key decisions and control the cultivation of landraces on-farm; consequently they control or "freeze" the human component of local crop development. The major objective of these conservation efforts concerns continuation of natural rather than human processes. These proposals demonstrate that conservationists are reluctant to or limited in their professional capacity of dealing with unpredictable and uncontrollable human dynamics characteristic of farmers' management. As a consequence, these conservationists ignore or avoid the human component of landraces. These "on-farm" and *in situ* strategies follow the "blueprint" paradigm to conservation (Table 3.1).

Building upon the "process" approach to conservation, landraces may be managed "on-farm" through farmers' continued utilisation. Accordingly, farmers rather than conservationists are in control. If we consider that through the development and implementation of the *ex situ* strategy conservationists control the entire process, it may be rather difficult to accept unpredictable or "unreliable" farmers as partners in conservation. Another shift concerns the strong development orientation of activities that promote and support farmers' management and utilisation of agro-biodiversity. Consequently NPGRPs and their conservation professionals have become involved in more crop development activities, monitored and only if necessary intervened (collection) for the sake of conservation.

Other actors involved in conservation and putting utilisation first

Conservation organisations as well as research organisations, universities, NGOs and community-based organisations (CBOs) have started agro-biodiversity projects that aim to contribute to conservation *in situ* of agro-biodiversity. They respond to international attention to the strategy and financial resources that have become available for its implementation. In an effort to support the establishment of agro-biodiversity projects, the A-Team always worked with a diversity of actors (Appendix I). The resulting agro-biodiversity projects focused on local utilisation of crop genetic diversity, rather than on *in situ* conservation. In the A-team's formulation work, our partners' major approach was to enhance farmers' utilisation of crop genetic diversity. Projects started to support local crop development, e.g., participatory plant breeding, building community seed banks, organising diversity fairs and strengthening local seed supply. In their approach, these organisations followed Berkes *et al.* (1995) in the sense that they considered biodiversity conservation an indirect outcome, rather than an objective of the project and of farmer practices. This perspective is crucial to the social organisation of "on-farm management", as objectives of conservationists are linked to the objectives of farmers and crop development organisations. Through a focus on utilisation they merge achieving sustainable agro-biodiversity management and sustainable agricultural development.

Projects as experiments to study the social organisation of the approach

Various conservationists and crop development specialists have developed "on-farm management" strategies pursuing the "process" approach to conservation. They broaden their conservation perspective and focus on strengthening and increasing farmers' ability to manage and opportunities for utilisation of crop genetic diversity (Berthaud, 1997; de Boef *et al.*, 1997b; Smale *et al.*, 1998b; Sthapit & Joshi, 1998; Cromwell & Van Oosterhout, 1999; Almekinders *et al.*, 2000). When this approach is translated into projects, the role of NPGRPs and the social organisation of activities change with the modified objectives and activities. Compared to their current role, NPGRPs become more active in stimulating farmers' use and increasing farmers' access to germplasm (Cooper *et al.*, 1994; IPGRI, 1996a; Damania, 1996; Bellon *et al.*, 1997; de Boef *et al.*, 2000b). These new activities and partners, but also the change in conservation paradigm have had major implications for NPGRP's social organisation, and the institutional frameworks in which they are embedded. Bridges need to be built across various institutional and professional barriers, linking various organisations and bridging the gap between conservationists and farmers. Such bridges can only be constructed by broadening institutional mandates of NPGRPs and by supporting learning and action projects. The case studies will specifically focus on and analyse such processes of learning and experimentation. Agro-biodiversity projects including NPGRPs and other crop development organisations have been approached as experiments to study the social organisation of the "on-farm management" strategy.

3.2 Social construction

Introduction to "system thinking"

In the current section, I briefly introduce "system thinking", as it provides some of the initial answers to the questions raised above. Conventional conservationists' norms, practices and science are based on "hard system thinking". "Hard system thinkers" take systems as real. They focus on components; system boundaries and goals that are given or assumed fixed. Analysis and problem solving focus on goal seeking and on best technical means or models to reach a goal. "Hard system thinking" is usually applied to natural systems, e.g., *ex situ* conservation. The "blue print" approach described above may be considered an effort to conserve genetic resources as a hard system using "hard system thinking".

Problems associated with hard system approaches when applied to "human activity systems" have led to the development of another perspective with related approaches and methodologies: the "soft system perspective" (Checkland, 1981). "Soft system thinkers" do not take the world to be systemic. Soft systems are social constructs; they exist only to the extent that people agree on their goals, boundaries, membership and usefulness. To stimulate reflection and debate and accommodation between social actors and practices in soft system thinking models have been constructed to develop various perspectives (Engel, 1997). Once actors join a group and agree on goals, boundaries and activities they form a soft system. An emergent property is a major proposition of system thinking; it is the whole resulting from the components forming a system different from the sum of its individual part. In a soft system the difference between output of joint action compared to the sum of individual actions by actors forming a soft system is considered its emergent property (Wilson & Morren, 1990).

"System thinking" and the approach's social construction

The hard and soft system perspectives are instrumental explaining institutional and professional barriers to the social construction and implementation of "on-farm management" of agro-biodiversity as a conservation strategy. "On-farm management" may be considered an "emergent property" of collective actions of groups of social actors including farmers, crop development and conservation organisations active in crop development.

Conservationists unravel, predict and control natural processes in the implementation of *ex situ* strategies; they use a hard system perspective. Consequently, in the construction of "on-farm management" they use a similar perspective and their models are unpractical, non-sustainable or inequitable; above all they are rejected by development partners and farmers. Conservation professionals increasingly realise that with *in situ* and on-farm strategies they target at the continuation of dynamic human, ecological and genetic processes. However, they struggle with the human dynamics of farmers' management (Maxted *et al.,* 1997b; 1997c; Lenné & Wood, 1999; Brush, 1999). Their struggle may be explained by their application of a "hard system" perspective addressed to the human activity system of farmers' management. Hence, conservationist's norms, expertise and science may be considered barriers in the attempt to construct and implement "on-farm management" as a conservation strategy.

When "soft system thinking" is used, "on-farm management" is considered a soft system. Continued management of crop genetic diversity (landraces) is conceptualised as an "emergent property" of this soft system. Control over and management of crop genetic diversity are in the hands of farmers, with conservationists supporting and monitoring farmers' management. Conservation through the "on-farm management" becomes a model that is socially constructed by a group of actors including farmers, conservationists and other crop development organisations. In a process of social construction, a diversity of actors with dissimilar perspectives upon reflection and debate, through negotiation and accommodation will lead to joint action (Engel, 1997). The method of social construction turns out to be a rather open "process" instead of a rigid "blueprint" with a predetermined outcome. An obvious consequence of applying "soft system" instead of "hard system thinking" is that no uniform questions, answers and solutions exist. Thus by socially constructing "on-farm management" no single conservation strategy may be formulated. Due to the collective nature of the approach, communication and organisational tools are essential. They are necessary to facilitate the establishment of platforms for joint management of agro-biodiversity and to encourage processes of social learning. These tools and insights into processes of social construction complement technical expertise in management and conservation of crop genetic diversity.

Emphasising the social construction of an approach

In this line of thinking, the social construction of "on-farm management" does not appear an effort to design a conservation strategy but rather a way to approach complex ecological and social relationships and to seek ways to support these relationships. The problems encountered in agro-biodiversity management are open to interpretation. All actors maintain unique perspectives on the problem, its definition and what constitutes the improvement of the situation. As knowledge and understanding are socially constructed, it appears crucial to seek multiple perspectives on a problem situation by ensuring the involvement of a variety of actors and groups. For more sustainable management of agro-biodiversity, with all its uncer-

tainties, complexities, unpredictable social and natural factors, all actors need to become involved in the continuing process of learning, building new institutions and requiring platforms facilitating change (Röling & Jiggins, 1998).

Social construction and participation

The linkage between conservationists and farmers in the social organisation of the "on-farm management" may be analysed by studying various interpretations of "participation". Pimbert & Pretty (1997) in their paper "Parks, people and professionals" consider it essential for sustainability and biodiversity goals to be met that all relevant actors appropriately participate in the conservation process. They have desegregated the term participation into seven types (Table 3.2). This typology is helpful to understanding the interactions between farmers and

Table 3.2 Typology of participation

Typology	Components of each type
A Passive participation	People participate by being told what is going to happen or what has already happened. People's responses are not taken into account. Shared information belongs to external professionals.
B Participation resulting in information transfer	People participate by answering questions posed by extractive researchers and conservationists using questionnaire surveys or similar approaches, for example to identify selection criteria for plant breeding. People do not have an opportunity to influence proceedings, as findings, research or project design are neither shared nor checked for accuracy.
C Participation by consultation	People participate by being consulted and external agents listen to views, for example to identify breeding objectives and variety recommendation domains. External agents define both problems and solutions, and may modify these in the light of people's responses. Such a consultative process does not concede any share in decision-making and professionals are under no obligation to take on board people's views.
D Participation for material incentives	People participate by providing resources, for example labour or land, in return for food, cash or other material incentives (seeds, fertilisers). Much on-farm testing, maintenance of varieties or accessions fall into this category as rural people provide the resources but are not involved in experimentation.
E Functional participation	People participate by forming groups to meet predetermined objectives related to the project, which may involve the development or promotion of externally initiated organisations. Such involvement is not observed during early stages of project cycles or planning, but rather after major decisions have been taken. These institutions tend to rely on external initiators and facilitators, but may become self-dependent.
F Interactive participation	People participate in joint analysis, which leads to action plans, formulation of new local groups or strengthening of existing ones. Researchers use interdisciplinary methodologies that seek multiple perspectives and make use of systematic and learning processes. Learning groups take control over local decisions, and in this way people have a stake in the maintenance and further evolution of jointly created structures and practices.
G Self-mobilisation	People participate by taking initiatives independent from external institutions to change systems. Such self initiated mobilisation and collective action may or may not challenge inequitable distribution of wealth and power.

Modified from Pimbert & Pretty (1997) and Pretty (1995)

conservationists in the "on-farm management", and to understanding interactions between farmers and other professionals working for other fields of crop development.

Skills of professionals in science and technologies need to be effectively combined with strengths of local resource managers, based on local knowledge and experimentation, by empowering people through modification of conventional roles and activities. Interactions between conservation professionals and rural people change from control, coercive and teaching systems to facilitation, participatory and learning systems. Consequently, for the social construction of the "on-farm management" strategy, the types of interactions may gradually move between the extreme types, thus from "passive participation" to "self-mobilisation". To date there have been few systematic attempts by conservation organisations to adopt participatory planning methods for the development of "on-farm management" activities. It is clear that for such a move, the actors involved have to enter a process of institutional change and learning, at various levels of agro-biodiversity conservation and management. In the end, what we aspire to achieve with "on-farm management" is a type of interaction that approaches "interactive participation" and "self mobilisation". In this scenario, farmers will maintain and utilise crop genetic diversity and autonomously and collectively seek assistance or support for their management, and have access to germplasm, knowledge and information.

When focusing on "on-farm management", conservation professionals and local people are considered managers each with their strengths and weaknesses. Scientific, technical and facilitation skills of conservationists need to be effectively combined with farmers' skills based on indigenous knowledge and local experimentation. Interaction between conservation professionals and farmers will shift from systems based on control, coercion and teaching to systems based on facilitation, participation and joint learning. Few systematic attempts of conservation organisations are known that have adopted soft system approaches and have used interactive and more self-mobilisation types of participation in the social construction of the "on-farm management" strategy. It is clear that for the use of such approaches actors (professionals and farmers involved) will have to enter a process of social learning. Using a "soft system" approach, I will reflect on experiences and projects with the objective of constructing and implementing "on-farm management". I therefore included the soft system perspective in the book's third research question (Table 3.1).

Box 3.1 Key research questions (II)

i. In what way is "on-farm management" of agro-biodiversity as strategy constructed?

ii. What is the social organisation for the development of the "on-farm management" strategy?

iii. What are the implications of using a socio-ecological and a soft system perspective for the institutional frameworks that support farmer management of agro-biodiversity?

iv. What can be learnt from the application of the socio-ecological perspectives while using them in the study of institutional aspects of agro-biodiversity management?

4

Research methodologies

In this chapter, I provide background information on a number of methodologies, and elaborate on how I use them in this book. "Positivism" and "constructivism" are introduced as major research paradigms relevant to the study. Qualitative research and case study analysis are introduced. "Experiential learning" is the methodical perspective used to learn about and elaborate concepts and theories on the basis of experiences. "Experiential learning" is introduced as a research framework, refining the research process. Reflecting on the "socio-ecological perspectives", I use "grounded theory" and "experiential learning" as research instruments. "Grounded theory" is used to draw some conclusions on the book's socio-ecological perspectives (Chapter 14). "Experimental learning" is used to draw some conclusions in relation to the development of an enabling institutional framework that supports farmer management of agro-biodiversity (Praxeology; Chapter 15). Figure 4.1 gives a graphic overview of the methods for scientific inquiry and the paradigms used in the book's research process.

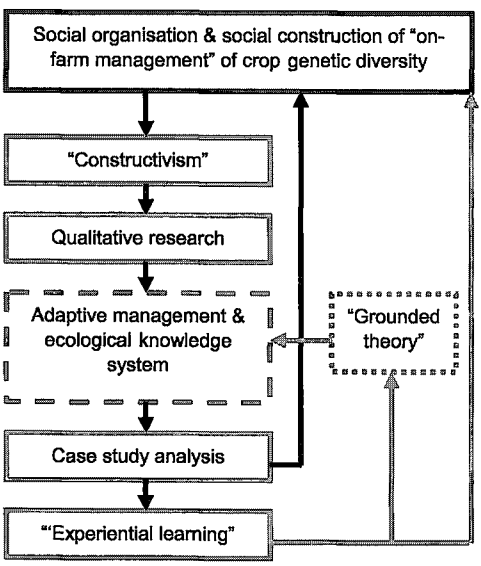

Figure 4.1
Methods of scientific inquiry used in the study

4.1 A paradigm shift

> "A paradigm may be viewed as a set of basic beliefs ... that deals with ultimates or first principles. It represents a worldview that defines, for its holder, the nature of the world, the individual's place in it, and the range of possible relationships to that world and its parts, as, for example cosmologies and theologies do" (Guba & Lincoln, 1994: pp. 107).

Guba & Lincoln (1994) use three questions as criteria to compare research paradigms:

i. The ontological question: what is the form and nature of reality and what is there that can be known about it?

ii. The epistemological question: what is the nature of the relationship between the "knower" and "would-be knower" and what can be known?

iii. The methodological question. How can the inquirer (would be knower) go about finding out whether whatever he or she believes can be known?

Since the 17th century, positivism has dominated science and research. This paradigm is based on a premise that a reality exists independently from observers, which is driven by fixed laws (the ontological question). Science is human's discovery of the true laws of nature thus unfolding one reality, with the ultimate objective to understand, predict and control natural phenomena. To come to a complete unfolding of reality, the complex world is broken down into discrete parts, analysing them, shaping models as a basis for understanding and predicting the whole. The methodology of positivism is experimental and manipulative, research questions and hypotheses are empirically tested to verify them. Research conditions are controlled (manipulated) to prevent unpredictable elements influencing the outcomes. Research tools are reductionistic and quantitative (the methodological question). Scientists are believed to be detached from the world, they are neither influenced by nor influence the researched objects themselves. If either form of influence is recognised, they will do their utmost to reduce or eliminate it using prescribed procedures, values and biases. Findings of positivist research are considered replicable and true (the epistemological question). The knowledge generated is assumed to be universal, time- and context-free. As a consequence, investigation controls to a large extent the studied system. Control is equated with good science assumed to generate "true knowledge". Science is assumed to be the source of technology that is generally applicable and can be disseminated extensively (Woodhill & Röling, 1998). The positivist perception is the foundation of the "Transfer of Technology" paradigm dominant in agricultural research and development (Chambers & Jiggins, 1987).

Constructivists adopt a position contrary to the one of positivists. Realities can be recognised as multiple, intangible mental constructions, socially and experientially based, local and specific in nature. These realities are often shared among many individuals and across cultures. Multiple constructions of reality exist, which does not mean that they are more of less "true", in any absolute sense, but simply more or less informed or sophisticated (the ontological question). Taking up a constructivist position, investigator and investigated object are interactively linked. "Findings" are created or constructed as investigators proceed (epistemological question). The objective of research methodologies based on this paradigm is to obtain and refine individual constructions through interactions between investigator and respondents as they observe and interact with material phenomena, social and natural processes. Hence, knowledge is the effective action in the domain of existence (Maturana & Varela, 1987). Resultant different constructions are interpreted using conventional explanatory techniques. They are contrasted using interchange based on arguments, with the ultimate objective to

Box 4.1 Some illustrative positivist statements

- Reality exists independently from the human observer.
- Through scientific research we can build objective and true knowledge about the reality.
- Scientists discover and "lay bare the naked truth", "lift the veil hiding it", and "reveal its secrets".
- The goal of science is to add to the "store of human knowledge".
- Scientific research is the source of innovation.
- Technology is applied science.
- Development results from the transfer of results of science to users.
- Experts can solve problems. In fact, we do not have to worry too much about the future. Science will find the answers.
- Social science is not really science: it has not resulted in any true generalisations and cannot be used to send man to the moon.

Source: Woodhill & Röling, 1998.

achieve a joint or consensus construction that is more informed than before investigation (the methodological question) (Guba & Lincoln, 1994; Pretty, 1994).

A problem with the positivist research paradigm is that it takes up an absolute position and excludes other possibilities. Other more pluralistic ways of thinking about the world and acting to change emerge while taking up a constructivist position. Within this position, positivism is identified as just "one of the ways" (Pretty, 1994; Röling, 1996). The dominant view of agricultural science is based on what Woodhill & Röling (1998) call a realist-positivist epistemology. Box 4.1 presents some typical statements related to this position. Röling & Wagemakers (1998) describe the "erosion" of what they call the positivist paradigm in agricultural science unable to cope with current agricultural, social and environmental questions.

Trust is fading away among experts and specialised institutions capable of solving problems in the socio-ecological interface. Loss of trust in positivist science is related to uncertainty and surprise as elements of environmental crises. Human survival depends on human understanding of the impact of human activity on the biosphere and on simultaneous adaptation of human activity based on this understanding (Jiggins & Röling, 2000). "Positivist" agricultural science is limited to deal with uncertainty and unpredictable characteristics of social and ecological processes. Röling & Wagemakers (1998) argue that taking up a constructivist perspective increases the capacity of agricultural science to develop solutions to problems in the socio-ecological interface, resulting in more ecologically sound agriculture (Chapter 6). Embracing such a perspective on sustainable agricultural development, knowledge is jointly constructed in platforms through facilitated social learning (Woodhill & Röling, 1998).

Studying the social organisation and construction of "on-farm management" of agro-biodiversity, I will follow this school of thought. "On-farm management" occurs in the human-natural interface described above, with its unpredictable social and ecological dynamics. The competence of 'positivistic conservationists" to construct "on-farm management" as a conservation strategy has been inadequate, particularly due to their limitations to deal with characteristic unpredictable social and ecological dynamics of crop genetic diversity and farmers' management (Section 2.3). When "on-farm management" is considered a soft system, actors' dissimilar views on what they consider "on-farm management" have to be discussed, negotiated and accommodated. In the case studies, I will describe processes of various groups of

social actors that jointly construct the conservation strategy. As a researcher I cannot detach myself from these construction processes, as in most of the projects discussed I have been an actor myself.

4.2 Qualitative research

Science has overemphasised quantitative methods even in fields that do not easily lend themselves to quantification such as biology and social sciences. Qualitative research is often referred to as lacking solidity. The maturity of a field of science is commonly believed to emerge as the use of quantitative research methods increases. Within positivist research, inquiry attempts to verify hypotheses, usually formulated as mathematical propositions.

Denzin & Lincoln (1994: pp. 4) indicate that the term "qualitative" in qualitative research implies the following:

> "An emphasis on processes and meanings that are not rigorously examined, or measured (if measured at all), in terms of quantity, amount, intensity, or frequency."

They stress that

> "Qualitative researchers stress the socially constructed nature of reality, the intimate relationship between the researcher and what is studied, and the situational constraints that shape inquiry. They seek answers to questions that stress how social experience is created and given meaning".

Box 4.2 Five phases of qualitative research

i. Researchers and the "researched": taking a constructivist approach researchers cannot isolate themselves from the "researched". Ethics and politics of research cannot be ignored, "the age of value-free inquiry" and objective science is over.

ii. Paradigms: researchers' beliefs about ontology, epistemology and methodology.

iii. Research strategies and interpretative perspectives: these activities direct researchers in linking the paradigm used to the empirical world, and connect them to specific sites, people, groups, institutions and bodies of relevant interpretative material. The strategy used operationalises the paradigm for specific empirical sites turning these into study objects.

iv. Methods of collecting and analysing empirical materials: researchers use various methods; these vary from interviewing to direct observation, to analysis of documents and personal experience.

v. Art of interpretation: this appears a rather creative part of the research process. As qualitative interpretations are constructed, researchers cannot simply remove themselves from an interview or a meeting and subsequently distil their findings. They start making field notes, organise and document these notes, moving gradually to interpretation. Text is created as a working document, ultimately writers attempt to make sense of what they have learnt. The final story may take various forms from confessional, realist, historical, critical, analytical, "grounded theory" and so on. The phase of making sense of their qualitative research findings is both an artful and a political one. No single truth emerges due to the constructional nature of interpretation in qualitative research.

Source: Denzin & Lincoln, 1994

Interconnected, generic activities define the qualitative research process in process-oriented qualitative research by means of steps with the following labels:

> "Behind these terms stands the personal biography of the gendered researcher, who speaks from a particular class, racial, cultural, and ethnic community perspective. The gendered, multi-culturally situated researcher approaches the world with a set of ideas, a framework (theory, ontology) that specifies a set of questions (epistemology) that are then examined (methodology, analysis) in specific ways. Empirical data on the question are collected and then analysed and written about. Every research speaks from within a distinct interpretative community, which configures, in its special way" (*Ibid.*: pp. 11).

These authors have characterised five phases to describe research activities in a qualitative research process (Box 4.2); these phases correspond to the structure of the book.

4.3 Case study analysis

Case studies are the major analytical tool used in the book. Epistemological questions raised in case study analysis are "what can be learnt from a single case?" and "what from different ones?" Stake (1994) considers case study analysis a process of learning about a case, a product of learning by researchers and readers. The more the object of a study is a specific, unique and bounded system, the greater is its usefulness to answer the question "what can be learnt about it?" Stake describes three types of case studies (Box 4.3).

Box 4.3 Case studies: three types.

Intrinsic case studies are undertaken because the researcher wants a better understanding of the individual case. No relationship to other cases is relevant and purpose is not theory building, an intrinsic interest of the researcher guides him or her in studying the issue addressed.

Instrumental case studies examine a particular case to provide insight into an issue or refine a theory. The case itself is of secondary interest; it plays a supportive role, facilitating an understanding of something else. The choice of case is made because it is expected to enhance understanding of what matters to the issue or theory. Stake (1994) adds the point that often case studies are used for various reasons at the same time, thus combining intrinsic and instrumental backgrounds.

Collective case studies are instrumental studies extended to several cases. Individual cases in the collection may or may not be known in advance to manifest a common characteristic, though they may be similar or dissimilar. The cases have been selected because the aim is that the collective will enhance understanding of individual and collective materials being studies, and may lead to better theories.

Source: Stake, 1994: pp. 237

Case studies may be regarded as a small and initial step towards generalisation. However, this should not be emphasised. There is a danger that researchers' attention is drawn away from the original (general) features of understanding individual cases. In reporting case studies, researchers need to balance between letting cases develop their own stories and using an analytical framework directing cases to answering questions at higher levels. It is clear that researchers decide on what are the stories of the case, or at least what of the case's story they report. It is evident that each case has a story or its own, however, the researcher tells it. This

character adds a strong subjective element to case study analysis; researchers decide on criteria for reporting. A range of boundaries demarcates researchers' ability to tell their own story and provide their own perspective on the case. There are numerous criteria for selecting contents, these include those set by funding agencies, institutional environments and research protocols, researchers' functions during the research process and their career patterns, and aimed types of publications. In the course of investigating and writing down the case, researchers' make subjective choices. The knowledge revealed in a case study reaches readers filtered through the researchers' experiences and understanding. Research outputs result from social experiences (meetings, discussions, and events) in which researchers participate; they also depend on their observations, experiences and choreography to analyse and report these. As knowledge is socially constructed, case study researchers first construct their knowledge about cases, and subsequently assist readers in their own construction.

Many cases are reported in a manner that may be linked to reports on other cases. However, the extent to which case-researchers take responsibility for making comparisons may vary. They may acknowledge or refer to other researchers' case studies. Stake (1994) considers comparison a powerful conceptual mechanism that fixes attention to a few comparable attributes. Where there are multiple cases of intrinsic interest (Box 4.3), comparison may be useful. Generalisations from differences between or among case studies are less reliable compared to generalisations from one case.

I reflect upon my experiences in a number of projects and in working with a range of organisations by making use of case study analysis. I tell stories of projects and organisations and effort to manage, conserve and utilise crop genetic diversity. This record is subjective, based on my experiences and perceptions. Experiences reported upon and information provided have not been collected during specific research assignments, with me as an "outsider" studying social interactions among actors involved. In fact, I have been an "insider" with functions ranging from employee to co-researcher, facilitator, advisor, team leader, co-ordinator, administrator or negotiator. These functions have shaped the institutional and professional framework for learning. Together with co-authors of the case study chapters, I have reflected upon experiences and lessons learnt. Each case study tells its own story with its own intrinsic and instrumental value (Box 4.3) to the scope and objectives of the book.

4.4 Grounded theory

The methodology of "grounded theory" is referred to as a comparative method, using data in a variety of forms such as field notes, videos and secondary data gathered using interviews, focus group discussions and participant observation techniques. "Grounded theory" may be distinguished from other types of social research in that it inductively builds theory rather than tests theory that derives from deductive principles and methodology. The approach explicitly involves creating theory and conducting social research as two components of the same process (Glaser & Strauss, 1967). Locke (1996) stated that the "grounded theory" approach not only requires constant comparison and contrasting of data and theory, but also that the emerging theory drives ongoing data collection.

Social scientists using "grounded theory" are interested in patterns of action and interaction among social actors. They are not solely interested in creating theory about actors, but are much more concerned with discovering processes of interactions. Repetitive comparisons

between proposed linkages among events contribute to further development of the emerging theoretical framework. "Grounded theory" is appropriate when used in action research that addresses dynamic situations of management. Glaser (1992) recommends keeping methodological rules to a minimum in the interest of a developing useful theory. Paine (1997) elaborated this position while applying "grounded theory" in his book; he interpreted "grounded theory" as the evolution of a theory rather than verification and testing of a position determined from the start.

"Grounded theorists" have developed two schools that can be distinguished in the belief of practitioners about the role of researchers, the use of data sources, and the basic inquiry paradigm to which they adhere. Following the first and original school, researchers are supposed to keep their distance and independence from the studied so as not to "contaminate" data and concepts formed. Researchers are considered "neutral" or "value free". Straus & Corbin (1990) proposed a radical change from this positivist position. They developed the second school that takes up a constructivist position. Accordingly researchers should be involved actively in the research process and continuously question their data to arrive at conceptual categories. Consequently, the two views on the role of the researcher are reflected in contrasting perspectives on the source of data and their use for conceptualising these data. The first school maintains that researchers should not include any "a priori" knowledge to the study; the second permits researchers to gain insight into the data through existing theory, non-academic publications, personal and professional experiences (Locke, 1996; Steins, 1999). Following a constructivist position, social phenomena are conceived of as continuously changing in response to changing conditions. Thus the second school of "grounded theory" incorporates such change processes into its methods. Therefore, determinism is rejected; individuals are seen as social actors capable of making choices according to options perceived. Corbin & Strauss (1990) state that "grounded theory" seeks not only to uncover conditions but also to determine the way in which actors under investigation actively respond to these conditions, and to the consequences of their actions.

In this book, I adopt the second school of "grounded theory". Rather than a neutral observer, I have been a researcher engaged in social processes I have studied. I used "grounded theory" in the further development of two "socio-ecological perspectives" that refer to patterns of action and processes of interaction of social actors. While applying these perspectives to the study of the social organisation of and in processes of social construction of "on-farm management" as a conservation strategy, I have attempted to gain insights into the perspectives used. The study itself has been undertaken as an iterative process. The "socio-ecological perspectives" have been identified as important concepts and perspectives that provided me with tools to study processes of social construction and interactions among social actors. These perspectives were applied and further investigated. Drawing general lessons from the use of these socio-ecological perspectives and using "grounded theory", I could contribute to the their development.

4.5 Experiential learning

The methodological and conceptual setting of the book is based on the framework of "experiential learning". Checkland (1985) developed the framework; it is presented in Figure 4.2. F is a framework of emergent concepts, ideas and perspectives; M a methodology - a method to

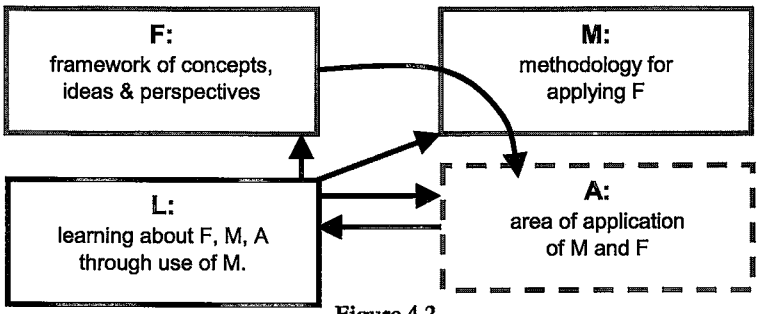

Figure 4.2
Research framework for experiential learning
based on Checkland, 1985; Hamilton, 1995

apply these concepts and ideas; and A the area in which they are applied. Checkland (1985) indicates that "A has no sharp boundaries" as it is a human activity system, "the application of F through M may lead us into byways not initially expected". Learning results from the application of the methodologies related to the framework, and applied in the specific area; in addition, lessons may be learnt about M and A. The framework of "experiential learning" results in an iterative research process, providing insights in frameworks of concepts and ideas, methodologies applied and areas of application. "Grounded theory" is translated into a learning process.

In this book, "socio-ecological perspectives" are used as frameworks for concepts and ideas. They constitute the framework of perspectives (P) on the basis of which a methodology (M) is developed to reflect upon experiences and interactions among social actors in the social construction and the social organisation of the "on-farm management" strategy (A). Case studies (Part III) are analysed making use of three "windows of reflection" (Chapter 7). The case studies and windows make up the methodology (M). They are developed based on the "socio-ecological perspectives" (P). In the book, much will be learnt about the "on-farm management" strategy (A) using "socio-ecological perspectives" (P) and "windows of reflection" (M). The entire research process of "experiential learning" contributes to the book's major objective to create enabling and adaptive institutional frameworks for the development and implementation of the "on-farm management" strategy. In addition, we learn much about the "socio-ecological perspectives" and the methods applied. Figure 4.3 presents the book's experiential learning framework. This framework will guide the research process in the various parts of the book.

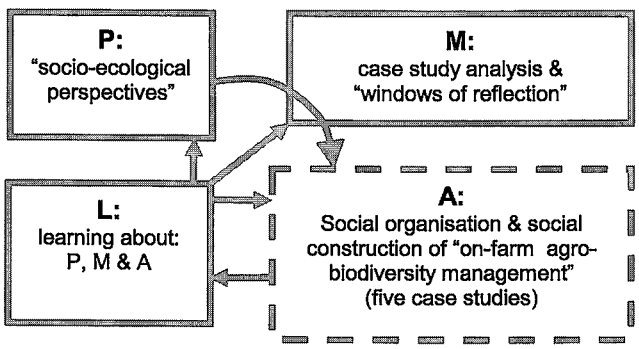

Figure 4.3
Research framework (I)

Part II

Socio-ecological perspectives

5

Adaptive management

The current chapter introduces the "adaptive management" perspective that I use in the study of "on-farm management" of agro-biodiversity. Adaptive management emphasises the ecological sphere to management of ecosystems, whereas the "ecological knowledge system" perspective that is presented in Chapter 6 emphasises the social sphere of ecological agriculture. Both perspectives focus on interactions between human management institutions, policies and learning, I therefore have called them "socio-ecological perspectives". Adaptive management is characterised by its objective to enhance the capacity of management systems to respond to ecological and human dynamics. Its scientific basis in ecology is explored. Two ecological key features that have been crucial for its development are introduced: the "ecosystem cycle of adaptive renewal" and the concept of "resilience". They are used to reflect on agricultural development and management of agro-biodiversity. Subsequently, adaptive management is introduced. The dynamics of organisations involved in ecosystems management is discussed, linking their dynamics to those of ecosystems. In the conclusion of this chapter the cycle of adaptive renewal as developed by ecologists is utilised as a model to better understand the dynamics and dimensions of social organisations. The implications for managers of applying this "ecocycle model" in organisational development are briefly introduced. The model explains the phases of crises and renewal that form organisations or institutional frameworks (such as conservation organisations) and makes them more adaptive and responsive to change in society, economy and ecology.

5.1 Cycle of adaptive renewal

Holling (1986, 1995) uses the following key features to characterise ecosystems:

- their structures and functions are not constant; changes are episodic rather than continuous and gradual;
- their spatial organisation and scales are not uniform; scaling up from small to large cannot be a process of simple aggregation;
- as a consequence they do not have a single equilibrium or state; movement between diverse states is a fundamental element of maintaining structure and diversity. Destabilising forces are important in maintaining diversity; resilience and stabilising forces are major features maintaining productivity and development capacity.

For a long time, ecologists have perceived terrestrial ecosystem behaviour as solely controlled by two functions: *exploitation* and *conservation*. Rapid colonisation of recently disturbed areas was emphasised during the *exploitation (r)* phase. Energy and materials are slowly accumulated and gradually stored in the *conservation (K)* phase. Based on the key features of ecosystem behaviour, Holling (1986; 1995) developed a model drawing a cycle emphasising four phases in a continuous process of adaptive renewal. He added the *release* or *creative destruction* (Ω) and *reorganisation* (α) phases. During *release*, accumulated and tightly bound biomass and nutrients become increasingly overconnected; agents such as forest fires, insect pests or intense pulses of grazing release them. During *reorganisation* (α), soil processes minimise nutrient loss and rearrange nutrients to a phase that they become available for the subsequent phase (*r*) in the cycle. Figure 5.1 illustrates the eight-shaped cycle of adaptive renewal.

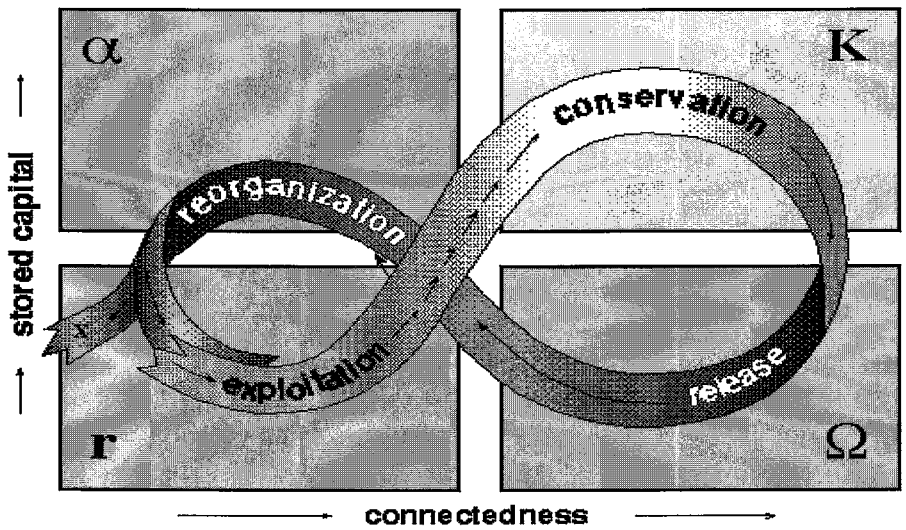

Figure 5.1
The cycle of adaptive renewal
based on Holling, 1986; 1995

Biological time flows unevenly throughout the cycle. Typically, the cycle slowly proceeds from exploitation to conservation, very rapidly to release, rapidly to reorganisation and back to exploitation. For example, the stock of nutrients and biomass slowly accumulates during the sequence from the *r*-phase to the *K*-phase. At the same time, stability and "connectedness" increase. Moving through the *K*-phase, nutrient capital gradually becomes tightly bound within existing structures. In the sequence from the *K*-phase to the Ω-phase, systems are brittle and overconnected as they slowly move to maturity (end of the *K*-phase). This results in a moment, when ecosystems become vulnerable to dramatic transformation caused by small events and fast processes. From an equilibrium perspective, the system is considered highly stable. However, resilience becomes smaller and smaller as system components are interwoven to such an extent that they become vulnerable to external agents, such as fire or drought, flipping the entire system into a different phase. In fact, the system becomes vulnerable to dramatic change, as a result of loss of resilience. In the sequence from the *K*-phase to the Ω-phase, the system may be considered an "accident waiting to happen". This moment is also the phase in which human organisations take a rather forceful interest demanding change in policies and practices for ecosystem management.

With an ecosystem becoming overconnected, a sudden change triggers the entire system during the Ω-phase. In the subsequent sequence of the Ω-phase to α-phase, only weak connections develop permitting chaotic behaviour and resulting in unpredictable consequences. During the α-phase, small and fast variables dominate slow and large ones. The ecosystem will be most affected by sudden events that facilitate a diversity of species to emerge or disappear, or exotic invaders species to become established. Instability comes as regulation is lacking. During the α-phase, human groups or individuals can make the greatest structural change in future ecosystem structures and functions. In the *r*-phase, stability (and new) configurations of relationships will be (re-) established. Thus in the four-phase cycle, chaos emerges from order and order emerges from chaos. The phases are not distinct; ecosystems move through them by gradual transformation from one to the other, sometimes fast sometimes very slow. Changes are characterised as non-linear and complex; they result in chaotic behaviour. The cycle may be associated with a cycle of birth, growth, death and renewal underlying any complex adaptive system. Uncertainty and unpredictability are elementary components of these systems, whether they are ecological, human, institutional or social systems. The adaptive cycle has been further developed and verified in various studies of large ecosystems, their management, and the dynamics of organisations involved (Gunderson *et al.* 1995b; Berkes *et al.*, 1998).

5.2 Ecosystem resilience

A fundamental characteristic of ecosystems is that systems behaviour is fundamentally non-linear in both time and space. Within the adaptive cycle, resilience reflects the ability of systems to stay on the same branch of development when they are going through the four-phase cycle. Loss of resilience moves systems closer to thresholds, and ultimately cause them to flip from one equilibrium state or cycle to another (*x* in Figure 5.1). Such threshold effects occur in large-scale ecosystems, for example when loss of resilience irreversibly flips tropical forests into grasslands, or savannahs into bush-shrub landscapes. This description of resilience varies from the conventional equilibrium-based definition. Equilibrium-based resilience

aims at a constant state with low variability, resistance to and absorption of change. Resistance to disturbance and speed of return to the equilibrium are emphasised in the conventional definition. It is based on a predictive science that constitutes an equilibrium-founded, linear, cause-and-effect view of ecosystem dynamics. Ecosystem managers, using the conventional definition, assume natural resources to be predictable in their behaviour. They predict yields; perturbations can be calculated, controlled and excluded from the managed system.

When using the definition of resilience based on a more dynamic (chaotic) perspective of ecosystems in the adaptive cycle, resource managers consider conditions in an ecosystem far from any equilibrium. Constant development is emphasised. Instability may flip systems into other regimes or behaviour, i.e., in other stability domains. An important measure of such resilience is the magnitude of disturbance that can be absorbed by systems before they alter their structure. Resilience is closely related to overconnectedness, a character of ecosystems in the sequence from the *K*-phase to the Ω-phase (Figure 5.1).

Loss of resilience in ecosystems concurs with gradual loss of functional diversity. Such loss is followed by shifts (flips) of ecosystems to an irreversible state (x). In Figure 5.1, the x-state is illustrated between the α-phase and *r*-phase. Control or output oriented management practices often result in ecosystems evolving to spatially uniform and functionally less diverse. As a result, such managed ecosystems grow more vulnerable to external and internal disturbances, that otherwise would have been absorbed; ecosystem resilience declines (Holling, 1986). Biodiversity is an important property contributing to ecosystem resilience. It facilitates continuation of complex ecological functions. Following the adaptive definition of resilience, biodiversity is considered "an insurance function" of ecosystems maintaining adaptive capacity and not flipping to a degraded stage in response to external (ecological and human) forces. Practices that aim to increase ecosystems" robustness and buffering capacity have their roots in this resilience perspective; they regard biodiversity an important property maintaining ecosystem resilience (Holling, 1995; Holling *et al.*, 1998).

5.3 Resilience, agriculture and biodiversity

Similarities emerge among management practices responding to the dynamics of ecosystems, agro-ecosystems and agro-biodiversity. The adaptive cycle provides an interesting perspective for analysing agro-ecosystem dynamics and the function of biodiversity in agriculture. When the perspective is applied to high-input farming systems, these are considered over-connected with their monocultures and extensive land clearance. Modern agriculture fixes agro-ecosystems in the *conservation K*-phase of the adaptive cycle. They are overconnected and become more and more brittle, increasingly turning fragile. The known consequence of such management practices is increased vulnerability to "external agents" such as pests and diseases or climate variations. Hence such agro-ecosystems lose ecological stability and resilience. External inputs are required to keep responding to these external agents; the inputs thereby replace ecosystem functions (Holling *et al.*, 1995). Apparently agro-ecosystems flip, leading to irreversible loss of agro-ecosystem structures and functions, terminating ecological services as provided by biodiversity. Taking the adaptive definition of resilience, agro-ecosystems are fixed in one phase, they are disconnected from adaptive ecological processes. The capacity of agro-ecosystems to respond to external ecological and social changes is lost; they do not flow through the four-phase cycle.

Typical modern agriculture emerges as an "eco"-system to which ecological principles are no longer applicable. Taking the above-described perspective of ecologists, it appears a malfunctioning ecological system that is fixed in the adaptive cycle's *K*—phase and *r*-phase. The use of chemical fertiliser to some extent disconnects crop root systems from soil-life; chemicals used for plant protection accomplish some "independence" of co-evolving weeds, insects, fungi and bacterial life that would be in a balance with crop growth and production. Hybrid or "genetically fixed" varieties block out (genetic) adaptation of crops to the dynamics of agro-ecosystems. This whole of modernisation of agriculture has made agro-ecosystems extremely vulnerable or "brittle". (Socio-) economic instead of ecological feedbacks direct modes of production; inputs are used to produce in an (economically) optimal manner, controlling, regulating and diminishing ecological dynamics. This process of disconnection of agriculture from ecology is the product of an ever-increasing process of industrialisation of agricultural production.

The ecological perspective on ecosystems and biodiversity is relevant when addressing the ecological functions provided by genetic diversity in agricultural production. At the global level, agro-biodiversity provides the stock germplasm available to plant breeding, biotechnology and crop development. At the more local level in non-industrialised agriculture, crop genetic diversity maintains or raises agro-ecosystems resilience. It provides the ecological service responding through genetic adaptation to environmental change.

The solution of storing germplasm in genebanks to genetic erosion is based on a model in which maintenance and generation of genetic diversity are disconnected from ecological and human dynamics in agro-ecosystems. *Ex situ* conservation is thereby in sharp contrast with the "on-farm management" strategy that aims at continuation of local social and ecological processes that generate crop genetic diversity. With the construction of "on-farm management" a similar ironic situation emerges as Holling and colleagues described for management of large ecosystems. They point to the nested position in time and space of social and ecological systems. Addressing farmers' management of agro-biodiversity such a nested and interwoven situation also emerges. In ecosystem management, it was realised that developing sustainable management practices (thus maintaining resilience) should go in hand in hand with the social and economic aspirations of people living and using these ecosystems ("the development position"). Likewise, farmers cannot be cut off their own aspirations using agro-biodiversity. Therefore "on-farm management" of crop genetic diversity is not only a conservation strategy, it is an ecological and adaptive approach to managing and utilising crop genetic diversity. The strategy may be approached as a component of the effort to strengthen the human-ecological linkage in agro-ecosystem management and agricultural production. Genetic diversity is emphasised to enhance resilience of agro-ecosystems.

5.4 Adaptive management

Unpredictable interactions between people and ecosystems as they jointly evolve are the central focus of adaptive management as a "normative perspective". Ecologists engaged in the management of large ecosystems have developed the approach. Key to adaptive management has been an increased understanding of ecosystems dynamics, the cycle of renewal, the associated notion of resilience and the associated dynamics of human society and their institutions (Holling, 1986). Its major objective is to maintain and enhance the capacity of ecosystems to

stay in the same branch of development, while going repeatedly through the phases of the adaptive cycle; thus preventing ecosystems moving closer to thresholds, and flipping from an equilibrium to a more degraded state.

Holling (1995) defines adaptive management as follows:

> "The release of human opportunities that require flexible, diverse and redundant regulation, monitoring that leads to corrective action, and experimental probing of the continually changing reality of the external world".

Tools used in conventional natural resource and ecosystem management include risk assessment, planning and design. The science of conventional resource management provides management organisations with methods that are incomplete, inadequate and inappropriate for responding to situations in which surprise is an important property of ecosystem dynamics (Jiggins & Röling, 2000). As a consequence, conventional management institutions are hampered in their capacity to deal with ecosystems' unpredictable and chaotic behaviour. Policies that assume smooth change and reversible conditions will be limited in their ability to accommodate ecosystem dynamics. Such policies are burdened by continuous ecological surprises, to which they can only react, instead of adapt.

Adaptive management may be considered a response to a widely perceived sense of a societal crises linked to unpredictable environmental problems. It approaches crisis raising a gradual understanding of the interactions between humans and their physical and biological environment, and focusing on the dynamic ecological processes on which they depend. Adaptive management perceives change, uncertainty and surprise as fundamental to ecological processes. Through its development by ecologists who facilitate change in, or are responsible for, the management of ecosystems, the perspective is bound to specific ecosystem boundaries. Based on studies of specific complex ecological systems, adaptive management translates essential ecological understanding into localised implications to human society, its institutions and management practices (Jiggins & Röling, 2000).

Adaptive management regards ecosystem management policies as "experiments". Managers and policy-makers continuously learn from these "experiments" (Holling, 1978; Walters, 1986). Hence it facilitates social and institutional learning (Lee, 1993). The approach strengthens linkages and feedback mechanisms among research, management and policy frameworks and concerned citizens and social actors. It differs from conventional approaches that emphasise feedbacks that shape policy, followed by systematic experimentation to shape future policy, and so on. An iterative and continuous learning process guides management; it contributes to the design of management systems that are responsive to ecological and social change. The approach is inductive as it relies on comparative studies that combine ecological theories with observation and active human interventions in ecosystems. These interventions are based on understanding human responses to social and ecological change (Gunderson *et al.*, 1995a). As a consequence, adaptive management replaces economic with ecological imperatives (Jiggins & Röling, 1999).

Lee (1993) and Gunderson *et al.* (1995b) link adaptive management to organisational development and learning. The capacity to learn and modify management models distinguishes adaptive management from conventional approaches. Learning in this context is generally regarded as collective learning, including groups, communities, and organisations. They learn by shared perceptions of problems, their causes and solutions, and agree on goals and under-

take concerted action. Management policies and practices are designed, implemented, monitored and evaluated, and redesigned. In many cases complex evolving human management systems that rely only on traditional or indigenous knowledge demonstrate adaptive characteristics of being responsive to ecological dynamics. There are many examples of societies that have demonstrated rapid social learning in times of crisis. Hence they have evolved indigenous "adaptive" management systems. Adaptive management may be conceived as a contemporary scientific approach that builds on indigenous management systems (Holling *et al.,* 1998). In this context, knowledge may be considered as "effective action in the domain of existence" (Maturana & Varela, 1987). The target of adaptive management is to (re-) optimise societies' sensitivity and responsiveness to environmental feedback. A parallel between indigenous (or traditional) and adaptive resource management emerges. Flexible learning-by-doing management systems are better adapted to long-term survival than rigid management systems working along blueprints (Berkes & Folke, 1998).

Adaptive management has been outlined and tested over the past two decades (Holling, 1986; 1995; Lee, 1993). Its theory has been expanded and practised in the management of large ecosystems (watersheds, lakes, forests) and management of a range of natural resources (water, forests, grasslands, fish). Particularly in North America, adaptive management as normative perspective is increasingly used and further developed in "real attempts" to manage large ecosystems in a sustainable manner (Gunderson *et al.*, 1995a; Berkes & Folke, 1998).

5.5 Organisations in the adaptive cycle

The role of institutions has also been explored under the umbrella of adaptive management. Institutions are considered mechanisms that couple people to their environment. Berkes & Folke (1998) and Gunderson *et al.,* (1995b) have explored the potential and achieved role of institutions in matching socio-ecological dynamics. The latter take the "cycle of adaptive renewal" as a point of reference; the outcome is valuable, enhancing our understanding of the evolution and development of "adaptive" management organisations.

The adaptive cycle provides useful insights into the dynamics of organisations involved. Gunderson *et al.* (1995b) characterised groups of key organisations or people dominant in the transition from "exploitation" to "conservation", to "release" and "reorganisation" and back to "exploitation" (Figure 5.1). These groups are characterised as "bureaucrats", "activists", "catalysts" and "strategists". Each group specialises in certain activities and has adopted specific strategies, goals and ways of defining and solving problems. A range of case studies (Gunderson *et al.*, 1995a) illustrated this pattern of coupled ecological and organisational dynamics. The evolution and configuration of these groups in the "adaptive cycle of renewal" result in AM. An "adaptive manager" can best be described using Paul Engel's (1997) metaphor of "theatres of innovation". An "adaptive manager" is the "director" who guides and facilitates various "actors" performing their "role" in the "play" of adaptive management of in the "theatre of ecosystem management". Table 5.1 gives a brief description of the four "roles".

Bureaucrats undertake activities ranging from the exploitative to the conservation phase. Most resource management organisations have been established to carry out policies, according a set mission or target, and then spend most of their time and resources becoming more efficient in the implementation of these policies. Strategic analysis gradually becomes

Table 5.1 Attributes of groups dominant the cycle of adaptive renewal

	Phase in the adaptive cycle			
	Exploitation to conservation	Conservation to release	Release to reorganisation	Reorganisation to exploitation
Attribute	$r \rightarrow K$	$K \rightarrow \Omega$	$\Omega \rightarrow \alpha$	$\alpha \rightarrow r$
Group type	Bureaucrats	Activists	Catalysts	Decision makers Strategists
Activity focus	Self-serving	Insurgence	Unlearning	New learning co-operation
Strategy	"Do as before but more"	"Weathering the storm"	"Unlearning yesterday"	"Inventing tomorrow"
Response to change	No change	Conflict	Shedding old behaviours	Reframing strategies
Time horizon	Time of office (linear time)	Present (discontinuous)	Time out (multiple scales)	Near future (multiple scales)
Space horizon	Building and holding bounds	Destruction of old bounds	Suspension of bounds	Creating new bounds
Nature of truth and reality	Constructed	Competing explanations	Discovering what works	Reconfiguring myths

Source: Gunderson *et al.*, 1995b

weaker; the primary concern of these organisations is to be efficient in their operation rather than critically reflecting on original policies, mission or targets. In bureaucratic management organisations the question "Are we doing things right?" is asked rather than "Are we doing the right things?"

Activists are critical towards the "creation" of crises that provide opportunities for a management system to shift from the *K*-phase to the Ω-phase. Activists identify single issues, that they perceive as inadequately addressed. To be successful in their actions, activists focus on narrowly defined goals and identify specific opponents, whom they challenge for whatever is their current goal. Activists who focus on a single-issue can be ignored or controlled by bureaucracy, but if the attention of the general public is raised to the point of focus, vulnerabilities of bureaucratic organisations are exposed. This may result in a period of crisis, which undeniably exposes the inadequacy of existing policies and management organisations.

In the Ω-phase, catalysts emerge as new groups or platforms of actors. They create opportunities for setting the necessary steps or activities that move the cycle in an adaptive direction. Such groups or platforms of technical people function informally outside traditional "bureaucratic" organisations; they draw upon contacts with these organisations and create alternative policies and institutional arrangements. Catalysts lack organisational formality, are temporary in their existence and are self-organised. Hence, constraints on creativity are removed in such groups; in this phase of the adaptive cycle, creativity is considered an essential property for change.

A group or platform of strategists becomes officially empowered to take up a formal position in the subsequent phase. They can be distinguished from the self-organised shadow network (catalysts) by the formal position as decision-makers; their existence is also temporary. Often

these groups of strategists take decisions regarding the selection of policy options. To be effective they engage a wide range of critical people who influence public opinion. A key ingredient to the success of these platforms is their ability to design credible future solutions to problems of the past. Therefore these groups span the past and the future.

5.6 Adaptive organisations and their management

Hurst (1995) utilised and modified the adaptive cycle of renewal (Section 5.1) to develop what he called the organisation ecocycle. The model may be used to study and guide change and renewal in organisations. He states that a major difference between natural and organisational systems is that organisations are made up of self-conscious actors, who are capable of rational action. Therefore the capacity for conscious rational action (C) is added to the emergent (A) and constrained (B) behaviours that characterise ecosystems (Figure 5.2). He distinguishes three contexts of management action (rationalities), integrates these contexts into an uneven pattern of organisational change and demonstrates the appropriateness of identified management actions. He thereby reveals patterns and a rhythm of renewal within organisations. He identifies eight management actions that move organisations through the ecocycle, and organised them in the "lazy eight", distinguishing two half loops with different strategic direction. The first half loop moves from "entrepreneurial action" (8), through "strategic management", "conservation" leading to "crisis" (3) (Figure 5.2; solid arrows). The second loop moves from "confusion" (4) through "charismatic leadership", "creative networks" to "choice" (7) (dotted arrows). Each loop moves through the centre area of rational action, however directions in management actions are distinctly different. Strategic management (1) is characterised by an instrumental rationality. The foundation of an organisation at this point is to move to a primarily economic and quantifiable direction, thus along an economic imperative. Charismatic leadership (5) as management action of the other (dotted) loop guides organisations through the area of rational action (C). The management action based on intrinsic rationality that is founded on values, i.e., "action is taken for its intrinsic worth in demon-

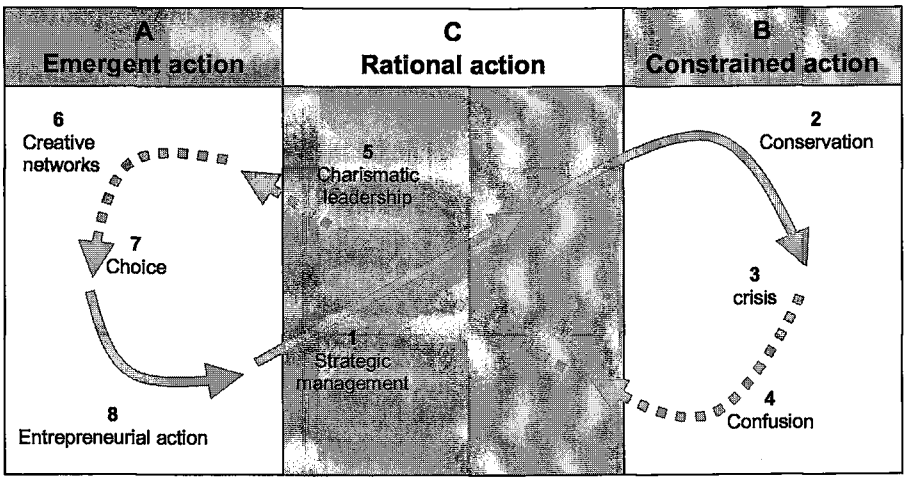

Figure 5.2
The organisational ecocycle
source: Hurst, 1995

strating deeply held beliefs about human relationships". The terminology of ecologists elaborating the adaptive cycle to illustrate the dynamics of ecosystems and particularly the degree connectedness of the systems may be used to illustrate the consequences of these two types of rational management actions. Strategic management leads organisation towards a situation of tightly connected and constrained performance (conservation phase; *K*) and charismatic leadership develops loosely connected, creative networks in which new connections are established and new activities are initiated (re-organisation phase, α).

In the context of this book, the organisational ecocycle model is interesting in that it reveals paths of crises and renewal in social systems such as individual organisations but also those connected within larger institutional frameworks. The model follows "adaptive ecosystem management" emphasis on the value of allowing crises to happen (if not creating them within organisations) as necessary releasing energy and adaptation to change. Any organisation moves through the ecocycle with phases of crisis and renewal. "Adaptive organisation managers" thus accommodate change and adapt management actions to patterns and rhythm of the cycle, similar to what "adaptive ecosystem managers" would do. A similar parallel with the life cycle appears. Organisations, when established (or born), usually embrace innovation and learning. As they grow and age, they become preoccupied with routine and performance, thus asking the question "Are we doing the things right?" rather than "Are we doing the right thing?" Flexible teams become rigid structures, open networks gradually close, and control supersedes change and learning. Just like the tightly connected and therefore brittle ecosystems, in which management organisations operate as bureaucrats, organisations in this phase become highly connected, single-minded and performance-oriented, and therefore critically insensitive to changes in the environment. In addition, the ability to learn is lost thus dominant organisations in this phase are similar to the dominant players in the ecosystem's conservation phase. The only way out of this brittle and overconnected situation is the cycle of crises and renewal, in which they change again from performance to learning organisations. Hurst calls this the "restoration of excitement and emotional commitment"; these are values often lacking in large businesses or organisations.

Hurst presents the ecocycle or renewal cycle of organisations as an evolution of social systems, putting emphasis on people and their interactions. He thereby links crisis to renewal as part of the evolution of social systems, and elaborates with the cycle the different phases of change between crisis and renewal. The organisational ecocycle may be used as a perspective to understand and guide organisational change. The resulting perspective is complex but useful. Where the performance loop (solid arrows in the lazy eight) was familiar to the dominant style of business management in the 1970s up till the mid 1990s, the learning loop (dotted arrows) is advocated by various current management gurus. Hurst described times of crises and renewal in various enterprises (e.g., a steel company in Canada) but also used it to explain changes in society and economy, for example to describe the rise and fall in the world market of Japanese and US car industries. He refers to the hunter-gatherers in the Kalahari, the movement of Quakers in 17th and 18th century Britain, and the innovative organisation of enterprises such as 3M and Nike.

5.7 Adaptive management, organisational development and "on-farm management"

The organisational ecocycle provides a management perspective for organisational change, renewal, innovation and learning. In this book, I use the model to complement the adaptive management perspective. I use it to reflect upon the role and position of various organisations involved in conservation and crop development within institutional frameworks at various levels and a "global agro-biodiversity management system", and place them in a context of change and renewal. I will not use the model to analyse the performance of individual organisations in the agro-biodiversity system, but use it to reflect upon the type of organisations operating within the system and identify opportunities for change and renewal. The organisational ecocycle complement adaptive management model developed by ecologists. They have identified individual actors dominant in the four phases of the adaptive cycle of renewal. With the new model, we can reflect upon change within organisations in response to change. The model thus opens a "window" to analyse of organisations moving through the cycle and to reflect upon management actions guiding the organisations through the cycle.

A combination of the adaptive cycle of renewal ant the organisational ecocycle model facilitates a historic reflection upon the institutional frameworks and organisations operating in the "global agro-biodiversity system". This combination emerges as a new perspective to explore the creation and design of enabling institutional frameworks that may support farmer agro-biodiversity management. Hurst used the lazy eight of Holling as model to describe and analyse processes of change and renewal in organisations as social systems. In most of his case studies, he defines boundaries for enterprises, branches of industry or specific social movements. He approaches these social (and economic) systems primarily within an economic context and does not relate these social systems to the broader social and natural or ecological environment. Holling developed the adaptive cycle of renewal as model to link ecosystem management systems to ecological dynamics, thereby emphasising the ecological dynamics of an ecosystem. In this book, the challenge is to explore and combine both models and use them as a socio-ecological perspective in the study of institutional aspects of agro-biodiversity management, a field in which social and ecological (but also political and economic) systems meet and cannot be separated. The boundaries for the system of agro-biodiversity management can be drawn at various levels, and for each level a diversity of actors plays a role in management. This brings me back to soft system thinking developed as a management theory by Checkland (1981; 1985). A link with this field emerges where systems and their boundaries are socially constructed. The soft system perspective is further introduced in Section 6.2 as basic input to the ecological knowledge system perspective.

Box 5.1 Key research questions (III)

i. In what way is "on-farm management" of agro-biodiversity as strategy constructed?

ii. What is the social organisation for the development of the "on-farm management" strategy?

iii. What are the implications of using an adaptive management and a soft system perspective for the institutional frameworks that support farmer management of agro-biodiversity?

iv. What can be learnt about adaptive management while using it as socio-ecological perspective in the study of institutional aspects of agro-biodiversity management?

In this book, adaptive management is not only a socio-ecological perspective that supports the study of the social construction social organisation of "on-farm management" (research question 3); it also becomes a learning perspective. Through its use in the field of agriculture and agro-biodiversity management, I am in the position to learn much about the perspective in a specific area of application (agro-biodiversity management) and, in an application of grounded theory, I am in the position to contribute to its further theoretical development (research question 4). The book's research questions are refined in Box 5.1.

6

The ecological knowledge system

The chapter introduces system thinking and in particular 'soft system thinking' as approach to better understand and deal with human activity systems. 'Soft system thinking' constitutes a basis for the development of the "ecological knowledge system" perspective. I elaborate on this perspective because it addresses the social sphere of facilitating sustainable agriculture, and therefore may be used in the study of the social construction and social organisation of "on-farm management". First, I provide some background information on the ways in which I refer to institutions and organisations. They form and shape the basic social systems addressed. In the final section I introduce the five dimensions that characterise the social context of the ecological knowledge system: practices, learning, facilitation, supportive institutions and conducive policies.

6.1 Institutions and organisations

Institutions are humanly devised constraints that structure human interaction. They are made up of formal constraints (rules, laws, constitutions), informal constraints (norms of behaviour, conventions and self-imposed codes of conduct), and their enforcement characteristics (North, 1993). Institutions are also defined as sets of rules actually used by a groups of individuals to organise repetitive activities that produce outcomes affecting those individuals and potentially affecting others (Ostrom, 1990). Much confusion exists about the distinction between institutions and organisations. Most importantly, it should be realised that organisations are social groups, people who work or act together in an agreed framework. Organisa-

tions are networks of contracts, nested in an institutional framework that defines structure and boundaries. In addition, organisations are considered key action points of social systems (North, 1990). Institutions influence the structure and goals of organisations, but over time action of social, political and economic organisations affect institutional frameworks as rules, norms and property rights, and thereby contribute to change and renewal.

One of the ways people are connected to their natural environments concerns systems of property rights. Regimes of property rights – the structure of rights to resources and the rules in which these rights are exercised – design how people control their use of the environment and natural resources (plant genetic resources or biodiversity in this book) and how they behave towards each other in the use (Bromley, 1991). Property rights are important parts of society's institutions, due to the way in which they have been designed, influencing interactions between people and their natural environment, e.g., interactions between people and biodiversity.

6.2 Soft system thinking

Efforts of conservationists and other crop development actors to design strategies that support farmers' management of crop genetic diversity have been described in Chapter 2. A "soft system" perspective has been used to reflect on the capacity of conservationists to contribute to the development of "on-farm management" as a conservation strategy (Section 2.5). As the "soft system perspective" is an important foundation to the ecological knowledge system, I will further introduce system thinking in the current section.

The Communication and Innovation Studies Group of Wageningen University has used "soft system thinking" to design tools that aim to enhance social actors' capacity to solve agricultural problems. Röling (1996; pp. 45) illustrates the use of "soft systems thinking" referring to the social aspects of sustainable agricultural development:

> "Sustainability is not considered an absolute criterion based on ecological carrying capacity or biodiversity, but an emergent property of a soft system, the result of negotiation and agreement".

"System thinkers" study reality and aim to intervene in it by probing and dealing with complex situations (Engel, 1997). Two complementary traditions are distinguished in system thinking; they differ in the way they look at the world (Checkland, 1981; Checkland & Scholes, 1990). Table 6.1 compares hard and soft system thinking.

"Hard system thinkers" focus on components; boundaries of systems and goals are assumed to be given. A picture of the whole (variety, farming system) can be drawn by analysing components of the system. "Hard systems thinking" is usually applied to natural systems (plants and ecosystem) or designed systems (computers). Hard system thinking geneticists and plant breeders focus on genes when studying and developing varieties. "Hard system thinkers" use models to represent the investigated system; these models are easier to study than the system itself; they can stand back as observers and examine systems objectively. Researchers do not have an impact on the system, because the system functions as a distinct entity (Röling & Engel, 1991). Problems arise when applying "hard system thinking" to human activities, which are not unambiguous and clearly lack defined boundaries. Human activities continuously change due to the wide range of interactions, which constantly take

Table 6.1 Hard and soft systems compared

	Hard systems perspective	Soft systems perspective
Origin	Scientific view on the world, integrally related to engineering concepts and quantitative methods.	Action research, the unspecified nature of most problem situations, and that both researcher and client are part of the problem.
Epistemology	"The world is systemic or can be taken as if it is: systems exist".	"The world is not systemic, but sometimes it is useful to take it as if system exist, systems are constructions".
Inquiry process (methodology)	Uses systems concepts and thinking during the problem identification stage; starts with a systems model.	Focus is on problematic situations: defer modelling to a much later stage.
	Systems models are concerned with processes, inputs and outputs.	Systems models concern social actors, their activities and their relationships.
Aims	To improve one's knowledge about the world by improving one's models.	To improve human performance through debate, reflection, action and learning.
Recognising goals/ desired ends	Processes functionally articulate goal-seeking wholes (....) goals are inherent to the whole.	Social actors might behave as a systemic whole if they wish to and know how to do it. Boundaries and goals are permanently (re) negotiated.

Source: Engel, 1997

place among members of one system, and members of other systems. A researcher of such a human activity system cannot remain disconnected; their very presence already has an impact on the system and results in change.

The hard system perspective characterises blueprint approaches to crop development and conservation. As a consequence, involved conservationists and crop development researchers are continuously battling to grasp human, ecological and genetic dynamics of landraces and farmers' management. The problems encountered or the failures in developing local conservation approaches are partially founded in the hard systems perspective used while applying it in the dynamic human activity system of farmers' management of crop genetic diversity.

Problems associated with "hard systems" approaches when applied to human activity systems have led to the development of "soft system" thinking with related approaches and methodologies. "Soft system thinkers" do not take the world to be systemic. Soft systems are social constructs; they exist only to the extent that people agree on their goals, boundaries, membership and usefulness. "Soft system thinking" may be used in the design of learning paths that increase the capacity of social actors facing a common problem, to negotiate accommodation among actors' conflicting goals and perspectives, and reach a point where they agree to initiate collective action (Engel, 1997). "on-farm management" as conservation strategy is an example of such a soft system. Conservationists, policy makers and other actors in the agro-biodiversity arena socially construct this strategy. For the implementation of the strategy, the soft system contributing to the realisation of the strategy only becomes operational through interaction, agreement and negotiation on joint actions by the actors involved. Because of the emphasis on management "on-farm", the interaction and above all agreed action of farmers emerges as crucial.

A specific application of "soft system thinking" developed by the Chair Group Communication and Innovation Studies at Wageningen University is the Agricultural Knowledge and Information System (AKIS) (Röling, 1988; Röling & Engel, 1991; Engel, 1997). AKIS has been developed as a diagnostic framework, which provides a better understanding for guiding decision making about the design of, investment in, and staff development for agricultural innovation. AKIS may be used to analyse how social actors in a soft system, such as scientists, farmers, but also breeders, conservationists, development workers, and so on are linked in the creation, adaptation, sharing, storage and application of knowledge and information. AKIS may be used in an analytical manner to guide interventions aimed to ensure that actors do, in practice, interact in ways that give rise to desired emergent properties, i.e., outputs that would not have emerged without the interactions. Examples of such emergent properties are agricultural innovation or "on-farm management" of landraces. Systems boundaries are negotiated and agreed upon to achieve jointly identified goals such as landrace conservation and increasing of community's seed security. The "knowledge systems" perspective has become common practice in addressing interactions among social actors operating involved in agricultural innovation (Röling, 1988; Engel, 1997). Within the socially constructed boundaries of a soft system, actors become engaged in joint processes of learning and innovation. This soft system is thus not something that "exists".

Rapid Appraisal of Agricultural Knowledge Systems (RAAKS) is a methodology based on AKIS (Engel *et al.*, 1994; Engel & Salomon, 1997). RAAKS has translated AKIS into practical methods for actors to form a soft system by looking interactively at their interactions through various "windows". Through these windows actors identify and analyse interactions as flows of knowledge and information. Thereby RAAKS builds a learning environment in which actors' interactions may be reviewed and enhanced. The function of the RAAKS learning path is to achieve joint performance, and support and enhance the group of actors' capacity to become engaged in joint processes of learning.

6.3 The ecological knowledge system

With the aim to address the social and institutional aspects ("the social sphere") of sustainable agriculture and building upon AKIS and soft system perspectives, Röling & Jiggins (1998) have developed the ecological knowledge system perspective. It has five dimensions: practices, learning, facilitation, institutional support and conducive policies. These dimensions are considered a consistent entity that functions and operates in accordance with objectives of the system. Figure 6.1 illustrated this perspective and its five dimensions. The ecological knowledge system perspective emphasises in a complementary fashion to adaptive management, the social and institutional aspects of

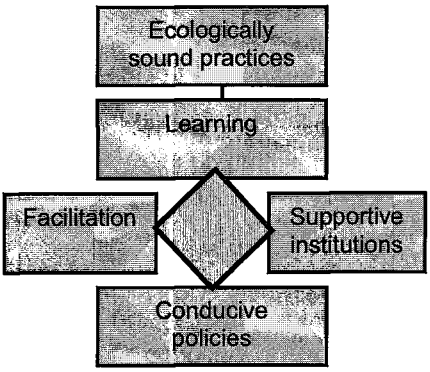

Figure 6.1
The ecological knowledge system
Source: Röling & Jiggins, 1998

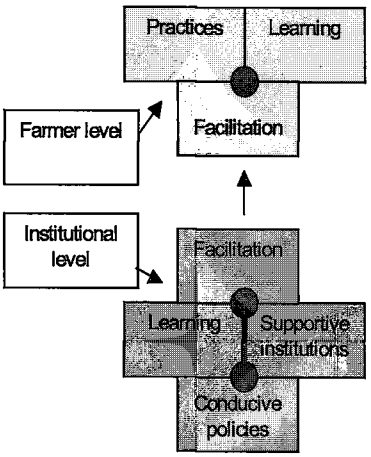

Figure 6.2
Dimensions of and facilitation levels within the Ecological Knowledge System

pro??cesses of change that facilitate agricultural development within socially and ecologically defined boundaries.

Röling & Jiggins (1998) specify the ecological knowledge system with the key features that relate to the level of operation that facilitate and clarify the path leading towards sustainable agriculture. Figure 6.2 elaborates the dimensions among the farmers and institutions involved.

The main objective is to achieve practices at the farmer level that result in a sustainable management of complex (agro-) ecosystems. Management involves ecosystems at various levels; it does not "focus on instrumental control of ecosystems to optimise the value of key variables, but on adaptive and responsive management of diversity and complexity to optimise opportunities and outcomes" (*Ibid.*, pg. 306). This feature links agriculture to ecosystem management at the level of the farmer's or community's livelihoods.

Learning groups or platforms, bringing together concerned actors, are the basic units of learning (Röling, 1996). Collective learning about and joint adjustment of practices and policies are necessary for the development of ecologically sound agriculture. As a consequence, the rationality that drives the knowledge system moves from an "instrumental" to a "communicative" rationality (Habermas, 1984; 1987).

Many efforts to develop ecological agriculture are limited to technical expertise. Facilitation is a key feature as its assists in interactive processes of social learning, negotiation, accommodation and agreement. These processes are used to construct a soft system. Facilitators in such processes need communication and process skills on the one hand, and technical knowledge and expertise on the other. In their professional attitude the need to be open to learn in these interactive processes.

Institutions that support ecologically sound agriculture are decentralised organisations; they are platforms for resource management, learning groups and networks that operate at various levels of (agro-) ecosystems. Facilitators are members of these learning networks; their function is to support others in learning together.

Policies concern processes of change addressing institutional and policy frameworks. Agricultural policies currently support industrialised and high-input farming. When taking an ecological knowledge system perspective, these frameworks support the "transition" to and promote ecological agriculture. Other policy features are the prevention of the externalisation of environmental and ecological costs of agricultural production and the promotion of consumer awareness of and trust in "eco-products".

6.4 Soft systems, the ecological knowledge system and "on-farm management"

In this book, the soft systems and the ecological knowledge system perspective are used to study the social construction and organisation of "on-farm agro-biodiversity management" and to design a supportive institutional framework. AKIS and RAAKS emphasise the identification of actors and analysis of flows of knowledge and information. Based on the ecological knowledge system, I have identified the following features to study the social organisation of "on-farm management": social actors (supportive organisations and networks), platforms for management of agro-biodiversity (institutions, learning), and flows of germplasm, knowledge and information (conducive policies). With the emphasis on institutional frameworks and organisations involved in crop development, I particularly emphasise interactions and activities at the institutional level. I realise that I will thereby fail to address an important component of the ecological knowledge system, being the farmers' level of ecologically sound practices and social learning. In Chapter 7, I elaborate how these features are addressed and utilised as to construct through the "windows of reflection" the structure if the case studies. In a similar manner to the adaptive management perspective, the ecological knowledge system becomes a learning perspective in this book. By its use in a study of institutional aspects of agro-biodiversity management, I aim to contribute to its application, use and theoretical development. Box 6.1 refines the research questions with respect to the socio-ecological perspective introduced in this chapter.

Box 6.1 Key research questions (IV)

i. In what way is "on-farm management" of agro-biodiversity as strategy constructed?
ii. What is the social organisation for the development of the "on-farm management" strategy?
iii. What are the implications of using an adaptive management, a soft system and an ecological knowledge system perspective for the institutional frameworks that support farmer management of agro-biodiversity?
iv. What can be learnt about adaptive management and the ecological knowledge system while using them as socio-ecological perspective in the study of institutional aspects of agro-biodiversity management?

7

Perspectives and windows of reflection

In this chapter, the "windows of reflection" are introduced. These "windows" shape the case studies. They also link the case studies with the two socio-ecological perspectives. The perspectives and "windows" are elaborated within the research framework (Figure 7.1).

7.1 Socio-ecological perspectives

I use two perspectives that refer to interactions between social actors who operate in areas in which nature and man, ecology and society form "one inseparable whole". Based on their introduction in the two previous chapters, I have concluded that social and ecological dynamics are highly interwoven within agro-ecosystems. The perspectives thus recognise man as a "partner" and "participant" in nature (De Groot, 1992). The same applies to agro-biodiversity; the social and ecological processes that contribute to its development cannot be separated from it. In this book, I use adaptive management and the ecological knowledge

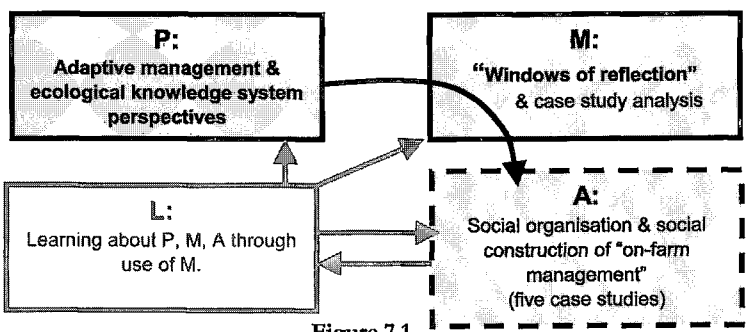

Figure 7.1
Research framework (II)

system as perspectives that emphasise this connection between nature and man. Figure 7.1 illustrates the two perspectives in the research framework. The perspectives contribute to the research methodology (M) used to study "on-farm management", thus responding to research questions i, ii and particularly iii (Box 7.1). In an application of grounded theory, these lessons are elaborated in a contribution to their theoretical development (research question iv).

Box 7.1 Key research questions (V)

i. In what way is "on-farm management" of agro-biodiversity as strategy constructed?
ii. What is the social organisation for the development of the "on-farm management" strategy?
iii. What are the implications of using an adaptive management, a soft system and an ecological knowledge system perspective for the institutional frameworks that support farmer management of agro-biodiversity?
iv. What can be learnt about adaptive management and the ecological knowledge system while using them as socio-ecological perspective in the study of institutional aspects of agro-biodiversity management?

7.2 Windows of reflection

In the case studies, four "windows of reflection" shape the structure for the presentation and analysis of the available and gathered information. These case studies are of an intrinsic and instrumental value (Box 4.3) to the scope and objectives of the book. The "windows" do not provide a fixed format, but are a general guide. This guide enables each case study to tell its own unique story in the overall context of the book.

The term "window of reflection" is used as a metaphor; it is derived from the "windows" used in the RAAKS methodology. Engel & Salomon (1997) proposed "windows" to guide a joint appraisal of interactions among actors engaged in an agricultural knowledge system. Similarly, the authors of the case studies look through the "windows of reflection" at the information and documentation gathered, reflect on specific discussions and their own experiences.

The "windows of reflection" have been developed on the basis of three elements in the research process:

- "adaptive management" and "ecological knowledge systems" perspectives;
- overall research questions (Box 7.1); and
- characteristics of the process of social construction and social organisation of "on-farm management".

Figure 7.1 returns to the research framework; the linkage is refined between the perspectives (P), the "windows of reflection" (M), and the study of the social construction and social organisation of "on-farm management" in the case studies (A). In this chapter, socio-ecological perspectives (P) are elaborated in the "windows of reflection" as methodological tools used in the book. The first chapter to Part III (case studies) will introduce the case studies as methodological tools, and thereby completes box M in the research framework (Figure 7.1). The perspectives and windows further contribute to answering the first two research ques-

tions and thereby facilitate learning about the institutional framework that supports farmer management of agro-biodiversity (Chapter 15; praxeology).

The windows used to structure and analyse the case studies are (i) actors, (ii) flows of germplasm, knowledge and information; (iii) social organisation; and (iv) social construction.

Window 1: Actors

A brief description is given of the social actors involved. We (the authors) particularly refer to actors' objectives and mandates, thus refer to their contributions and activities in agro-biodiversity conservation, agricultural research and (community) development. We describe and analyse the levels (global, regional, national and local) at which actors operate. In addition we refer to the public, private and civil domains of agro-biodiversity management as means to place the organisations and projects within larger institutional frameworks and society in general. This window assists in placing the actors in a framework based on adaptive management, thus identifying those actors involved in policy, resource management, research, and representation of civil interests.

Window 2: Flows of germplasm, knowledge and information

This window addresses issues related to germplasm flows. Related to germplasm flows are knowledge and information flows. The local and institutional crop development systems (Section 2.6) further assist in the analysis of these flows. An important dimension to be addressed with this window refers to interactions between actors who operate in various domains of resource management (public, private and civil) and at global, national and local levels. This window uses elements of the AKIS-perspective that has been one of the foundations of the ecological knowledge system. In RAAKS, identification and evaluation of flows of knowledge and information are important tools to reflect upon and seek ways to improve the performance of the "agricultural knowledge system" that a group of actors have agreed upon to form. We will use the current window in a similar manner to analyse the flows and if possible identify ways to improve the performance of the "agro-biodiversity management system". The institutions that regulate these flows (e.g., property rights) are crucial to this window; some of the case studies directly address these institutions.

Window 3: Social organisation

Through this window, we reflect on the organisational structure and development, institutional framework of projects and organisations. We thereby regard projects "institutional experiments" in which the social organisation to develop "on-farm management" strategy may be studied. We look at the positions and opportunities within these projects to operate as platforms for agro-biodiversity management. Such platforms include actors with different objectives and that operate at several levels and within distinct domains. This is an application of the "soft system thinking". In the two programmes operating at global, national and local levels (CBDC and IPGRI *in situ*), efforts to link actors with distinct research objectives will be discussed and analysed. Adaptive management emphasises the function of research to establish linkages between policy, resource management and citizens. This issue is particularly important when considering that local agro-biodiversity management is an objective formulated at global and national levels, whereas its implementation by the very nature of the practice of farmer management of agro-biodiversity is undertaken at the local level. Facilitation and learning appear crucial to linking actors with distinct objectives, particularly in the forma-

tion of platforms for agro-biodiversity management. These dimensions of the ecological knowledge system are reflected upon through the third window. In conclusion, this window contributes to identification of barriers that obstruct the establishment of necessary linkages between actors. Where possible, bridges across these barriers are described.

Window 4: Social construction

The fourth window synthesises elements addressed in the other windows into a process of social construction. In the case studies, we particularly refer to the establishment of linkages between conservation and utilisation of agro-biodiversity, or conservation and development. The processes of the social construction of the "on-farm management" strategy are taken as individual cases, because they are based on discussions among partners in the projects or refer to interactions between various organisations. We learn much about the role of various actors, particularly conservation organisations (NPGRPs) in the development of the strategy. We also learn about opportunities to link conservation with development. Supporting institutions and networks that facilitate the development of ecologically sound practices are addressed. Both socio-ecological perspectives emphasise social and institutional learning. Shifts in objectives and activities of organisations or projects are reflected upon as learning processes.

Part III

Case studies

8

Introduction to the case studies

Part III includes five case studies about organisations, professionals and other actors involved in the development of the approach referred to as "on-farm management" of agro-biodiversity. Each case study tells its own unique story or "tale". The four "windows of reflection" have guided the development of each chapter. Therefore in the case studies we refer to (i) actors, (ii) germplasm, knowledge and information flows, (iii) social organisation and (iv) social construction. Each case study tells its story with an intrinsic and instrumental value to the scope and objectives of the book (Box 4.3). The case studies describe the development and social organisation, and activities of two global programmes, outputs of two formulation missions and the exploration of linkages between two organisations. These "points of entry" differ, but the "windows of reflection" have assisted us in focussing and "finding" a proper balance. The case studies are based on activities undertaken until 1998, when I resigned from CGN. Each case study is concluded with an epilogue, in which an update is given of relevant activities until April 2000. In this chapter, I introduce the reasons for including each case study in the book. In addition, I briefly introduce these case studies, give some detail on my relationship with the organisations and projects described, and present major sources of information.

The Netherlands: Centre of Genetic Resources (CGN) and Zeeuwse Vlegel.
The first case study start with a story of an attempt to link the Centre for Genetic Resources, the Netherlands ("a genebank") and Zeeuwse Vlegel (a farmer organisation) in an effort to enhance utilisation of wheat diversity in the Netherlands. Taking into account the degree of agro-biodiversity still used by farmers, inclusion of a case study on the Netherlands in a book on "on-farm management" of agro-biodiversity may come as a surprise. However, after some

years of working with organisations in developing countries and sometimes discussing the use of agro-biodiversity in agriculture in the Netherlands with colleagues from the South, many parallels have emerged. An important parallel referred to the institutional framework in which the National Plant Genetic Resource Programme (NPGRP) has been embedded. During identification of the case studies, I was wondering how to include some experiences from my organisation at home (CGN) and relate the subject of institutional aspects of agro-biodiversity management to farming in the Netherlands. Since 1995, I have been involved in and supported various projects of the Chair Group Technology and Agrarian Development (TAD) of Wageningen University. Through my participation in TAD's projects, I could look through an "outsider's" window at the "genebank". I also learnt about efforts of farmer and consumer groups to increase the level of agro-biodiversity in farming in the Netherlands. Following my decision to include a case study on the Netherlands, I approached Joost Jongerden of TAD to join me as author of this chapter. We use TAD's effort to link the "genebank" and "a farmer organisation" as entry points to develop the story. Taking into account the level of agro-biodiversity used in agriculture, it was not opportune to analyse efforts to construct the "on-farm management" strategy; we decided to analyse efforts to enhance utilisation of genetic diversity instead. We decided to focus on two actors illustrative of the current link between CGN and Zeeuwse Vlegel (a farmer organisation in the Province of Zeeland). We described and analysed the institutional framework and major activities of both organisations, explored and described their efforts to link agro-biodiversity conservation and utilisation. Making use of the "windows of reflection", we could identify various barriers to linking conservation and utilisation. It should be realised that this case study does not relate to a project; it merely describes and analyses some of the interactions between actors involved in linking agro-biodiversity conservation and utilisation.

Major sources of information for the Netherlands case study included discussions within the context of TAD. Joost Jongerden has been following the activities of Zeeuwse Vlegel for many years. Publications, materials and discussions with my former colleagues of CGN have provided us with basic information for writing this chapter. A group of persons involved in organisations described reviewed the chapter. They have made significant contributions to the content and analysis presented.

Bhutan: Agro-Biodiversity Centre (ABC)

The second case study is based on a mission to formulate a proposal for the establishment of an Agro-Biodiversity Centre (ABC) in Bhutan. Emphasis was put on the development of a project that would build the centre. The mission proposed the development of a centre pursuing an integrated and process approach. The co-author of this chapter, Karma Tse-ring, was one of my colleagues in the formulation mission. He is currently co-ordinator of Bhutan's National Biodiversity Programme. During the mission, we discussed and explored ways to develop an integrated conservation programme. The case study is limited as it is based on a proposal and formulation mission, rather than on its implementation. When I started to develop the structure of the book, I decided to discuss and include the integrated approach developed and proposed by the team in Bhutan. I considered the most important innovative aspect of the proposal its emphasis on an integrated approach to conservation strategies, i.e., using *ex situ*, *in situ* and on-farm approaches emphasising decentralised approaches to agro-biodiversity conservation.

Major sources of information for this chapter included the formulation mission's detailed report and proposal, interviews and workshops during the mission with numerous actors involved in biodiversity conservation and agricultural research in Bhutan. However, primary sources are the team's discussions during and following the mission.

Ghana: Centre for Biodiversity Utilisation and Development (CBUD)

In the mid-1990s, Dr Asibey from Ghana approached the Royal Netherlands Embassy in Accra with a proposal to develop a centre for biodiversity product development. This proposal matched the interest of DGIS in supporting activities in the area of management and sustainable biodiversity utilisation. The Embassy approached me to join Dr Asibey in a mission to develop a proposal and institutional framework for this centre. The project's innovative character made me decide to include the case study. With its emphasis on platform building and facilitation in product development, the centre meets important elements of the social organisation of "on-farm management" and efforts to link biodiversity conservation and utilisation. Another interesting point in the context of this book is the role of the NPGRP in relation to the centre. CBUD may provide the NPGRP with opportunities to support farmers' and foresters' biodiversity management and sustainable utilisation of biodiversity products. As for the Bhutan case study, the same limitation applies to this case study. The case study is based on findings of a formulation mission and proposal, rather than on practical implementation.

The proposal and detailed report of the formulation mission have been major sources of information for this chapter. During the mission, Dr Asibey and I interviewed a wide range of actors involved in biodiversity conservation, management, research, rural development and product development. The most important sources have been the enlightening and stimulating discussions with Dr Asibey during and after the formulation mission. For this reason, he has joined me as co-author.

IPGRI *in situ* project

When discussing this book with my co-promotor Dr Jan Engels of IPGRI, he suggested to include one case study on IPGRI's project "Strengthening the scientific basis of *in situ* conservation on-farm" (IPGRI *in situ* project). I explained that I was reluctant to include the project as case study, because in the other case studies I intended to describe and analyse organisations and projects with which I had been involved myself. However, he persuaded me to include both the CBDC programme and IPGRI *in situ* project as case studies. I contacted Dr Devra Jarvis (the project's co-ordinator) and she agreed and joined me in writing this chapter. The IPGRI *in situ* project is relevant as a case study because it links institutional, scientific and development aspects in the construction of *in situ* conservation, and emphasises the development of the conservation strategy within an NPGRPs. IPGRI emphasises the scientific and development orientation of the project's national components. The project links global, national and local dimensions to the social organisation of the strategy's development.

This case study has been written together with Dr Devra Jarvis, Dr Jan Engels and Dr Toby Hodgkin. The latter was invited to join the team because he has been responsible for the project's development. I have worked for some time at IPGRI Headquarters, when I studied available documentation on the project and discussed the evolving chapter with the other

authors. Thus, the basis for this chapter differs from the other case studies, in which I have been directly involved or have worked in one way or another. The constructive and open attitude of IPGRI researchers has facilitated the study and critical reflection on he project's social organisation and evolving strategy to develop "*in situ* conservation on-farm".

Community Biodiversity Conservation and Development (CBDC) Programme

This programme has been one of the starting points of my work in the A-Team and local agro-biodiversity management. I have co-ordinated its formulation phase and was involved in the first years of its first implementation phase. The CBDC experience has been a critical point of reference in many activities in other projects. Therefore, it was evident that the CBDC-Programme would become an important case study in the book. Similar to the IPGRI *in situ* project, CBDC brings together local and global dimensions in the social construction and social organisation of the "on-farm management" strategy. The CBDC partners include various NGOs and some NARSs and conservation organisations from the North as well as the South. These partners shared their strong community orientation towards conservation and development of biodiversity. For this reason, they have adopted a decentralised and bottom-up approach to the programme' organisation and implementation. The programme emerges as an important global biodiversity programme that contributes to the development of the "on-farm management" strategy. Through its focus on community management, its partners, supported by the programme's organisation, CBDC is innovative in many ways. In the chapter, I have only included some specific aspects that I considered relevant to the book's main focus. I am aware that I have not paid attention to many other interesting aspects and experiences of CBDC.

Major sources of information for this chapter have included various publications and internal reports and documents of the CBDC-Programme. However, major inputs have been discussions with CBDC-colleagues during CBDC workshops, meetings and project visits. Members of CBDC's Programme Co-ordination Committee have reviewed a draft version of the chapter. Through various discussions during the chapter's development and reviews of numerous drafts, Dr Conny Almekinders has made a contribution worth mentioning.

9

The Netherlands: A genebank, a farmer organisation and wheat diversity

Walter S. de Boef & Joost Jongerden

If we look at the focus of the Agro-biodiversity Team (A-Team) of CGN, the image appears that issues such as local management and the linkage between conservation and utilisation of agro-biodiversity should be addressed in developing countries only. The A-team (see Preface) had a strong development-orientation indeed and solely focused its activities on the South. When partners of the A-Team from developing countries came to Wageningen, we (the team) assisted them in meeting farmers. These visits always resulted in discussions on the limited use of genetic diversity of agriculture in the Netherlands. We started to wonder what role CGN could play to enhance the use of genetic diversity in the Netherlands. A "mirror" was presented to us during these discussions; we modified our perspective on agriculture and genetic diversity in our own country. Many questions were raised. Are underlying principles of the Convention on Biological Diversity only valid in the South? Can or should we also apply these principles in the North? If so, what are the implications for the role of CGN in agricultural development in the Netherlands? Other people concerned with agro-biodiversity had also raised these questions, above all by our colleagues at CGN. These questions prompted Walter de Boef to use the issue of the relationship between a formal conservation organisation and a farmer organisation to explore opportunities to strengthen "farmer management of agro-biodiversity" in the Netherlands. This case study aims to contribute to a better understanding of the position of a conservation organisation within the institutional crop development and research frameworks in which it is embedded.

Dutch NGOs, farmer and consumer groups demand that the institutional agricultural research system supports the development of more ecologically sound and organic modes of

farming. Demands are made on agricultural research and development organisations, but also on the national genebank. Can a genebank respond to demands articulated by various groups? If so, to what questions and how? And if not, what barriers are encountered? In this case study we focus on two actors at the far ends of the crop development chain as a means of finding some answers to these questions. The study is limited in that it only refers to some crop development actors. CGN is the first actor, a genebank, which by its name of Centre for Genetic Resources, the Netherlands, suggests a broad mandate to conserve and support utilisation of plant genetic resources. The second actor is the Zeeuwse Vlegel, a farmer organisation that plays an active role in the development of more ecologically sound agriculture in the Province of Zeeland, and acts as a learning environment for farmers to shift to more ecologically sound agriculture. We decided to study both organisations and opportunities for collaboration. The chapter starts with an introductory section in which the context of agricultural development and the use of genetic diversity of farming in the Netherlands are elaborated. In subsequent sections, we concentrate on actors and flows of germplasm and information. Some specific activities and strategies of both actors that aim to increase utilisation of genetic diversity of agriculture are analysed.

9.1 Context: agricultural development, farmers and genetic diversity

Agricultural development

The development of agriculture in the Netherlands is based on a process of intensification and scale enlargement of production, in which family farms have remained the basic production units. Through intensification of the use of land, capital and technology, and a reduced labour input, these family farms have become one of the most productive farming systems in the world. The system through its orientation towards bulk production with a focus on technological innovation and capital investments has become less competitive in this, more open, market for agricultural products. A combination of factors has made the Dutch farming system one of the most vulnerable systems in Europe (Knickel, 1997). Factors that contribute to this increased vulnerability include a high level of specialisation and continuous drive for technological innovation, reliance on credit to follow this treadmill (Röling, 2000), limited off-farm activities by farmer households and increasing environmental regulations imposed by the government. Rural sociologists have perceived that since the 1960s Dutch farmers and other actors in the agricultural sector have undergone a process of acculturation to new lifestyles, types of farm management, and complexes of norms and values, attitudes and behaviour (Somers, 1998).

Farmers have become aware that they have few opportunities for the development of alternatives and for change to more ecologically sound practices. Farmers have become components of specialised and highly connected actor networks and chains of agro-industrial production, in which it is very difficult for an individual farmer or farm household to change production. This process is enforced by a drive to keep prices for agricultural products low. In relative terms, prices have barely increased over the past decades. This is in contrast with prices for inputs. This "price squeeze" results from the treadmill of agricultural intensification and innovation initiated when Common Agricultural Policies of the European Union were established (Röling *et al.*, 1998). Through technological investments, continuous modernisation and industrialisation, one group of farmers is able to follow the treadmill of agricultural

development; they are supported by the Ministry of Agriculture (LNV) and the knowledge and agricultural innovation networks that support agro-industrial production. Another group of farmers follows this treadmill from a distance and demonstrates a more reluctant or "conservative" attitude towards innovation; the Ministry and the associated networks are largely ignoring this group. This group is less vulnerable to economic dynamics (Van der Ploeg, 1999). Through the use of inputs, farming systems have become disconnected from ecological dynamics. A similar process of disconnection has occurred in the link between farmers and consumers (Jongerden & Ruivenkamp (1996). This process has contributed to the creation of a negative image of agriculture and farmers among the "public". This image in its turn is responsible for diminishing political support to the primary sector.

The Dutch agricultural system is a clear example of natural and biological resource management within a control or output management perspective (Section 5.3). Agro-ecological resilience has been reduced. A most prominent example of the consequences of this reduced resilience was the series of crises in the animal production sector in the 1990s; crises that could only be combated at extremely high costs to the government and society. Following these crises, the government has started to revise its policy with respect to animal production.

Farmers involved in arable production face many problems in responding to decreasing world market prices for their products. With their capital intensive production system, they are less able to adapt to changing cereal markets. The government has started to develop policies to support landscape protection, ecologically sound or organic production, thus reducing competitive opportunities for intensive agricultural bulk production (Röling *et al.*, 1998). Organic agriculture is promoted by individual farmers, farmer and consumer groups and by some researchers and policy makers. The proposed changes in production are based on technological innovations and rely on existing actor networks. A growing interest of policy makers in organic agriculture has been encouraged by the high costs to society to combat crises in intensive agricultural production, and growing domestic and foreign markets for organic products. However, conventional actor networks still perceive changes on the basis of existing technological regimes and agro-industrial chains. They constitute crucial barriers to the development of more specialised, high quality production of organic or regional products (Van Weperen *et al.,* 1998).

Reduction of diversity of agriculture

The Netherlands is a country in which agro-biodiversity at all levels has decreased to the extreme. Uniform, often human-made, landscapes and a push towards industrialisation of agricultural production have led to this decrease (Jongerden & Ruivenkamp, 1996). Examples include tomato production in almost "closed systems" in greenhouses and pork production in industrial complexes. Diversity among and within farming systems has been dramatically reduced. The number of crops cultivated in the country has decreased; dominant crops in arable farming include wheat, potatoes and sugar beet. The drive for agricultural modernisation since the late 19th century has resulted in a complete replacement of landraces by improved varieties. The wheat variety *Wilhelmina* developed by Broekema at IvP (Box 9.1) already covered 67% of the national wheat area in 1931 (IvP, 1940). Almost all wheat landraces have been lost in the Dutch version of the "green revolution". Awareness of and responsibility for conserving landraces "simply came too late". Most Dutch landraces have been lost.

Box 9.1 A historic reflection on public wheat breeding in the Netherlands

The history of wheat breeding has been strongly linked to the development of Wageningen as the country's agricultural university and research centre. In the late 19th century, L. Broekema and Otto Pitsch started a wheat and barley-breeding programme in Wageningen. They followed breeders in Germany, who had started breeding programmes some years earlier. The programme was implemented at the Institute of Plant Breeding (IvP) associated with the Agricultural College, a predecessor of Wageningen University. In 1894 Broekema released the wheat variety, *Wilhelmina*, named after the Dutch Queen at the time. *Wilhelmina* was the product of a cross between two important Dutch landraces. For more than 30 years this variety has been very popular in the country (Prakke, 1967; Sneep, 1976). Up until the 1950s, IvP had remained an active public player in the arena of wheat breeding. With the rise of a competent and strong private breeding sector, the public sector gradually withdrew from practical breeding. Public research organisations involved in plant breeding shifted to more basic and applied research. With the foundation of Wageningen Agricultural University, the institute became the Plant Breeding Department; currently called the Laboratory for Plant Breeding. The CGN wheat collection contains materials based on the breeding work of Broekema and Pitsch.

Development of the plant breeding sector

In 19th century Netherlands, utilisation of improved wheat varieties followed trends in Germany where plant breeding and promotion of mineral fertilisers resulted in an increased production. German breeders developed modern varieties that were adopted in the Netherlands. Since the early 20th century, the Dutch government has supported the development of its own public breeding sector (Box 9.1). When a diversity of often regionally operating commercial small scale and co-operative breeding companies had been established in the 1950s, public involvement in practical plant breeding decreased and shifted to breeding research in support of the private sector. The diversity of breeding companies was dramatically reduced in the last decade of the 20th century. Most companies have become branches of "multinational life science conglomerates" such as Advanta, Aventis and Novartis. The scale of operation of breeding programmes has shifted from specific regional and niche markets to markets that reach beyond the Dutch and European boundaries. Through mergers of companies, breeding programmes have been linked or have been integrated. This process has resulted in fewer programmes that cover a diversity of "regional markets".

In the era of biotechnology, the "life science conglomerates" have started to set up their own research branches or incorporate plant genetics laboratories. As a consequence, the market for public breeding research has become less significant. In response, Dutch breeding research institutes have shifted to more fundamental and strategic research in genetics or biotechnology. This shift was endorsed by a gradual reorientation of research organisations. Agricultural research organisations in their operations and focus shifted from the public to the private domain. It should be realised that the Ministry of LNV still allocates substantial financial resources to genetic research; in 1997 through programme support it contributed 40% of the overall budget of the Centre for Plant Breeding and Reproduction Research (CPRO, 1998a). With its market orientation, CPRO started to consider the Ministry of LNV its major client. With CPRO's research re-orientation, this LNV funding should be regarded as an incentive to support plant genetic (biotechnological) rather than crop genetic or agricultural research.

9.2 CGN: actor, flows and evaluation of wheat diversity

Actor: research & institutional framework

CGN is part of Plant Research International, a product of a merger between three plant research organisations in Wageningen. This research organisation operates as a public enterprise. CGN was part of the Centre for Plant Breeding and Reproduction Research (CPRO), one of the centres that merged early 2000 into Plant Research International. In this chapter, we refer to CPRO, because we cover activities in a period when it still had that name. CPRO (and its successor) are affiliated to the Agricultural Research Department (DLO), a non-profit foundation. Through funding, DLO maintains strong links with the Ministry of LNV. It finances the National Plant Genetic Resources Programme (NPGRP) and covers CGN staff and operational costs. CGN maintains a special status within CPRO as an executive agency of the NPGRP and is responsible for management of the national (CGN) germplasm collection. It participates in two other programmes funded by the Ministry of LNV: the DLO-agro-biodiversity research and DLO-North-South programme. Other activities of CGN are financed through external funding. Since 1990, CGN has participated in eight EU-funded projects with a plant genetic resource component.

The NPGRP has an Advisory Committee in which the Ministry of LNV, the commercial plant breeding sector, research organisations and an NGO are represented. Such a committee has been established for all research programmes financed by the Ministry of LNV. The NPGRP committee acts as a discussion forum; it strengthens the partnership between various sectors and CGN. The committee has an informal and advisory status with respect to CGN's collection management and strategic development. CGN management and staff are responsible for strategic decision-making. In 1997, the CGN strategy was revised accordingly (Van Hintum *et al.*, 1997).

Actor: international network and collections

CGN in its implementation of the National Plant Genetic Resources Programme (NPGRP) partially operates within an informal network of plant genetic resources organisations under the European Co-operative Programme for Genetic Resources (ECP/GR). It is important to note that ECP/PR also includes members from non EU-countries. ECP/GR members have informally been assigned responsibilities; each national genebank assumes responsibility for a number of "mandate" crops. CGN maintains "mandate" collections of lettuce, spinach, horticultural cabbages (Brassica), onions, sugar beet and wild Solanum species. It shares responsibility with a German genebank for sugar beet and Solanum collections and with an English genebank for some collections of horticultural crops. Assignments of "mandate" collections are often based on the value of existing collections, and the fact that international research and breeding programmes for these crops are situated in the country concerned. For example, CGN maintains important lettuce collections based on the national lettuce research programme (of one institute that merged into CPRO). The fact that commercial lettuce breeding programmes are located in the Netherlands is another important factor. Mandate collections of horticultural crops are considered unique in the world as far as their composition, quality and availability of information and documentation are concerned. This uniqueness is illustrated by the distribution of samples; these collections of vegetable crops account for more than 75% of the requests (Table 9.1).

Table 9.1 Distribution of CGN accessions, 1988-1998

Crops	%
Lettuce	36.8
Cabbage-group	21.0
Spinach	17.1
Onion	1.2
Beet	0.4
Potato	3.5
Wheat	7.1
Others cereals (barley, oats)	5.2
Pea & Faba bean	4.8
Tomato, Pepper, Eggplant & Cucumber	2.0
Others	0.9

Source: GENIS (1998)

Actors: link with Dutch commercial breeding

CGN maintains strong links with commercial plant breeding programmes operating in the country. It has installed crop working groups in which private sector representatives hold important positions. The status of these working groups is informal; strategic matters and collaboration with respect to the collections' management are being discussed. Breeding companies support CGN in regeneration and evaluation of collections, in some cases they co-finance expeditions to collect germplasm. Partnership between CGN and breeding companies is strongest in the conservation, management, characterisation and evaluation of various vegetable crops, potatoes, wheat and flax.

Flows: wheat collection

The CGN wheat collection has its roots in the wheat breeding and research of Dutch public breeding institutes. It is primarily based on the working collection (approximately 4,000 accessions) of the Foundation for Plant Breeding that was one of the breeding institutes subsequently incorporated in CPRO. The collection consists of bread wheat varieties, landraces, breeding material and some wild species. It is based on working collections and the Wageningen *Triticinae* collection of IvP (Box 9.1). This collection includes unique wild species related to cultivated bread wheat. Table 9.2 gives an overview of CGN's wheat collection. A major part of the collection consists of landraces collected during expeditions by researchers in Central Asia (Pakistan, Nepal) and Africa (Ethiopia, Morocco).

Hardly any Dutch landraces have been maintained. The collection only includes 3 Dutch landraces, being *Zeeuwse, Gelderse Ris* and *Diekhuis tarwe*. It should be realised that the *Diekhuis tarwe* is a selection of *Wilhelmina* by a farmer with the name Diekhuis. The following observation illustrates the limited genetic resources awareness of plant breeders in the mid 20th century. A private breeding company, that stopped breeding spelt wheat in the early 1950s, threw its collection of Dutch Spelt wheat landraces in the dustbin (Dr Anton Zeven, personal communication). This demonstrates that appreciation of landraces by plant breeders and a sense of responsibility for maintaining collections have developed since the 1960s and 1970s.

Table 9.2 Countries of origin of the CGN bread wheat–collection, 1995

Region	Landrace	Variety	Research material	Unknown	Total
Netherlands	3	100	19	1	123
Europe (excluding Netherlands)	581	791	485	43	1900
Americas	16	239	65	13	333
Africa	352	24	17	12	405
Asia & Australia	1329	138	24	35	1526
Unknown	6	54	42	48	150
Total	2287	1346	652	152	4437

Source: Van Soest & Boukema, 1995

However, genetic diversity of the original Dutch landraces could be rescued indirectly. The first improved and released varieties (e.g., *Wilhemina*) were developed using these landraces. The landraces have been maintained in the CGN collection in an indirect manner (Van Soest & Boukema, 1995).

Table 9.3 Distribution of CGN samples (all crops among user groups), 1988-1995

User group	Netherlands (%)	Other countries (%)
CGN	6	--
CPRO	17	--
Genebanks	--	5
Other NARSs	5	23
Commercial breeding	30	12
NGOs	1	1

Source: GENIS, 1996

Flows: germplasm and accessions

CGN is responsible for collections of 20 crop species with a total of approximately 20,000 accessions. Table 9.3 gives an overview of the dissemination of samples by CGN to various user groups between 1988 and 1995. Since its establishment in 1988, CGN has disseminated 3,000 samples on average per year. CGN used 6% of the accessions for characterisation and evaluation purposes. CPRO is an important recipient. Up until 1995, it has received 17% of the samples. It should be realised that the plant breeding research organisations that merged into CPRO have in fact transferred a major part of their working collections to CGN to ensure their conservation. These CGN collections can therefore be considered as "their collection". Much knowledge of the material remains with some of these research groups. However, given the strategic shift from plant breeding to plant genetic research (biotechnology), the CPRO demand has decreased considerably in recent years (Loek van Soest, personal communication). Dutch commercial breeding programmes have requested 30% of the samples. In this context it should be realised that most breeding companies in the country belong to "multinational life science conglomerates"; through their global breeding programmes materials supplied to Dutch branches may "flow around the world". Foreign research organisations applied for approximately 25% of the disseminated samples. Between 1988 and 1995 2% of the requests for samples were submitted by NGOs.

Table 9.4 gives an overview of the dissemination of samples to various regions between 1988 and 1998. A large group of clients came from the Netherlands (61%). CGN collections are predominantly utilised as germplasm sources by breeding programmes and research organisations that operate within the Netherlands. Hardly any samples were sent to developing countries (3%). Researchers in international research organisations belonging to CGIAR generally submitted requests from these countries. In this context it should be realised CGN is a relatively young and small genebank in the "global plant genetic resource system". Old and famous genebanks in the USA, Russia and Germany maintain higher levels of dissemination among developing countries; they also hold collections with germplasm useful for tropical agriculture.

Table 9.4 Geographic distribution of CGN samples (all crops), 1988-1998

Region	%
Netherlands	61.0
European Union (-Netherlands)	15.2
Europe (others)	10.0
North America	7.2
Japan and Australia	3.1
Rest of the world (most developing countries)	3.4

Source: GENIS, 1998

Flows: information

Linked to the flow of germplasm is the flow of information. CGN has processed results of characterisation and evaluation of its accessions in the CGN documentation and information system (GENIS). The database with accessions and passport data is accessible to any potential user via Internet. Characterisation and evaluation research are often undertaken in joint (EU-funded) programmes of various genebanks, sometimes in close co-operation with breeding companies. Breeding companies, as major clients of these genebanks, are thus in a position to express their interests often related to tracing resistance to certain diseases. In 1998, CGN started to use a Material Transfer Agreement, in which it included an article stating that recipients provide CGN with evaluation data that will be made available to other users after a period of time ("embargo"). Recipients who do not fulfil these requirements may be refused future access (CGN, 1999).

Flows: Material Transfer Agreement

To keep its germplasm available for future research and utilisation by any party, the Ministry of LNV has decided not to claim legal ownership of or seek any intellectual property rights over germplasm held in CGN's genebank. To ensure such continued free availability of germplasm and related information, the Ministry through CGN passes on similar obligations to all future recipients of CGN accessions. Therefore recipients have to sign a "Material Transfer Agreement" (MTA) before gaining access. By signing an MTA, they agree neither to claim ownership of the CGN material to be received or of material essentially derived from the CGN material nor to request intellectual property rights for that specific germplasm (CGN, 1999). An MTA is used to guarantee future free access by potential recipients or users to the CGN collection. The collection thereby remains in the public domain.

Flows: *bona fide users*

In the provision of access to its collection, CGN follows the FAO International Undertaking of Plant Genetic Resources (IU/PGR). CGN provides access to "bona fide" users. Any organisation requesting access to the material for research or breeding purposes is considered "bona fide". CGN uses an internal protocol to respond to requests. This protocol indicates the number of seeds provided for recipients for each crop (Van Hintum & Hazekamp, 1993). No legal restriction limits dissemination to other users. The practical reason for limited distribution of samples is that CGN has available small quantities of "user samples" for each accession. Therefore CGN cannot comply with requests by individual farmers or hobby gardeners (Visser, 1998). In practice, however, CGN complies with almost all requests. If individual farmers approach CGN and request seeds of a specific variety, CGN advises them to contact or consult an NGO, a farmer organisation, an experimental stations or breeding company that may assist them in multiplication (Liesbeth de Groot & Loek van Soest, personal communication).

Social construction: evaluation of wheat diversity for organic agriculture

CGN has been exploring ways to contribute to diversification of agriculture in the Netherlands. Various genebanks in Europe have gradually become involved in the evaluation of accessions for organic agriculture (Begemann *et al.*, 2000; Mulvany, 2000). In line with this trend, CGN evaluated wheat accessions from its genebank and sister organisations in 1996 and 1997. The evaluation included landraces, old varieties and some species related to bread wheat (Spelt, Emmer and Einkorn). These species had been included because organic agri-

culture in neighbouring countries had expressed an interest in their cultivation (Loek van Soest, personal communication). The evaluation was conducted under low input conditions at the CPRO experimental farm. Criteria considered important in organic wheat production, such as juvenile development, weed-competitive capacity, adaptation to low input agriculture and resistance to some diseases had been included. Compared with the genebank accessions, control (modern) varieties performed considerably better for most criteria, specifically for levels of disease resistance. This demonstrates that materials from a genebank cannot be directly used in farming; they may be used for breeding programmes. The most promising accessions have been identified and recommended for use in the development of varieties targeting organic and low input agriculture (Elberse & Van Soest; 1997).

Growing conditions at the CPRO experimental farm approximated low input agriculture (low N), but do not represent those in organic farming. The evaluation was conducted at a site that had previously been used for conventional research purposes. Farmers who shift from conventional to organic production need about five years to change the soil structure and fertility and remove residual effects of earlier applications of mineral fertilisers and pesticides. CGN was not in a position to use more sites for the evaluation, as it neither had the financial resources, nor sufficient seeds of individual accessions for such a multi-location evaluation. Within the current organisation of NPGRP, CGN's staff and financial resources were barely adequate to conduct an evaluation as described above. Within the Ministry of LNV, such activities are considered beyond CGN's conservation mandate. This evaluation was designed and implemented with only limited participation of farmer organisations and NGOs active in the organic farming sector. Through direct collaboration, they might have provided relevant information or provided "organic" experimental sites for conducting the evaluation. The organisation of the crop development system in the Netherlands and the position of CGN within this system provided limited opportunities for collaboration with farmers or farmer groups in the evaluation of wheat accessions.

9.3 Zeeuwse Vlegel: actor, flows and utilisation of wheat diversity

Actor: farmer organisation

Zeeuwse Vlegel is an initiative of farmers in Zeeland, a province in the Southwest of the country. Its objectives are to produce bread wheat in an economically viable and ecologically sound manner, to market bread produced with this wheat, and to reduce the distance between producers and consumers (Zeeuwse Vlegel, 1996). Zeeuwse Vlegel started with 4 farmers cultivating some hectares in the late 1980s, and rapidly increased to 22 farmers cultivating 130 hectares in 1994. Marketing and consumer interest in this type of bread lagged behind farmers' interest. In 1998 the area was reduced to 70 hectares.

Zeeuwse Vlegel's historical roots are wheat farmer study clubs established in the 1980s and discussions among young farmers. In these groups, farmers expressed their concern about the existing mode of high input agriculture. They discussed and demonstrated an interest in switching from bulk wheat for animal feed to wheat for regional bread production. Dropping prices for bulk wheat combined with increasing conventional production costs stimulated farmers' interest in alternatives. They decided to elaborate plans for a joint project to produce environmentally sound and economically viable wheat for local bread production. This was a courageous initiative, since agro-ecological conditions were regarded unfavourable for culti-

vating wheat for this purpose. Farmers agreed to cultivate wheat under low input conditions. They only use one early application of herbicides to control weeds. Neither pesticides nor mineral fertilisers are being used. Zeeuwse Vlegel farmers cultivate their wheat under these conditions. However, when joining the group it is not necessary for them to shift to "organic" production. Actors in the institutional crop development and agricultural networks originally viewed Zeeuwse Vlegel's plans with scepticism. According to the technical advisors, agronomists and other farmers, wheat cultivated without fertilisers and pesticides could not produce grains with a good baking quality. The practice of Zeeuwse Vlegel proved the contrary. Under these low input conditions, Zeeuwse Vlegel for a number of years has been able to grow good quality wheat for bread production. Another characteristic of Zeeuwse Vlegel concerns the direct relationship between wheat quality and bread quality. Each kilogram of wheat grains produced should be of good quality, as Zeeuwse Vlegel does not use additional gluten to enrich its wheat flour. Neither does Zeeuwse Vlegel mix its flour with imported high-protein flour (De Koeyer & Wiskerke, 1994; Wiskerke, 1995).

Actor and flows: the chain and barriers to innovation

Many barriers in the chain of grain production, processing and marketing had to be bridged. Zeeuwse Vlegel was confronted with problems associated with the scale and bulk orientation of the entire sector (Jongerden & Ruivenkamp, 1996). It started discussions with co-operatives, input suppliers, banks, the milling industry, bakeries, supermarkets, and consumers. To produce Zeeuwse Vlegel bread, it had to establish a regional platform for actors responsible for various component of the chain, to discuss problems and jointly seek solutions. In this way, a diversity of actors became partners in the Zeeuwse Vlegel project. They joined the platform as they appreciated the farmers' initiative. But above all they joined because the project was elaborated in an economically viable and pragmatic manner. Zeeuwse Vlegel had to approach all actors "in a chain" from farmers to supermarkets selling bread, which illustrated to what extent farmers have become embedded in rigid actor networks that limit farmers' opportunities for innovation.

Flows: wheat flour

Zeeuwse Vlegel has to meet milling industry standards (Box 9.2). To find a proper set of varieties that will adequately adapt in baking quality to the local environmental variation posed a real challenge. In 1998, Zeeuwse Vlegel farmers cultivated eight varieties on their 70 hectares. After harvest, wheat batches are stored separately to determine the baking quality of individual varieties. Zeeuwse Vlegel blends these varieties in such a manner that it can produce flour with a standard baking quality. A standard blend of varieties cannot be used, because varieties differ in their response (in baking quality) to environmental variation. Zeeuwse Vlegel uses a diversity of wheat

Box 9.2 Standards in flour quality

The milling industry provides bakeries with flour that results in a standard dough and bread quality. In conventional processing chains, the milling industry mixes wheat from various farms to meet these standards. In the Netherlands it is common practice to produce flour as a blend of Dutch and foreign (French) wheat. The standard poses a barrier to the production of bread produced with wheat flour from one region. Variations in climate between years and the diverse responses of varieties to such diverse conditions result in an unacceptable variation in baking quality. Zeeuwse Vlegel challenges this barrier using a diversity of wheat varieties.

varieties to meet demands for uniformity made by the processing industry.

Flows: varieties and seeds

A major problem for Zeeuwse Vlegel is to obtain access to bread wheat varieties with a good baking quality, resistant to various fungal diseases and robust in their response to environmental variation. Zeeuwse Vlegel had difficulty identifying varieties on the Variety List meeting its criteria. It should be mentioned that in the 1970's and 1980's some wheat breeding companies in the Netherlands conducted programmes with the aim to increase the baking quality of varieties targeted for the Dutch market. They have not been successful and discontinued these programmes (Loek van Soest, personal communication).

Most varieties included in the Dutch version of the Variety List are high yielding non-baking types, targeted to animal feed production or developed on the condition that flour is mixed with foreign high baking quality flour. Zeeuwse Vlegel had to search for varieties beyond those included in the Dutch Variety List. Since its early years, Zeeuwse Vlegel has cultivated particularly four wheat varieties with an exceptionally good baking quality: *Renan* and *Ramses* (winter wheat), and *Anemos* and *Sunnan* (spring wheat). However, Zeeuwse Vlegel continues to look for additional and better varieties. This search for diversity is the major issue addressed in this section.

In its search for appropriate varieties, Zeeuwse Vlegel had to look beyond the Dutch Variety List. A technical advisor recommended some varieties cultivated in Belgium and France. Their marketing in the Netherlands is permitted, because EU-regulations state that a variety included in a List of one Member State may be cultivated and traded throughout the Union. In 1990, Zeeuwse Vlegel had identified a number of promising foreign varieties. It contracted the Zeeland Experimental Station to test identified European varieties. These varieties were evaluated for criteria provided by Zeeuwse Vlegel. In addition, their baking quality was determined. Zeeuwse Vlegel decided to annually contract the station for such evaluations.

In 1998, eight varieties were cultivated on the total area of 70 ha used for Zeeuwse Vlegel wheat production. Table 9.5 presents the origin of the most important varieties. The availability of and access to some of these wheat varieties posed a problem. *Sunnan* was taken from the Variety List. Since, it is not allowed to trade seeds of "non-listed varieties", Zeeuwse Vlegel lost one of its varieties. Farmers cultivating this variety could continue using their own seed. Box 9.3 presents the history of *Sunnan's* return on the Variety List. This history illustrates that regulatory frameworks appeared more rigid than they actually are. Zeeuwse Vlegel and other actors regarded the framework as creating barriers to innovation and a broader use of genetic diversity in farming.

Table 9.5 Origin of some Zeeuwse Vlegel wheat varieties, 1998

Variety	Country of cultivation	Country of breeding
Winter wheat		
Renan	Belgium Germany France	France
Florin	France	France
Ramses	Belgium	UK
Spring wheat		
Anemos	Germany	Germany
Arcade	Belgium	Belgium
Sunnan	Sweden	Sweden

Sources: CEU, 1990; 1997; CPRO, 1990; 1998b

Box 9.3 Return of *Sunnan*

Sunnan is a spring wheat variety developed by Weibull AB, a Swedish breeding company. In 1986 Weibull's application for breeders' rights to *Sunnan* was approved in the Netherlands. Weibull's agent was the seed and breeding branch of Cebeco-Handelsraad, a large co-operative agro-conglomerate that covers the entire agricultural production chain. Its breeding company has a considerable share in the Dutch breeding and seed market of arable farming (cereals). In Dutch variety tests *Sunnan's* yield performance appeared low; it yielded only 93 percent of the recommended varieties' average production. However, it demonstrated a better baking quality and high level of disease resistance; these qualities compensated for its low yield performance. In 1991, due to its limited sale in the country, Cebeco Handelsraad withdrew *Sunnan* from the Variety List; it was no longer available.

The Dutch Seed Law prohibits seed production and trade of varieties that have not been included in the Variety List. The Law is rather explicit in that it states that "only varieties are put on the List whose cultivation is considered in agreement with common interest". For arable crops, the use of listed varieties is compulsory. Due to the withdrawal of *Sunnan*, the variety lost its legal and commercial position. Because of the baking quality and adaptation to low input conditions, Zeeuwse Vlegel decided to continue cultivating *Sunnan,* even though it had been withdrawn from the Variety List. Zeeuwse Vlegel farmers used their own *Sunnan* seeds.

The Seed Law states that breeders or, in case a breeders' right had been withdrawn, another company is permitted to maintain, multiply and trade a variety. When Weibull and Cebeco-Handelsraad withdrew *Sunnan* from the Variety List and abandoned their breeders' right, it became a public or "free" variety. Subsequently, a solution that facilitated its cultivation had been found. During a meeting facilitated by the Chair Group Technology and Agrarian Development of Wageningen University, Zeeuwse Vlegel discussed the issue with experts from CPRO and CGN. Zeeuwse Vlegel submitted an application to become an official variety maintainer following the advice of the Secretariat to the Variety List Committee and CGN. It also requested to put *Sunnan* back on the Variety List. This request was granted, and Zeeuwse Vlegel contacted Weibull to obtain a sample of foundation seeds. Zeeuwse Vlegel compared the sample from Weibull with a sample maintained and used in Zeeland. It came to the remarkable conclusion that the Zeeland sample was more uniform, and therefore Zeeuwse Vlegel decided to use its own sample for seed production. It may be concluded that Zeeuwse Vlegel farmers had done rather well in variety maintenance.

Zeeuwse Vlegel has become an official *Sunnan* variety maintainer. It has made history. Its action resulted in a first time reappearance of a removed variety on the List. An important issue is that it reappeared at the request of a farmer group. The case is also unique, in that a farmer organisation has become the official variety maintainer. Zeeuwse Vlegel will produce *Sunnan* seed for use by its members; its objective is also to sell seeds in the organic farming sector. The entire discussion around *Sunnan* has triggered a discussion on the functioning and composition of the Variety List. The case has shown that the seed and variety regulatory framework is more flexible than initially assumed.

Zeeuwse Vlegel was the first farmer group that actually contributed to the return of a variety on the list and took its own responsibility for maintaining and producing seed. Being the first demonstrates that Zeeuwse Vlegel's perception of the rigid nature of regulatory frameworks is widespread. It is important to realise that a solution was found in a discussion organised by a university group that acted as facilitator, bringing together representatives of farmer organisations (Zeeuwse Vlegel), organic agriculture, CGN and members of the Secretariat to the Variety List Committee. The case of *Sunnan* (Box 9.3) demonstrates how farmers produce high quality seeds and maintain a pure stand of a variety, a motion lost in Dutch agriculture. By taking responsibility for maintaining *Sunnan* on the market, a stronger link could be devel-

Box 9.4 Three Variety Lists

The Diversity Project of the Chair Group Technology and Agrarian Development (TAD) of Wageningen University held a discussion on the issue of how to reform seed and variety regulatory frameworks from the perspective that they should become more supportive to organic and regional agriculture. In one of the debates, the idea was put forward to split the current Variety List into a Red, White and Green version. The Red List would include varieties recommended not to be cultivated. An example of a "red" variety would be *Bintje*, a potato variety susceptible to most potato diseases. The White List would be used for varieties recommended for conventional agriculture and continue the current List. The Green List would be used for varieties, which perform well in low input cultivation, and in regional and organic agriculture. The Green List may accommodate "foreign" varieties that perform well in regional niches and organic markets. This proposal has not been adopted. "Green" criteria have been included in the variety testing instead, resulting in specific recommendations for "organic" varieties.

Source: Jongerden, 1999

oped and explored for the sake of farmer innovation between the local and institutional system.

A question has been raised whether or not regional markets can be catered for by commercial breeding companies. The general rule applied to in plant breeding is that a cereal breeding programme costs about half a million Euro for each variety released. To obtain a high return on investment, a wheat variety should be cultivated on approximately 100,000 ha for a number of years. This "economy of scale" poses a barrier to breeding companies for the development of varieties for specific niche markets. Niches like those of the Zeeuwse Vlegel are too small for a commercial breeding programme.

Flows: seed and variety regulatory framework

An additional release and testing procedure for varieties that to target organic and regional agriculture is currently being discussed among professionals involved in organic agriculture and organisations responsible for regulatory frameworks. A procedure may be considered that provides "green" varieties with a specific label. Such a label may indicate that varieties have demonstrated a good performance in specific "organic" or "regional" variety tests. An additional criterion for organic agriculture is that the variety should be free from genetic modification using modern biotechnological methods (Lammerts van Bueren *et al.*, 1998).

The German Federal Seed Office (FSO) maintains a pioneering position in Europe with respect to relaxing seed regulatory frameworks for organic farming. FSO has made a far-reaching recommendation that varieties, which do not meet strict criteria of variety release, may be put into circulation, provided these varieties are sold in limited quantities (Buntzel, 1997). FSO developed separate lists of high-yielding and "original" varieties. It refers to varieties that belong to a specific region. The label may be granted a similar status as is given to French wines with an *"appellation d'origine"*. To build some kind of European framework for the release of organic and regional varieties, FSO has proposed that the German procedure and label become European standards (Buntzel, 1997). Various social actors have become involved in discussions to transform seed and variety regulatory frameworks to support the development of organic agriculture in Europe. Box 9.4 reports on some preliminary results of these discussions.

Zeeuwse Vlegel and changing agriculture

Variety and seed regulatory frameworks posed other barriers to more "biodiverse" and organic agriculture. The case of Zeeuwse Vlegel is very illustrative of exposing barriers that Dutch farmers encounter when choosing a variety for cultivation. However, the case with *Sunnan* shows that the regulatory framework is less rigid than is often assumed by farmers. Innovations by small platforms of social actors and farmer groups may trigger changes within these frameworks. Through discussions and experimentation, Zeeuwse Vlegel farmers, but also professionals responsible for the implementation of regulatory frameworks, realised that these frameworks could be interpreted more flexibly. Hence bringing these actors together in one platform has resulted in innovation and change.

The agricultural sector has become tightly linked within industrial production networks. Processes of globalisation and intensification have enforced this trend. Agricultural policies and research organisations have been supported by the agricultural treadmill. NGOs or farmer groups have indicated that farmers themselves have started to develop more ecologically sound and regionally oriented modes of production and look for alternatives. Zeeuwse Vlegel is just one of the initiatives currently taken by Dutch farmers. Some of these groups have the potential to contribute to change within institutional and regulatory frameworks. Therefore collaboration of farmer groups with research and management organisations, but also with policy makers, appears a way to overcome various institutional and professional barriers.

9.4 Exploring linkages between CGN, Zeeuwse Vlegel and other actors

Sustainable Development Agreement: efforts to stimulate the link

In 1996, efforts were made to establish linkages between CGN and Zeeuwse Vlegel in a Diversity Project. These efforts were made within the framework of the Sustainable Development Agreement (SDA) between the Netherlands and three developing countries (Box 9.5). Eco-operation, the executive organisation for the implementation of the Agreement in the Netherlands took the initiative. It suggested that the objective of this project would be to stimulate the utilisation of agro-biodiversity in Dutch agriculture, because, as a reciprocal activity, the project could be linked to the establishment of an Agro-Biodiversity Centre (ABC) in Bhutan. CGN seemed a logical partner for the implementation of such a project in the Netherlands, because of its mandate and profile. An additional argument for its involvement was that CGN acted as the technical and institutional adviser to the Royal Government of Bhutan in the formulation of the ABC project (Chapter 10). As "participation" is one of the basic principles of the agreement, Eco-operation approached other social actors to participate in the development of a project proposal. A meeting was organised with representatives from Eco-operation, CGN, CPRO, Zeeuwse Vlegel and the Chair Group Technology and Agrarian Development (TAD) of Wageningen University. The various parties put forward the objective and status of the initiative and ideas for collaboration. CGN had prepared a practical proposal that covered the evaluation of Spelt accessions for utilisation in organic agriculture. The CGN representative indicated that within the current organisation of NPGRP, core funding and resources could not cover such an evaluation. The proposed project would support CGN's contribution to organic arable farming. The Zeeuwse Vlegel representative indicated that he was not interested in Spelt production. Eco-operation did not

Box 9.5 Sustainable Development Agreement

In March 1994, the Netherlands Government signed Sustainable Development Treaties with the Governments of Costa Rica, Bhutan and Benin. With these bilateral treaties, the governments of the four countries wish " ...to promote the implementation of the Rio Declaration on the Environment and Development and Agenda 21 adopted by UNCED". Partners expressed their conviction of "the necessity to build a new and equitable global alliance aiming at the creation of new forms of co-operation between states, between key sectors of society and between individuals". They agreed "to establish long-term co-operation between their countries based on equality and reciprocity as well as consultation and mutual assistance to effectively and efficiently pursue all aspects of sustainable development, thereby promoting the participation of all interest groups in their respective societies." The framework of the Sustainable Development Agreement has been used to contribute to the implementation of the Convention on Biological Diversity, which was signed and ratified by the four countries.

Source: Eco-operation *et al.*, 1998.

prioritise CGN's proposal for funding since it would not yield in visible outputs in the short run and did not seem best value for money contributing to the public and political debate on agro-biodiversity use in agriculture.

After consultation with Eco-operation, TAD proposed a project that would pursue a process approach to step-wise discuss barriers "in the chain from genebank to consumers" to promote utilisation of agro-biodiversity. This Diversity Project focused on the establishment of platforms in which actors discuss barriers and jointly explore ways to bridge these barriers. The proposal was approved by Eco-operation. CGN, Zeeuwse Vlegel and other organisations were invited to participate in various platforms.

At a meeting, Zeeuwse Vlegel suggested a project that would address its problem regarding the availability of and access to wheat varieties. Subsequently, Zeeuwse Vlegel formulated and submitted a proposal for a small project without links to the Diversity Project. The proposal was considered a "reciprocity project" within the Agreement between the Netherlands and Bhutan (Box 9.6). It was approved by the responsible organisations for SDA implementation in Bhutan.

Diversity Project: platforms for discussion

In the Diversity Project (1998 – 1999) TAD concentrated discussions around three major themes or barriers to agro-biodiversity. The first theme addressed ways to increase access to the CGN genebank of farmer organisations involved in organic or more ecologically sound agriculture. A platform was established including CGN, Zeeuwse Vlegel, the Louis Bolk Institute (LBI; a research institute associated with the organic agricultural sector), and a small plant breeding company concentrating on the production of vegetable varieties for organic farming. TAD organised a number of discussions and proposed that the four organisations expressed an interest in future co-operation. The platform did not succeed in achieving practical collaboration between Zeeuwse Vlegel and CGN. However, it contributed to CGN assuming a more active position in support of the utilisation of agro-biodiversity in organic agriculture. Another output of concerned LBI starting to operate as a "window" facilitating interactions between CGN and CPRO on the one hand, and organisations involved in organic agriculture on the other.

Box 9.6 SDA: the Bhutan – Zeeuwse Vlegel link

The SDA partner countries, Benin, Bhutan and Costa Rica, each had US$ 100,000 at their disposition to finance a "reciprocity project" in the Netherlands. The objective was to "reverse" the donor-recipient relationship and address a sustainable development issue in the Netherlands. Bhutan perceived two major sustainability problems in the Netherlands: (i) lack of natural forests and (ii) genetic erosion in Dutch agriculture. To address the problem of genetic erosion, Bhutan decided to financially support Zeeuwse Vlegel. Bhutan's Minister of Agriculture visited Zeeland and presented a cheque of US$ 100,000 to Zeeuwse Vlegel. This enabled Zeeuwse Vlegel to finance variety trials at the Zeeland Experimental Station, testing varieties with respect to agronomic performance and baking quality, and seek technical and legal advice, which led to return of *Sunnan* on the Variety List

Source: Chris Enthoven (personal communication)

The second theme in the Diversity Project is related to the production of specific varieties for organic agriculture. Discussions referred to possibilities of using participatory approaches to breeding and variety selection. Before the start of the project, research groups in CPRO were involved in an LBI project supporting the development of an organic breeding and seed chain (Lammerts van Bueren *et al.*, 1998). An indirect output of the platform was a conference co-organised by CPRO and LBI that brought together plant breeding and biotechnological researchers and representatives of the organic farming sector. It was clear that the two groups held distinct views on the kind of genetic or plant breeding research required for the development of organic agriculture.

The third theme of the Diversity Project concerned seed and variety regulatory frameworks. During the meetings, participants discussed the inclusion of "green" criteria in variety tests and earmarking "organic" varieties on the Variety List (Box 9.4). Direct collaboration was established through a project in which the Secretariat of the Committee for the National Variety List for Arable Crops (based at CPRO), CGN and the above-mentioned LBI participated. The project's objective is to realise the ideas that developed during these discussions. The project proposal has been successfully submitted for funding to the Ministry of LNV.

CGN, Zeeuwse Vlegel and the Diversity Project

From discussions in the project described above we may draw some general conclusions about the social organisation of crop development in the Netherlands, and on the position of CGN within the institutional framework of crop development and conservation in particular. They illustrated that CGN participated in the initial discussion with limited options of what it, as a genebank or genetic resources programme, could contribute to linking conservation and utilisation. Its proposal had been developed on the basis of its mandate and limited financial resources. Eco-operation approached CGN as a potential partner in putting agro-biodiversity on public and political agendas. Initially, CGN responded in a manner that was not prioritised by Eco-operation nor by other partners proposed. Due to a technical perception of the initiative, the opportunity to take the lead in an interactive and participatory agro-biodiversity research project was lost. In the subsequent TAD Diversity Project, CGN participated actively and constructively, and contributed to various initiatives. It started to play a more active role in linking conservation and utilisation of agro-biodiversity in the Netherlands.

With respect to links between Zeeuwse Vlegel and CGN, we conclude that CGN was limited in its ability to contribute directly to solve Zeeuwse Vlegel's major problem, that of access to varieties. It turned out that both organisations had entered the initial discussion on the project with divergent perspectives and specific problems to be addressed. Eco-operation, as a donor interested in linking these organisations, brought them together in a setting that turned out to be impractical. However, in the course of the implementation of the Diversity Project, CGN could, through its participation in the legal framework discussion, assist in bridging one of the barriers identified by Zeeuwse Vlegel (e.g., access to *Sunnan*). Through TAD's Diversity Project, Zeeuwse Vlegel could develop an alternative to maintaining or regaining access to *Sunnan*.

This case study illustrated the extent to which both Zeeuwse Vlegel and CGN are caught in actor networks and in the organisation of crop development that emphasise economies of scale and high productivity agriculture, thus stress uniformity instead of diversity. Although both organisations are interested in increasing utilisation of crop genetic diversity in agriculture, this does not mean that they are partners in research.

9.5 Barriers linking conservation and utilisation

In the study of CGN and Zeeuwse Vlegel, and efforts to link both organisations, we encountered a range of barriers that illustrate some aspects of CGN's position as an NPGRP in the Netherlands. We identified the following major barriers to linking conservation and utilisation and in some cases explored ways to overcome these barriers.

a) Limited access to the genebank collection. CGN provides *bona fide* users with small seed samples of accessions. These samples are sufficient for breeders and researchers, but insufficient for farmers or farmer groups. For the latter to become clients, multiplication is required. CGN cannot multiply these accessions; it neither has the capacity nor the resources to perform such a task. Taking into account the public function of CGN, the question of readily available genebank material for and distribution to a wider group of users may no longer be ignored, i.e., public funds for such activities should be made available.

b) Value of genebank accessions for direct use. Most material stored in a genebank cannot be directly used in organic agriculture. Activities such as pre-breeding and further selection are required. The current NPGRP mandate excludes such activities. The mandate limits CGN's opportunities for stimulating utilisation of genetic diversity in breeding and agriculture. In the case of organic agriculture, the Louis Bolk Institute may assume this responsibility in collaboration with private breeding companies or CPRO's breeding research departments. CGN could assist in such activities by providing access to documentation systems of the European network of genebanks, access to collections and technical support to the evaluation of genebank material.

c) Limited interaction with the organic sector. An evaluation of genetic resources is made before breeders and farmers are using these resources. The institutional crop development system has constructed barriers between conservation, research and practice. We observed the limited flow of information between actors in the conventional and organic farming sectors. The organic agriculture sector in the Netherlands has shown a tendency towards creating parallel structures to the conventional system thereby creating barriers to collaboration. Activities such as carried out by the Diversity Project may contribute to bridging these barriers.

d) Farmers' participation in evaluation. In developing countries where breeding of food crops is still implemented within public organisations, participatory evaluation and "on-farm testing" of accessions have been proposed. With breeding concentrated in large globally operating breeding programmes in the Netherlands, opportunities for using such approaches are hampered. Variety tests implemented by the Zeeland Experimental Station for Zeeuwse Vlegel may be considered a form of participatory varietal selection.

e) Breeding varieties for regional or niche markets. Within the current organisation of the institutional system in the Netherlands, breeding companies cannot provide small regional markets with specific varieties. Due to economies of scale, breeding companies are not interested in developing a diversity of varieties needed by farmers' organisations such as Zeeuwse Vlegel. The scale enlargement of breeding programmes that resulted from a concentration of breeding companies has worsened this trend. The question has been raised whether or not regional markets should be provided with improved materials. Commercial breeding companies are not interested and public breeding programmes do no longer exist. In their search for appropriate varieties, this situation may have stimulated farmer organisations to approach the genebank as a remaining public body within the institutional system. However, they should realise what it takes to develop a variety, and that the genebank's collection primarily maintains germplasm suitable for plant breeding and research rather than for direct use in cultivation.

f) Professional and psychological barriers to processes of change and learning. CGN like any other conservation organisation has been established as an organisation primarily with a technical mandate. Professionals working within such organisations have been selected for their technical and scientific qualifications. In this case study we learnt that to become involved in interactive and participatory projects, professionals working in an NPGRP require additional skills and should be proficient in communication and innovation. This professional barrier explains the difficulty of linking the A-Team (Preface) and conservationists in CGN. The two groups represent distinct types of professionalism.

9.6 NPGRP, institutional framework and change

CGN's institutional framework

CGN is responsible for the implementation of the National Plant Genetic Resources Programme in the Netherlands with conservation and promotion of crop genetic diversity utilisation as its major objectives. However, CGN in its efforts to contribute to link conservation and utilisation has been confronted with barriers created by NPGRP's weak institutional framework. Currently, CGN's management and staff prepare strategic plans, which are being discussed with an Advisory Committee. CGN has no formal board. Resource allocation remains the responsibility of the Ministry of LNV. Installation of a formal CGN Board would strengthen the public position of the Centre and its capacity to fulfil its mandate. The creation of such Board would also turn CGN, as a public body within an increasingly market oriented institutional environment, more accountable to private, public and civil actors in society. Another benefit of creation of such a board is that it may stimulate and create opportunities for operating in a partnership with various social actors. It should be realised that the Board should have a mandate in terms of resource allocation. In case the CGN mandate would be extended, resources to meet this mandate should be negotiated accordingly.

The reflection on CGN's institutional framework illustrates how CGN in times of a withdrawing government from society (agricultural research) and privatisation has moved into a rather vulnerable position. An NPGRP is a public activity by definition. Policy makers of the Ministry of LNV acknowledge this position, but in their interpretation only stress conservation as a public responsibility. Hence, they only take responsibility for one part of the mandate. It is assumed that market forces drive activities that contribute to utilisation of crop genetic diversity. In this situation, CGN is limited in its capacity to respond to changes in society that may be initiated by civil (farmer) groups with limited resources.

A genebank, plant breeders and a farmer organisation

From this case study, we conclude that a genebank and a farmer group are positioned at the far ends of the Netherlands' version of the crop development chain. Therefore, direct collaboration between these organisations did not seem realistic and yet through interaction with research organisations and CGN, Zeeuwse Vlegel has regained access to *Sunnan* nevertheless.

Before the 1980s, public institutions were more involved in pre-breeding providing plant breeding companies with base material for the development of varieties. This arrangement worked in the Netherlands, because commercial breeding companies were operating on a regional basis or were established within farmers' co-operatives. However, with scale enlargement and concentration of breeding programmes, the direct link between farmers and breeders has narrowed. Current breeding programme cater for major markets and promote the interests of dominant players in the agro-industrial chain in which farmers are merely considered individual components rather than major clients (Pistorius & Van Wijk, 1999). Within the process of "withdrawal" of the public sector from research, the gap between breeding and farmers has increased. Conservation organisations such as CGN remain single public players to be approached by farmer groups in need of diversity. This situation is not unique; similar developments have been observed in other European and North American countries (Kloppenburg, 1988; Fowler, 1994; Pistorius & Van Wijk, 1999). Genebanks within this context are easy public targets for interest groups that wish to express their concern about trends in plant breeding and needs for more appropriate varieties. However, conservation organisations have been set up in a manner to cater for the needs of actors in the dominant network, thus providing research and breeding material, and to a lesser extent respond to the needs of farmers and innovative groups. Activities of CGN initiated in the past three years have contributed to CGN "opening this window" to such groups, particularly those involved in organic farming.

CGN and "two Ministries of Agriculture"

If we consider the role of the Ministry of Agriculture (LNV) in the processes described above, two images appear. On the one hand, the Ministry has promoted "privatisation" of agricultural research and contributed to the strategic change from plant breeding to plant genetic research. This is in line with the dominant agricultural policies that concentrate on intensification, high-tech agriculture and bulk production. Röling *et al.* (1998) described this as part of an agricultural treadmill targeting at technological innovations with the objective to keep prices for agricultural products as low as possible. This is the dominant and conventional image of the Ministry (Van der Ploeg, 1999). With another image, the Ministry supports the development of more ecologically sound or organic agriculture, and provides subsidies for innovative projects of farmer groups and the "organic" farming sector. It contributes to the

formation of structures and production chains that are parallel to conventional chains. For example, it finances research organisations such as LBI to develop an "organic" breeding chain. This Ministry refers to the Convention on Biological Diversity and aims to strengthen farmer use of crop genetic diversity (Vermeij *et al.*, 2000). The first "image" is associated with the conventional production oriented network, whereas the second maintains a strong affiliation with nature management, ecology and organic farming.

This dualism is reflected in an unclear mandate and institutional framework of CGN and its institutional location within the research organisation with the name Plant Research International (successor organisation to CPRO). This organisation operates as a private enterprise and has taken up the successful step from being an applied breeding research organisation to becoming a strategic plant genetic research organisation. In this process it has lost its original affiliation with agriculture. It should be realised by the Ministry of LNV that CGN's institutional framework and institutional location need to be reconsidered. We realise that only the Ministry of LNV can decide on a re-organisation of the institutional framework and location of CGN as a public body. However, civil actors such as farmer groups and scientists have a social responsibility to ask this question and to raise awareness among policy makers and politicians.

Actors in the adaptive cycle of renewal

The case study's actors played roles of groups dominant in the four phases of the adaptive and learning cycle as presented in Section 5.5. Following this typology, Zeeuwse Vlegel as a farmer organisation or NGO has played its role as a critical "activist" group identifying barriers in the institutional system. CGN originally operated as a "bureaucratic" organisation hampered in its efforts to respond to change and learn through its position within a rigid institutional framework. It has been confronted by a lack of options determined its mandate and position within the institutional framework and dominant actor networks. In the adaptive cycle, Eco-operation and TAD have operated as "catalysts", facilitating the formation of new platforms for innovation and learning. The Diversity Project provided CGN with opportunities for assuming a more active position in strengthening the utilisation of genetic diversity in organic agriculture. Eco-operation funded the Diversity Project that facilitated the establishment of new partnerships. Within the boundaries of its current mandate, CGN has developed collaborative activities with new groups. With the current political interest of the Ministry of LNV in organic agriculture, more such projects may be realised. Looking at these players and phases in the adaptive cycle of renewal, the experiences need to be translated into policy frameworks and management strategies. We encountered a Ministry with two "faces". To facilitate change and renewal, strategic decision-makers (within and associated with the Ministry), often empowered by citizen groups and researchers, should be in a position to contribute to renewal. It appears not yet the time for such a phase of renewal. Following Holling's adaptive cycle, with the growing social and civil concern about food (GMOs) and agriculture, and political interest in organic agriculture, we assume that "this phase is not far away".

Epilogue: CGN and Zeeuwse Vlegel in 2000

As indicated in this chapter, CGN has started various activities in co-operation with actors from the organic farming sector, for instance, its collaboration with the Louis Bolk Institute

(LBI). It now supports LBI in a participatory plant breeding project that aims to develop methodologies for "organic plant breeding". CGN's role is to assist in the identification of appropriate wheat and carrot germplasm. CGN provided LBI with 25 spring wheat accessions from various genebanks in Europe and North America. These accessions will be multiplied and evaluated for use in organic agriculture. Through collaboration with LBI, CGN aims to strengthen links with other organic agriculture initiatives. Participation of CGN and LBI in the Diversity Project resulted in a co-organised conference in 1999 at which plant genetic research groups and breeding companies started a discussion with representatives from the organic agriculture sector. During the conference, opportunities were explored concerning the contribution of genetic and breeding research to the development of an organic farming sector. Another joint activity following the implementation of the Diversity Project is the project of LBI with the Secretariat of the Committee for the Variety List and CGN. This LNV-funded project aims to identify "green criteria" for variety testing and developing mechanisms for earmarking "green varieties" on the Variety List. An additional activity CGN has started is a participatory evaluation of clover germplasm recently collected in Central Asia. In 1999 CGN invited organic dairy farmers to make a participatory germplasm evaluation.

CGN in co-operation with the Chair Group Communication and Innovation Studies of Wageningen University carried out an interactive project with the objective to discuss various aspects of supporting the use of agro-biodiversity in agriculture in the Netherlands. This project was implemented as a result of an interactive debate on the Internet involving various actors in the agro-biodiversity chain. Through this debate, CGN could establish links with organisations involved in research, marketing, breeding, policy and practice. CGN's profile, as a public player, promoting the utilisation of agro-biodiversity, was strengthened. With respect to the institutional framework, CGN as a department of CPRO has merged with two other departments in the DLO-reorganisation that resulted in the formation of Plant Research International. CGN has maintained its independent status responsible for the NPGRP and national germplasm collection. At policy level, CGN's weak institutional framework and position have not improved.

Following the Diversity Project, Zeeuwse Vlegel and CGN have not initiated joint activities. In 2000, Zeeuwse Vlegel uses the remaining part of the Bhutan-grant for a trial in which it has included 13 winter wheat and 10 spring wheat varieties. It hopes to identify a suitable baking type variety that will complement its current set of varieties and has established an informal link with LBI's "organic plant breeding project". Partners of this project have visited the wheat variety trial in Zeeland. They will soon start to implement similar trials in two other regions of the country. Furthermore, Zeeuwse Vlegel has multiplied *Sunnan* and is currently selling its seeds to "organic farmers". Following the publication in organic farming journals of articles about Zeeuwse Vlegel and *Sunnan*, this variety has become popular among organic farmers. In 2000, TAD started the second phase of its Diversity Project with Eco-operation funding. During this phase, it will address remaining barriers in the chain between genebanks and consumers such as those related to marketing and processing of agricultural products.

10

Bhutan:
Integrating conservation strategies

Walter S. de Boef & Karma Tse-ring

In this chapter we explore the specific relationship between various conservation strategies and seek how they can be integrated at an operational level. With the initiative to establish an Agro-Biodiversity Centre (ABC) in Bhutan, we meet a National Plant Genetic Resources Programme (NPGRP) constructed from its onset in an integrated, decentralised and interactive manner. The chapter is based on a formulation mission undertaken in 1996 to assess the feasibility of the development of a framework and workplan for ABC (Pradhan *et al.,* 1997). The mission included Pirthiman Pradhan, Liesbeth Bijvoet and both authors of this chapter. During the mission, we interviewed various social actors and organised some discussions on agro-biodiversity conservation and management. Early 2000, the project proposal has been approved and ABC has started its activities. The case study does not reflect on ABC's current activities; it is merely based on ideas developed by mission members and on the information that they gathered.

The chapter follows the general outline of the case studies. In a first section, Bhutan and its biodiversity are introduced. In the second section, we will introduce the actors involved in agro-biodiversity management, and outline some flows of germplasm, knowledge and information. The approach to construction of the ABC as integrated NPGRP is described and analysed. In the final section, we will reflect on some critical aspects of the social organisation of ABC as NPGRP and particularly refer to the proposed partnerships between ABC and organisations involved in nature management, agricultural research and extension.

10.1 Context: Bhutan and biodiversity

Both climate and topography, but also cultural factors have contributed to a wealth of biodiversity in flora, fauna and agriculture in the Kingdom of Bhutan. Agriculture is the core sector in Bhutan's economy. Major crops include maize, rice, wheat, barley, buckwheat, potato, apple, cardamom, oranges and a wide range of millets, vegetables, pulses and oilseeds. Many of the indigenous and "introduced" crops possess significant genetic diversity. Most show a relatively high degree of adaptation to the specific environments in which they have developed. In Bhutan, it is extremely difficult to draw a line between biodiversity in agriculture and in nature. For their livelihood, rural families depend on wild fruits and vegetables, medicinal and ornamental plants, mushrooms, forest animals, fodder and non-timber forest products.

The Royal Government of Bhutan (RGoB) is pushing towards attaining food self-sufficiency using conventional concepts of agricultural development. Modern (foreign) varieties of rice and some other crops have been introduced, resulting in genetic erosion of local crop genetic diversity and loss of biodiversity. Exotic food and cash crops replace a diversity of food crops; buckwheat that has been widely cultivated in the east of the country, for example, has been largely replaced by maize. Farmers cultivate apples and potatoes as cash crops; they divert their major attention in agriculture.

10.2 Actors and flows of germplasm, knowledge and information

Institutional actors

Institutional actors involved in conservation and utilisation of agro-biodiversity primarily belong to the RGoB. Within the political structure of Bhutan, no independent NGOs are active. We will briefly describe organisations that operate in the management of agro-biodiversity:

Services provided by Ministry of Agriculture (MoA) are delivered through three operational divisions: (i) the Research, Extension and Irrigation Division (REID) responsible for promoting innovation and development, (ii) the Crop and Livestock Services Division responsible for animal production, livestock breeding, mechanisation and input supply services, and (iii) the Forest Services Division (FSD) responsible for management of forests, national parks and protected areas. REID operates through four Renewable Natural Resources Research Centres (RNRRCs), each with a regional and commodity mandate. Renewable Natural Resource (RNR) offices operate at Dzongkhag (District) level; Agricultural Extension Officers operate at Gewog (Municipality) level.

- The Nature Conservation Section (NCS) within FSD assumes primary responsibility for nature conservation activities. NCS is responsible for the management of 9 national parks and protected areas. FSD operates at Dzongkhag level through Forestry Extension Officers, operating within RNR Offices.
- The National Environmental Commission (NEC) is a national policymaking body and regulatory agency. NEC is a high level cross-sectoral body, it is not an executive agency. It participates in international environmental dialogues. NEC has been responsible for the development of the National Conservation Strategy and Action Plan following Bhutan's ratification of CBD; implementation of this plan is left to MoA divisions.

- The Natural Resources Training Institute (NRTI) is the education institute within MoA; it trains technical staff and extension officers in agriculture, forestry, animal husbandry and other areas of natural resource management.
- In addition to central government organisations, a range of actors operates at the local level of the agro-biodiversity arena. These actors include community leaders, representatives of local government levels (Dzongkhag and Gewog) and religious organisations.

In agriculture and natural resource management, the RGoB is the central and sole institutional player. Working relationships between actors follow a hierarchical line of command, from central government to district agricultural extension officers and farmers. Technology development and its transfer follow a linear and top-down model. A strong distinction exists between organisations involved in agricultural development (REID, RNRRCs and Agricultural Extension Offices), and those responsible for nature management and forestry (NEC, NCS, National Parks, Forest Extension Officers). Although all actors belong to RGoB and are organised along policies targeting at Renewable Natural Resource Management (ISNAR, 1992; RGoB, 1992), organisations involved in agriculture, forestry and nature management have divergent goals in, perspectives to and strategies for the management of biodiversity.

Flows of germplasm, knowledge and information

Flows of germplasm follow the conventional organisation of institutional and local crop development systems (Section 2.6). Germplasm has been collected in Bhutan during expeditions organised by various CG-Centres. Before ABC's establishment, no accessions have been *ex situ* stored in the country. For a few crops, crop improvement programmes within RNRRCs are operational. These programmes are merely involved in variety selection; they obtain improved germplasm and materials from breeding programmes in CG Centres (e.g. IRRI for rice) or neighbouring countries (India). Advanced materials and promising varieties are tested and if successful multiplied, sometimes in collaboration with farmers. Extension officers at RNR Offices promote and disseminate improved varieties. Further dissemination of varieties takes place within the local seed supply system. Direct interactions between variety selection and farmers are limited. Box 10.1 illustrates researcher-controlled on-farm rice variety trials. Farmers in more favourable low altitude production systems have adopted improved rice varieties. Breeding and varietal selection have been less successful in high altitude rice production systems, where environmental variation is much higher. In these areas, farmers continue to cultivate a diversity of landraces. It may be concluded that plant breeding programmes have not been able to develop and disseminate modern varieties that have the potential to perform better under these apparently specific conditions.

Box 10.1 On-farm rice variety trials

The RNRRC in Bajo is co-ordinating the national rice breeding programme for Bhutan. It obtains its promising and advanced materials from the International Rice Research Institute (IRRI) in the Philippines. Materials are further selected on-station, while promising lines are tested in on-farm trials using participation by consultation and for material incentives. These on-farm trials are organised through involvement of district agricultural officers.

Ganesh Chetri, personal communication

Flows and the interest the establishment of an NPGRP

RGoB has expressed an interest in the development of an NPGRP to protect and maintain agro-biodiversity and develop mechanisms that control flows of germplasm within an international context. RGoB's intention to protect and benefit financially from it's wealth of biodiversity when for example utilised by foreign commercial plant breeding and pharmaceutical companies, has become a driving force for the establishment of the NPGRP. The principles of CBD (benefit sharing and sustainable utilisation) can be considered the root to the initiative.

ABC has been built up with a strong perspective on the role of the state in society and in the organisation of flows of germplasm, knowledge and information. With its traditional organisation of society, local institutions may constitute a basis for decentralised agro-biodiversity management and conservation. In the development of the policy framework for ABC, development of mechanisms that accommodate traditional common property right systems will pose a real challenge. This will depend on the willingness of RGoB to delegate responsibilities to local levels of administration and share these with farmer communities (Gadgil *et al.*, 1993). An example of such delegation can be observed within Integrated Conservation and Development Programmes (ICDPs) in and surrounding protected areas and national parks. ICDPs aim to ensure long-term conservation of natural resources and support local communities in sustainable economic development (Eco-operation *et al.*, 1998). Some of ABC's local activities that contribute to the implementation of *in situ* and "on-farm" conservation strategies could be integrated into the ICDPs.

10.3 Social construction of an integrated NPGRP

RGoB's commitment to conservation of biodiversity

During the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro, Bhutan signed the Convention on Biological Diversity. RGoB has originally focused on nature conservation resulting in 26% of Bhutan's area being protected as reserve or national park (Eco-operation *et al.*, 1998); RGoB aims to increase this figure to 30%. This focus has resulted in conflicts over landuse between people and nature management agencies (World Bank, 1992). ICDPs are used as instrument to solve this conflict between conservation and development.

Conservation and sustainable utilisation of biodiversity are conceived as integral parts of a national strategy to achieve sustainable development and natural resource management. This position is reflected in the following quote of His Majesty King Jigme Singye Wangchuck (Ministry of Planning, 1996).

> "Through the centuries, the Bhutanese have treasured their natural environment and have looked upon it as the source of all life. This traditional reverence for nature has delivered us into the twentieth century with our environment still richly intact. We wish to continue living in harmony with nature and to pass on this rich heritage to our future generations".

In Bhutan, agro-biodiversity is considered an important biological and cultural "national heritage"; Box 10.2 illustrates this perspective.

Box 10.2 A national perspective on biodiversity in Bhutan.

Bhutan's Natural Heritage

Located in the Eastern Himalayas, Bhutan is one of the ecological wonders of the world (...) A country rich in biodiversity, with its natural forest cover largely intact. Within Bhutan's borders, over 60% of the endemic species of the Eastern Himalayan region may be found. In addition, Bhutan's flora includes (...) over 300 species of medicinal plants, mostly alpine, that are used in traditional herbal medicine. As a result, Bhutan has been declared one of the ten global "hot-spots" for the conservation of biological diversity. Many ecologists believe that Bhutan represents the last best chance for conservation in the Eastern Himalayas, a region considered of critical importance to the global efforts to conserve biodiversity.

Conservation ethic

Preservation of the country's rich biological diversity may be attributed to two factors, the enlightened leadership and the strong conservation ethic of the Bhutanese people. Conservation is a central tenet of Buddhism. Buddhism believes in preserving nature and giving back to the earth what one has taken, and also in the sanctity of life. The importance of protecting nature in all its manifestations has permeated Bhutanese consciousness and has become integral to the Bhutanese way of life. Therefore, preservation of the environment and sacred cultural heritage sites are important and integral parts of the Bhutanese value system.

Source: 8th Five-Year Plan (Ministry of Planning, 1996)

Since the late 1980s, RGoB has planned the establishment of an NPGRP in consecutive Five-Year-Plans. In 1989-1990 the New Delhi Office of International Board on Plant Genetic Resources (IBPGR) assisted RGoB in the formulation of a project proposal for the establishment of a small Plant Genetic Resource Centre as part of a well coordinated NPGRP. The resulting proposal was based on the philosophy that activities, where relevant, would be undertaken in close co-operation with the national crop improvement programmes (IBPGR, 1990; Engels *et al.,* 1990). As part of a GTZ seed project, (Germany) a seed storage facility (genebank) was constructed at the main breeding research station in the early 1990s (Jan Engels, personal communication). Even though scattered conservation facilities were available, no NPGRP was implemented by the MoA. REID as the responsible unit within MoA had not been successful in the development of the necessary institutional framework and to raise funds for implementation.

Interest in the development of an NPGRP re-emerged in the 1996 discussions with partners in the framework of the Sustainable Development Agreement (SDA). The RGoB and the Netherlands Government have signed the SDA in 1994 (Box 9.5). Taking into account the ratification by Bhutan of CBD, the partners had identified the establishment of a Plant Genetic Resource Centre as SDA priority. Subsequently, the link with the Centre for Genetic Resources, the Netherlands was established. In 1996, a joint mission was assigned to develop and formulate a proposal. The proposal was submitted to the responsible organisations in Bhutan and the Netherlands and after a series of discussions and revision was approved early 2000. In the meantime, some interim phases have been implemented in preparation of the overall project. The ABC is a spin-off of the ratification of CBD by Bhutan and the Netherlands. CBD with its focus on various conservation strategies, sustainable utilisation and mechanisms for sharing benefits has opened its the doors to a more integrated approach to agro-biodiversity conservation and utilisation in Bhutan. ABC adopts three complementary strategies (*ex situ, in situ* and on-farm) to cover the entire range of agro-biodiversity; gradually it aims to address crop genetic diversity, biodiversity in forests and pastures and livestock.

ABC-Board: a national platform

To stimulate cross-sectoral linkages and ownership of the project and the NPGRP, the mission proposed to install an ABC Board with a broad institutional representation. It was the mission's aim that the Board will function as a national agro-biodiversity platform. The Board guarantees ABC's co-ordinating position within MoA and RGoB. Development of the ABC as a national programme is rather complex. Co-ordination and facilitation are emphasised to guide its development. Such a process requires specific expertise reaching beyond the technical skills of conservation and genebank management. The mission therefore proposed specific institutional assistance to the establishment of the Centre and the Board.

Process approach and agro-biodiversity surveys

The development of an integrated conservation approach appears a burden for a young and just established organisation. Responsibility for implementation of such an effort rests with various sectors of the MoA. To develop ABC as an integrated NPGRP, a process approach has been proposed to guide the project. Conservation methodologies are developed and refined in a process that is based on experimentation and learning. In its operationalisation the conservation strategies are approached as complementary. It requires some flexibility in project planning and implementation and use. An example of this approach is to start the project with agro-biodiversity surveys and use the information obtained to direct the project and prioritise conservation strategies.

One of the major questions that the mission had to answer was "How to start the programme?" We considered as essential input to the construction of ABC as integrated NPGRP a comprehensive inventory of agro-biodiversity. Following a recommendation by Hardon (1996), the mission decided to propose that ABC would start the project with agro-biodiversity surveys. These surveys would cover (i) various agro-ecosystems; (ii) levels of species, crop and genetic diversity; (iii) ability of farmers' communities to manage and utilise agro-biodiversity; (iv) actors and their potential role and function of the NPGRP (Pradham *et al.*, 1997).

The surveys' outputs are important inputs to a system that will set priorities among conservation strategies. This system of prioritisation combines the following factors in coming to conservation actions: (i) collected information on socio-economic and cultural values of crops; (ii) requirements of plant breeders and other users; (iii) levels of genetic erosion and loss of biodiversity; (iv) status of professional and institutional capacity to implement conservation *ex situ, in situ* and on-farm; and (v) institutional structures or platforms necessary to implement conservation strategies in an interactive manner. The ABC-Board uses the information obtained through surveys for the prioritisation of conservation activities. These elements constitute the social construction of an integrated NPGRP in Bhutan.

In the proposed ABC framework, research (surveys) and policy (decisions on what to conserve and what strategy to use) are associated. The approach is new in the world of plant genetic resources (Toby Hodgkin, personal communication). Most NPGRPs have been developed parallel to plant breeding programmes, thus breeders setting priorities (Section 3.1). Most NPGRPs concentrate on *ex situ* conservation and are limited in their capacity to start activities that contribute to *in situ* conservation (Section 3.2). However, it should be realised that breeding programmes are operational to a limited extent in Bhutan; therefore the starting point to the conservation effort is unlike that in other countries. It is based on a

"conservation ethic" as formulated in RGoB's policies (Box 10.2) and follows the basic principles of CBD.

Agro-biodiversity campaigns and local platforms

For the implementation of the *in situ* conservation and "on-farm management" strategies, ABC has to develop approaches that integrate conservation objectives within the local framework of MoA (RNR Offices). Consequently, ABC recognises farmers, groups of farmers and local extension officers as key partners. An initial step for ABC is to create awareness among extension officers and other professionals working at the Dzongkhag (District) and Gewog (Municipality) level. The proposed instruments for awareness raising and training are agro-biodiversity campaigns initiated through the agro-biodiversity surveys mentioned above. Local partners will be trained in techniques for sampling, documenting, and monitoring farmers' management and utilisation of germplasm. This investment in a local agro-biodiversity work force is a prerequisite for ABC's decentralised conservation approach. The surveys and campaigns include as additional partners students of the NRTI, who obtain specific agro-biodiversity conservation and management skills. The proposed campaigns bring together various actors. Once the local partners start to share a responsibility in the conservation and management of agro-biodiversity they may become local agro-biodiversity platforms. These platforms may constitute a local basis for the national network co-ordinated by ABC. It should be realised that the formation of these local platforms and elaboration of the associated decentralised approach to conservation with be a complex process. A major reason for this complexity is that embracing such an approach would mean a considerable shift in flows of information within the MoA's current organisation.

Policy framework: a precondition

Implementation of an NPGRP requires the appropriate legal and policy frameworks. Despite its international commitment to CBD, Bhutan has not yet developed mechanisms regarding collection, access to and exchange of germplasm ("code of conduct"), safe keeping of duplicate samples, material transfer agreements, intellectual property rights and plant quarantine. ABC as executive agency is not responsible for the development of such regulatory frameworks; however, it can provide policy-makers within MoA and NEC with the appropriate information and instruments. ABC than bridges practice and policy. Only with an appropriate policy framework in place will Bhutan be in a position to safeguard and benefit internationally from its wealth of biodiversity. Development of a policy framework is thus a precondition for establishment and development of ABC.

10.4 Social organisation: partnership with various actors

***Ex situ* conservation: link with agricultural research**

For the implementation of *ex situ* conservation activities, ABC should develop a partnership with MoA's research and extension agencies. With a focus on the genebank, this strategy has an image of being centralised. However, in Bhutan, its implementation is foreseen in a decentralised manner. ABC is in charge of the national seed storage facility and manages the national databases. For the specific crop expertise and infrastructure, ABC depends on four regional research stations (RNRRCs) that contribute to the characterisation, documentation, multiplication and evaluation of ABC's accessions. People working at the RNR offices once

they have received training (campaign, surveys) constitute the local network for collection and monitoring crop genetic diversity.

"On-farm management": link with agricultural research and extension

Regular monitoring of the dynamics of agro-biodiversity as an element of the "on-farm management" approach can only be effectuated through a partnership between ABC and MoA's research and extension services. The above-described surveys may serve as a baseline for a national network to monitor the dynamics of agro-biodiversity. Interventions such as collection of germplasm may be undertaken when gradual replacement of certain varieties or over-harvesting of individual species is observed. We realise that it is very difficult for one Centre with only limited staff to monitor ecological and social processes in a country like Bhutan. ABC builds up an extensive network of groups or platforms of farmers and professionals who monitor introduction of new materials and utilisation of agro-biodiversity. This network would serve as "early warning network" to combat genetic erosion and loss of biodiversity. The network connects "on-farm management" and *ex situ* conservation as complementary conservation strategies.

"On-farm management" also refers to strengthening the utilisation of crop genetic diversity through activities such as participatory plant breeding and varietal selection, support to local seed supply, and promotion of sustainable utilisation of biodiversity products. For this strategy, ABC has a function that differs from its strong co-ordinating role in *ex situ* conservation. A major role is support use of crop genetic diversity; ABC therefore links with research and extension organisations. ABC provides materials that can be used in variety tests and consequently be disseminated to farmer communities. In the case of rice variety trials (see Box 10.1) the material tested could be complemented by genebank accessions or varieties from other regions. Linkages between conservation and plant breeding efforts may be intensified under the umbrella of "on-farm management" of agro-biodiversity. In this way, ABC could stimulate access to and use of local germplasm in national crop improvement programmes. Such activities may terminate Bhutan's dependence on foreign improved germplasm.

***In situ* conservation: link with nature management organisations**

Within the institutional framework of the MoA, a distinct boundary separates organisations responsible for nature conservation from those in charge for involved in agricultural research and development, thus working with agro-biodiversity. The institutional division within MoA (NCS and ABC) needs to be avoided at local and operational levels when implementing "on-farm" and *in situ* conservation strategies. This integration was also envisaged with the RNR structure of MoA. The set-up of local agro-biodiversity platforms including professionals from various agencies may build a bridge across the existing institutional boundaries. ABC through its focus on agriculture may have a more farmer and development oriented perspective than nature management organisations linked to the NCS. Collaboration between NCS and ABC is required in the area of overlap for *in situ* approaches at species and population levels in national parks and protected areas. For the promotion of sustainable utilisation of forest and biodiversity products, ABC depends on a partnership with operational branches of the Forestry Services Division. Park rangers and foresters are in a position to monitor the intensity of forest exploitation. ABC may support park rangers in providing them with tools to raise awareness among rural people, and monitor exploitation and utilisation. Various

organisations within MoA have to enter a process of joint learning bridging the existing institutional and professional barriers. Collaboration with the ICDPs within and around the national parks and protected areas may contribute to the construction of a joint conservation effort.

The potential to use a participatory and interactive approach

In situ conservation and "on-farm management" are conservation strategies build on rural people's management of agro-biodiversity. The implementation requires high levels of participation by rural people and collaboration with a range of social actors. An integrated and decentralised organisation of NPGRP would contrast with the current hierarchical organisation of agricultural research and extension in Bhutan. The dominant organisation is characterised by central decision-making, a linear top-down flow of technologies and information, and research and extension following the "Transfer of Technology" paradigm (Van Schoubroeck, 1999). This organisation does not appear to create a barrier to the implementation of a "genebank" programme. However, when focusing on "on-farm management" and *in situ* conservation, the model may become a barrier to the partnership between ABC, its local partners and rural people. Opportunities for taking a participatory approach in its conservation and development work will depend on the partnership that ABC develops with local branches of MoA and the whether the model of agro-biodiversity campaigns and establishment of local agro-biodiversity platforms proves successful.

Initial steps towards an integrated approach

The success of ABC and its integrated approach to conservation will to a large extent, depend on the formation of national and local agro-biodiversity platforms. With these platforms, we want to emphasise the collective nature of the integrated conservation effort. The described process approach will provide the platforms with instruments on the basis of which they answer questions of where? what? how? and with whom? to start and implement the integrated conservation effort. The proposed approach may contribute to an agro-biodiversity conservation and management effort that is effective, efficient and achievable with the available resources, human and institutional capacities. The initial conservation effort is guided by surveys, constructed by national and local platforms and guided by a system to prioritise among various conservation strategies. These elements constitute the basis for setting up a monitoring structure, which in future may direct conservation activities in a manner that is responsive to genetic, ecological and social dynamics. ABC relies on a partnership with local people, local organisations and professionals in research, extension and nature management organisations. We emphasise the link between conservation and research, policy and practice. The proposed process approach facilitates learning and probing in the context of national and local agro-biodiversity platforms. The proposed integrated approach to develop an NPGRP in Bhutan emerges as a conservation programme that is based on principles of adaptive management.

Epilogue: ABC Project in 2000.

Since the last engagement of both authors in 1997, the ABC project and its proposal have been metamorphosed several times. Therefore the project as described in this chapter does not any more relate completely to the project. However, the proposal as developed by the

formulation team can be considered a first effort to install ABC as an integrated conservation programme. In April 2000, the grant agreement for the ABC-Project between the Government of the Netherlands and Royal Government of Bhutan was formally signed. A National Biodiversity Programme has been established within the Ministry of Agriculture in accordance with the National Biodiversity Strategy and Action Plan. One National Biodiversity Management Board will head this programme, which currently is in the process of being constituted. Agro-biodiversity is one of the five sections under the National Biodiversity Programme; therefore the ABC project will be implemented within this section. In the manner, the existing barriers between organisations involved in the conservation of natural biodiversity and those set up for the conservation of agro-biodiversity may be bridged. Within the current proposal, RGoB will have 100% responsibility for the implementation of the ABC-project; there will be no bilateral institutional linkage with an organisation in the Netherlands.

In the period 1998-1999, a team headed by Karma Tse-ring has been implementing the agro-biodiversity surveys as proposed in the 1997 proposal. The technical report with data on the status of agro-biodiversity in various regions of the country and consecutive necessary action to be taken to ensure its conservation is published in 2000. The delay in approval of the formal project has facilitated the use of the outputs of the surveys as input to the further elaboration and adaptation of the proposal. One component of the current proposal is that the component for addressing "on-farm management" is rather weak. In close co-operation with SEARICE and NORAGRIC, RGoB/MoA had developed a proposal for a special project that will particularly focus on this component. The Bhutan Utilisation and Conservation of Agro-biodiversity Project has been successfully submitted for funding to the Development Fund in Norway. Taking into account that this project has a strong development orientation; it may contribute to a decentralised and integrated approach that may link conservation and development at the local level.

11

Ghana:
Facilitating sustainable utilisation of biodiversity

Walter S. de Boef & Emmanuel O.A. Asibey

In this chapter, we pay specific attention to strategies for the development and sustainable utilisation of biodiversity products. The case study's focus varies from the other ones; we concentrate on the level of biodiversity referred to as species diversity. We discuss conservation and utilisation of forest plants and animals, i.e., biodiversity in natural forests and grasslands. This chapter is solely based on interviews with over twenty resource persons working in organisations active in biodiversity utilisation and product development in Ghana. We held interviews within the context of a mission, in which both authors were assigned to formulate a proposal for the Centre for Biodiversity Utilisation and Development (CBUD), Kumasi, Ghana (De Boef & Asibey, 1997). The approach to facilitate sustainable utilisation of forest products should be considered an experimental and hypothetical scenario. Since its formal establishment in 1999, CBUD and its partners have been experimenting with the approach, we however do not refer to the current activities and merely focus on the discussions during the phase and the resulting proposal. In the epilogue, we will refer to the current activities of the Centre.

In the first section, we provide some background information on nature conservation, changing landuse systems in Ghana, and the utilisation of non-timber forest products (NTFPs). In the second section, we refer to the diversity of actors involved in biodiversity product development. The proposed approach for product development is elaborated in the third section; this approach is characterised by bringing together social actors in platforms for product development and stimulating flows of products, materials, knowledge and information. The role of CBUD is to facilitate interactions and collaboration in product development. In the fourth and final section of this chapter we refer to the specific role of the national genebank in the CBUD programme.

11.1 Context: nature conservation, land use systems and NTFPs

Strategies to conserve natural and agricultural biodiversity

In nature management, local people are generally considered a threat to efforts to conserve biodiversity. However, in recent years, nature managers and conservationists have increasingly recognised local people's role in management and conservation of so-called "undisturbed" tropical forests (Wood, 1995). Conservation strategies that excluded local people in management have in many cases resulted in biodiversity loss. Development of buffer zones around national parks and support to the utilisation of forest products have become prominent components of nature management programmes (Ghimire & Pimbert, 1997). Strategies have been developed that strengthen local and indigenous people's status as nature's key managers or curators (Gadgil *et al.*, 1993); these interactive strategies that aim to link government and local people in natural resource or nature management are often referred to as co-management (McCay, 1996). Following the negative experiences with state owned and managed parks and reserves, common property right mechanisms have been developed that include and strengthen local people's status as "nature managers" (Begossi, 1998). These mechanisms often rely on traditional community-based resource management systems that have developed over a long period of time by rural people that manage complex ecological systems (Alcorn & Toledo, 1998). We observe similarities between strategies that focus on "sustainable utilisation of wild biological resources" in an integrated forest or ecosystem management approach, and "on-farm management of crop genetic diversity" as part of an integrated effort to strengthen local crop development. Both approaches rely and focus on local people, their management and utilisation of biodiversity.

Ghana: trends in the utilisation of forest resources

In Southern Ghana, the relations between crop production, livestock management and forestry, gathering and hunting are apparent and subject to change. Local people harvest in traditional shifting cultivation systems medicinal plants, wild fruits and vegetables, fungi and trees. Within the linked ecological and social systems (Berkes *et al.*, 1998), the indigenous management of the ecosystem and utilisation of biological resources was in a balance, but it has gradually been disturbed by harvesting practices putting pressure on the ecosystem's carrying capacity. Increased opportunities to market forest products have emerged. Certain species have been overexploited and threatened with extinction. Complete ecosystems have been transformed from tropical rainforest into savannahs or grasslands. Local management practices and associated indigenous knowledge have changed. Traditional barriers between those included and excluded as users of forest products have dissolved. Common property mechanisms have become inadequate to protect local resources within ecologically and socially acceptable boundaries. This trend has been enforced by other changes in rural society. Examples are changes that result from population growth and rural people's efforts to increase their income. Ghana's traditional resource management systems have started to deteriorate. To counteract this process a revised strategy for the management and utilisation of forest resources must be developed. This strategy should account for local people's development aspirations within the boundaries set by natural resources and ecosystems.

Box 11.1 Sacred groves: local institutions for *in situ* conservation

Forest features in all aspects of cultural life in the forest belt of West and Central Africa, from language, history and politics, to religion, art, medicine and food. Small forest areas have been protected, as sacred groves, in which a variety of sacred plants and animals that are associated with particular spirits are conserved. Fetish (animist) priests or clans of people are in charge of the management of these traditional biodiversity reserves. The prevalence of sacred groves throughout Southern Ghana demonstrates the strong cultural and spiritual affiliation of people with biodiversity. The maintenance and utilisation of these sites or sacred groves are institutions through which biodiversity and associated indigenous knowledge are kept alive; they are the local institutions for *in situ* conservation.

Non-timber forest products (NTFPs)

The dominant perspective in forestry management is concerned with timber extraction. Other biological resources that are generally known as "non-timber forest resources", get much less attention (Asibey & Beeko, 1989). Even though, one of major objectives for the creation of Ghana's system of forest reserves was to ensure a sustainable supply of forest products for the benefit of local people (Foggie, 1951), non-timber forest resources have barely received attention in concerned government institutions. Dei (1989) estimated that rural people in Southern Ghana depended for 16 to 20% of their food demands on wild animal and plant species. This figure illustrated the importance of these resources. Biodiversity has a high cultural value. A diversity of plants and animals is often conserved in sacred groves (Box 11.1). However, with the change in biological landscape in Southern Ghana, these groves have become isolated islands of biodiversity.

Types of NTFPs are illustrated in Box 11.2; they include plant, animal or other biological resources, traded and non-traded and above all used by people living in or near forests. These species often have multiple purposes. An example is rattan (e.g. "Demmere", *Calamus deeratus*) that is important for the cottage industry and for the manufacturing of fish-traps. Utilisation may have caused forest plants and animals to become overexploited; species have become less accessible or even extinct. An example is the "Tweapea" tree (*Garcinia kola*) that produced extremely popular chewing sticks. As a result of the high demand, "Tweapea" has been overexploited. Sticks of a much less preferred species are being used as "Tweapea" chewing sticks. Development of a commercial mode of production of "Tweapea" chewing sticks may sustain the species in the forest. They may also become a source of income for rural people (Adu-Tutu *et al.,* 1979). Another example of an NTFP with a growing market is the grasscutter (*Thrynomis swiderianus*), a popular source of bushmeat. In Ghana and other West African countries, a great demand for and trade in bushmeat has developed. Technologies for grasscutter breeding and production have been developed. Commercial production and marketing has been successful in Benin. On the other hand in Ghana, many barriers associated to the necessity

Box 11.2 Types of NTFPs

- bamboo & rattan
- edible plants
- animal feed
- medicinal plants
- toxins
- aromas
- biochemical products
- fibres
- ornamental plants
- animals and animal products
- ecological services, such as grazing areas, national parks and tourism

Source: FAO, 1991

Box 11.3 Limiting factors in the development of NTFPs

- Low density of NTFPs result in complex harvesting practices and marketing channels.
- Sustainable systems for extraction of NTFPs still need to be developed;
- NTFPs are associated with poverty, therefore people are not aware of or underestimate NTFPs' potential (economic) value;
- Development of practices to commercially produce NFTP-species is generally a complex and time-consuming process; the underlying assumption is that domestication results in reduced harvesting pressure on natural populations of the NTFP-species;
- A higher cultural and economic value of NTFPs regularly results in changing socio-economic and power relationships among rural people, men and women; these changed relationships again may lead to unsustainable harvesting and management practices;
- NTFPs are mostly considered part of the 'commons'; product, chain and market development can only be undertaken when property and user rights for NTFP-users or collectors are guaranteed;
- NTFP export markets are unpredictable.

Source: Van Rijsoort, 1998

to use a chain approach in grasscutter domestication, production and marketing have obstructed further development of commercial grasscutter raising.

A range of factors limits further development of NTFPs; Box 11.3 illustrates these factors. In research and development, NTFPs are only addressed to a limited extent. The development of a chain that covers domestication to marketing is a complex process in which many bottlenecks may be encountered. Therefore, an integrated and chain approach covering all aspects of product development is proposed for CBUD.

11.2 Diversity of actors, flows and platforms for product development

The actors involved in supporting and strengthening the utilisation and development of NTFPs cover a wide range of institutional, political and technical backgrounds; Box 11.4 presents a list of actors. They operate at various levels and domains, within a diversity of sectors of the economy and disciplines of research. In discussions with various people during the mission, we learnt that a majority of governmental organisations focuses on modernisation of agricultural and forestry production. Linkages between rural people or local groups (including NGOs) and government researchers are few and weak. During the interviews, it became clear that institutional actors had been reluctant or limited in their capacity to interact with actors beyond their own discipline, level of operation or sector of economy. Hardly any incentives have been developed within existing institutional frameworks that stimulate collaborative and participatory research. Neither local people nor organisations working at local levels knew how and to whom to submit their research demands. We concluded that there was a clear demand for an independent organisation that would take up the role of stimulating and supporting various actors to engage themselves in joint activities. We identified a niche for an organisation that will facilitate interactions and stimulate flows of knowledge and information among social actors.

Box 11.4 Social actors involved in the development of NTFPs

- People in rural areas (farmers, foresters, pastoral people);
- People in peri-urban areas (gardeners, livestock growers, food processors and traders);
- Urban and rural consumers;
- Grassroots groups or associations of rural people (farmers, tree growers, women);
- Community organisations and groups (administrative and religious);
- Non-governmental organisations involved in nature conservation, sustainable agriculture and participatory technology development;
- University departments and research organisation involved in botanical, forestry, agricultural, and biodiversity research;
- Commercial companies (active in areas like food processing, timber production, trade and transportation);
- Various governmental research and policy organisations dealing with nature management, forestry and agricultural research and development (Ministries, Research Councils; Marketing Boards);
- Donor agencies.

Source: De Boef & Asibey, 1997

During the mission, we identified an inert or reluctant attitude on the part of some individual actors to approach other actors and undertake joint action as a crucial barrier to initiate activities that support sustainable utilisation of biodiversity. During interviews with various actors, most professionals expressed their concern about the increasing overexploitation of NTFPs (De Boef & Asibey, 1997). However, they could not translate this concern into practice. Various actors expressed that they felt not to be in the capacity or right position to initiate action or bring various actors together and start to work together. They indicated that such activities were beyond the boundaries of their institutional mandates. Their potential inputs were perceived as inadequate to start a complex process of developing forest products. It was clear that neither conservation organisations, research institutes, NGOs nor private companies considered themselves in a position to act as intermediaries and to start a process of product development. We decided to propose the set up of a centre that would facilitate such collective process. The centre would bring together the disconnected and often isolated actors in platforms for product development.

11.3 CBUD: facilitating product development

Experiences in Ghana, but also in many other countries, revealed that the process of domestication, product and chain development is very complex and requires involvement of a diversity of actors and researchers. This complexity poses a critical barrier to any initiative that aims to achieve sustainable utilisation and management of forest resources. A major function of CBUD will be to establish linkages among various actors in a manner that stimulates joint ownership, supports the development of practices of sustainable utilisation, conservation and management of forest products. A first step in the "CBUD approach" concerns the establishment of platforms for product development and joint action. The formation of platforms was identified as a crucial element for the social construction of a collective approach to product development. We proposed that these platforms would facilitate (i) collaboration between the various actors; (ii) allocation of (financial) resources for joint actions; (iii) administration and monitoring of collective resources; (iv) negotiations on issues such as ownership

(common-property regimes), and (v) development of mechanisms for sharing the benefits of biodiversity products.

CBUD does not implement the projects itself; it supports partner organisations through co-ordination and facilitation. Taking into account this diversity of backgrounds of the various partners, it is crucial that CBUD takes up a position as a neutral facilitator. To endorse this position, the Centre and its programme is governed by a Board with representatives of policy bodies, research and development organisations, and NGOs. Box 11.5 provides an overview of the proposed services rendered by CBUD to partners in the projects.

CBUD's objective is to develop financially viable solutions acting as a facilitator in the step-wise process described above and to provide initial funding (50% of the budget) for the projects. For the remaining value of the budget, partners contribute services in kind; this is proposed to enhance the partners' ownership over the resulting approach and product. An additional point to be covered by CBUD concerns maintaining in this process a biodiversity conservation perspective. Monitoring of management and utilisation of forest products should be considered an integral part of the process.

Box 11.5 CBUD functions

- Creating incentives to initiate product development;
- Supporting collaboration between actors in various sectors and at diverse levels;
- Co-ordinating chains of product development;
- Providing funds to initiate projects and/or assist in fundraising;
- Facilitating institutional and technical support;
- Supporting development of common-property systems for non-timber forest resources;
- Monitoring resource management/utilisation to sustain natural populations of the species concerned;
- Training and education;
- Publishing popular and scientific papers.

Source: De Boef & Asibey, 1997

11.4 CBUD projects

During the mission, we proposed three product projects. We briefly describe these NTFPs.

"Prekese" *(Tetrapleura tetraptera)* is a medium sized leguminous tree. It is a multipurpose plant; the syrup made of its fruit juice is traditionally used for food flavouring. Other properties of the plant are that its fruits, leaves, bark and roots have a medicinal value and that the trunks may be used as electricity or telephone poles. "Prekese" as leguminous tree may be integrated in agro-forestry systems. Required activities for product development include selection of suitable types for agro-forestry with erect stems and/or a high production of fruits. Other activities include establishment of nurseries, development of technologies for local syrup processing and development of marketing channels for the "Prekese" products.

Snail (*Achatina spp.*) and crab (*Potamo spp.*) meat are socially and economically acceptable throughout the forest zone of West Africa. Intensive harvesting, deforestation, the use of pesticides in agriculture, the drying up and pollution of rivers and wetlands have reduced natural populations of snails in forests and crabs in rivers. Crabs and snails are a clear exam-

ple of an NFTP species that has become locally extinct through over-harvesting and environmental degradation. They also have the potential to be domesticated, integrated into farming systems and to become a source for additional income to small-scale farmers. Integration of snails into the farming system may result in an additional benefit as they may utilise organic waste products and therefore contribute to the farms' nutrient cycle.

Indigenous leafy vegetables constitute an important part of the human diet in Ghana. Traditionally, most of the starchy staple foods are eaten with vegetables. Though still in use among rural communities, the variation in rural people's diet is declining. In urban homes, traditional leafy vegetables are becoming rare; "modern vegetables" such as tomato, cabbage and lettuce have replaced the indigenous ones. Based on an increased awareness of healthier and more traditional foods, an interest has been re-awakened in indigenous leafy vegetables such as *Amaranthus* and *Corchorus spp.* Domestication, selection of high producing types, cultivation methods as well as techniques for processing leafy vegetables need to be further developed. Research groups have conducted some research on these species, however, information on the cultivation of these species has not become available to local farmer groups and NGOs yet.

11.5 The national genebank and CBUD

CBUD acts as a bridge across barriers between actors working in conservation and utilisation of biodiversity. Following the major focus of the book on crop genetic diversity and NPGRPs, we analyse the potential position in the CBUD programme of the Plant Genetic Resources Centre (PGRC) in Bunso, as national genebank of Ghana. What may be its role in projects that support and facilitate sustainable utilisation of biodiversity?

Firstly, we provide some background information on the Centre. PGRC implements its mandate based the *ex situ* conservation strategy. The Centre has not become involved in *in situ* or on-farm conservation activities. In fact, when discussing these conservation strategies during our visit, despite their training in plant genetic resource conservation in the UK, PGRC staff was not aware of these other strategies. PGRC is funded through the commodity crop improvement programmes (e.g. maize, small grain cereals and beans) of the national research organisation. Conservation activities are not covered in a National Plant Genetic Resources Programme, but co-ordinated by breeders at the Crops Research Institute. This institutional framework results in limited financial resources made available for conservation. This institutional dependency reduces PGRC's capacity to initiate conservation activities (collection, regeneration) for other crops than the major commodities and respond to changes in farmers' utilisation of crop varieties and crops. The framework has created a constraint on PGRC to develop a link with other user groups than breeders. PGRC is unable to respond to requests for access to genetic material by farmers, farmer groups and NGOs. Two of the NGOs visited during the mission indicated that they were interested in obtaining genetic material (seedlings of various tree species) from PGRC. However, PGRC could not cater for these local needs because it did not have capacity to multiply and distribute materials.

To sustain its activities, PGRC has started income-generating activities such as the commercial seed production of cash crops and production of seedlings of tree species. In 1997, PGRC generated 30% of its budget through such income generating activities. As a conse-

quence, part of the resources (labour, land) has been allocated to commercial activities that thus undermine implementation of often labour intensive conservation activities.

With respect to the utilisation of germplasm that is stored in the genebank, the CBUD product projects may provide PGRC with an opportunity to take up a more active position promoting the utilisation of its collections. CBUD Projects (e.g. indigenous leafy vegetables) can start to utilise PGRC collections or PGRC database to identify materials. Such activities may encourage the flow of information and germplasm from PGRC to the project partners. Another reverse flow of materials from the field into the genebank could result from this collaboration; collection of germplasm may be decentralised through the new partnership. Conservation and utilisation may become linked by participation of PGRC in CBUD projects. This participation may also increase PGRC's capacity to monitor trends that may lead to loss of biodiversity or genetic erosion. Resulting linkages with local organisations may raise "biodiversity awareness" of local organisations and rural people. Another property that may result from the partnership is the development of joint monitoring mechanisms to ensure sustainable forest resource utilisation. The CBUD programme has the potential to create opportunities for PGRC to play a more active role linking conservation and utilisation.

Epilogue: CBUD in 2000

The CBUD Project has been operational since mid 1999. It has passed a critical moment of staff selection, institutional and logistic instalment of the Centre. The onset of the three proposed product projects has also been critical. These are considered crucial in giving the Centre a profile among potential partners, but also among farming and forest communities.

The "Prekese" project started a survey to identify rural communities with whom CBUD will work: identify sources of seed, development of ways to produce seedlings, planting and commercial fruit products development. Together with food processing specialists, the range of potential "Prekese" products has been broadened from its use as seasoning to jam, baby food, toffees and chocolate, cookies and cakes. Efforts are being undertaken to develop "Prekese" gin. CBUD has started to promote fruit production and to facilitate product certification, product patenting and marketing.

The snail product project is building on experiences by other organisations in its domestication and production. A survey was implemented to identify partner communities for its multiplication. In two areas, volunteer farmer groups have started the construction of thirty improved traditional snail pits. These communities will concentrate on the development of breeder stocks. The progenies will be distributed among interested communities, who will be trained in commercial production. Various potential products have been identified including canned snails to be used in stews or sauce, as well as dehydrated or smoked snails. These products have yet to be fully developed. A food processing company has demonstrated much interest in the products and therefor has indicated an eagerness to join the project. Few activities have yet been undertaking with respect to the crab project. It is clear that for this product, unlike snails, CBUD can not build upon experience in domestication and production. Therefore, it needs to initiate and link with research organisations. However, the status of freshwater crabs is rather severe; various species are endangered, thus calling for determined action.

In the leafy vegetable project, CBUD works closely with PGRC. From its collection of over 100 accessions, 15 wild leafy vegetables have been identified and will be planted in co-operation with partner organisations and farmer communities for characterisation and evaluation. Communities and partners will rank wild leafy vegetables. Marketing opportunities for various species and their products will be explored. This project will start becoming operational mid 2000.

National and international organisations are following the project as an interesting experiment in the field of biodiversity management and utilisation. Various organisations, NGOs, companies, rural groups and individual researchers, farmers or foresters have approached CBUD since its inauguration. They proposed many biodiversity products to be supported by CBUD projects. However, CBUD is a young organisation with still limited staff. Therefore it is not able to respond to all these requests yet. The type of collaboration of CBUD with its partners still has to be developed, and the process of developing the institutional frameworks through establishing platforms of partners is yet to be operationalised. The focus of CBUD in its first year has been to get established as an organisation itself and start individual projects.

With this focus on project implementation, CBUD is taking more a co-ordinating and executive role in the projects than a facilitation role as proposed. It should be realised that the proposed institutional model working as facilitator in a pioneering operational area, takes considerable time and effort. Potential partner organisations have to be identified and relationships can only gradually be shaped. The primary producer is motivated by marketability of its produce, which depends on demands. Therefore, CBUD's strategy to concentrate on output appears logical in being accepted as a Centre with a facilitation role. However, it should be realised that the type of activities to be undertaken in a number of projects is so diverse that the Centre will depend on partners any way. The CBUD established with broad GO, NGO and academic representation and an executive committee is guiding the operations. Taking into account the broad representation of actors in society in the Board and the fact that the Board is the Centre's and Project's key decision making body, involvement of a broad range partners in CBUD's activities appears guaranteed. Ownership of the individual product projects by various partners may progressively be increased. We therefore conclude that the Centre has made a rather pragmatic start. Many challenges are still lying ahead, particularly with respect to its position as facilitating the development and sustainable utilisation of biodiversity products.

12

IPGRI *in situ* project: International and scientific construction of "*in situ* conservation on-farm"

Devra I. Jarvis, Walter S. de Boef, Jan M.M. Engels & Toby Hodgkin

The Project "Strengthening the scientific basis of *in situ* conservation of agricultural biodiversity on-farm" (in short "the IPGRI *in situ* project") brings together international, national and local dimensions of *in situ* conservation in one network of activities. It is a research project that aims to construct in an international and scientific effort the strategy of "*in situ* conservation on-farm". This effort is based on components that are implemented in the context of National Plant Genetic Resources Programmes (NPGRPs). The national units of the project are called the project's national components; they are implemented independently by a group of partners. The total of components is co-ordinated at international level by IPGRI. In this case study, we describe and analyse the project's social organisation and efforts to construct "*in situ* conservation on-farm". We particularly explore the social organisation of the development of a conservation strategy in an interface of social actors that operate at international, national and local levels. In accordance with the other case studies, the windows referring to actors, flows, social construction and social organisation have guided us in the presentation of information on the project in this chapter. The IPGRI *in situ* project applies the term of "*in situ* conservation on-farm" for the strategy that in other chapters is referred to as "on-farm management" of agro-biodiversity; in this chapter we use IPGRI's terminology.

Primary sources of information for the chapter were the experiences with and perspectives on the project of Devra Jarvis, Jan Engels and Toby Hodgkin of IPGRI. In discussions with Walter de Boef, these experiences and perspectives were reflected upon and analysed. In view of their position in the project, we will particularly reflect upon aspects of and specific activities at the project's international and national levels. For additional background information, Walter de Boef consulted documentation on the project available at IPGRI-Headquarters. Unlike in the projects described and analysed in the other four case studies, Walter de Boef had not been formally involved in this project. The three IPGRI authors are directly involved in the project, resulting in a prevailing perspective of IPGRI co-ordination in this chapter. However, the structure of the chapter using the windows of reflection provides some innovative insights into the project that are relevant when placing the IPGRI *in situ* project in the global arena of creating an institutional frameworks for the development and practical implementation of "*in situ* conservation on-farm".

We regard this chapter as one of the outputs of a collective learning experiment called the IPGRI *in situ* project. We consider the work of many people in the project and our discussions with national and local partners and other IPGRI staff inputs to the development of our perspectives. Responsibility for the chapter remains with the four authors, who contributed in their personal capacity. Its contents do not reflect the position of IPGRI nor the project's partners.

The chapter starts with a description of the primary actors in this case study, IPGRI, NPGRPs. In the second and third sections, we describe and analyse the development (social construction) of the project and its organisation. It is followed by a section in which the project's flows of germplasm, knowledge and information are analysed. This section also covers related policy frameworks. The fifth section elaborates and analyses the project's international and scientific effort to construct *in situ* conservation on-farm.

12.1 Actors: IPGRI and NPGRPs

IPGRI is an autonomous international scientific organisation supported by the Consultative Group on International Agricultural Research (CGIAR), it plays a specific role within the system. IPGRI does not hold germplasm collections, with the exception of banana and plantain collections within INIBAP. The Institute supports NPGRPs primarily in developing countries through research, technical and policy advice, networking and dissemination of information. IPGRI's headquarters are located in Rome, with offices in 15 countries worldwide. The work of IPGRI is financially supported by a large number of countries, international development banks and organisations. IPGRI aims to achieve three major objectives: (i) to enable countries, particularly developing countries, to better assess and meet their own plant genetic resources needs; (ii) to strengthen international collaboration in the conservation and use of genetic resources; and (iii) to develop and transfer knowledge and technologies relevant to improved conservation and use of plant genetic resources (IPGRI, 1999).

National Plant Genetic Resource Programmes (NPGRPs) have been established within NARS often within or associated with plant breeding programmes. Links of NPGRPs with other users (e.g., farmers, NGOs, seed programmes) have developed only to a limited extent. NPGRPs focus on *ex situ* conservation; their primary responsibility concerns the management of national genebanks. Few have become involved in "on-farm management" of agro-

biodiversity and *in situ* conservation. In Chapter 3, reasons for NPGRPs' reluctance and limited capacity to become involved in local conservation strategies (*in situ*/on-farm) have been elaborated.

The Convention on Biological Diversity (CBD) emphasises the need for implementing *in situ* conservation of agro-biodiversity. The Convention specifically refers to domesticated or cultivated species. Agenda 21 reaffirms this commitment as a component of sustainable agricultural development; it refers to the need for creating networks of conservation areas, developing methodologies and establishing programmes and policies to strengthen *in situ* conservation. CBD and Agenda 21 have put *in situ* conservation of crops and their wild relatives on the agenda of international and national policy-makers, scientists, conservationists and development workers. During the Keystone Dialogue Series on Plant Genetic Resources (Keystone Center, 1991), an urgent need was expressed to develop *in situ* conservation approaches within NPGRPs and to link *in situ* and *ex situ* strategies.

During an *in situ* conservation workshop co-organised by IPGRI in 1995, participants concluded that science and practice for *in situ* conservation in NPGRPs lagged behind policy commitments. Another conclusion referred to the need to build an international framework of scientific methods, tested conservation practices and tools, and a system for dissemination of useful experiences and tools (Engels, 1995). These recommendations contributed to IPGRI taking the initiative to develop an international and scientific *in situ* project.

12.2 Initial steps

IPGRI's strategy and four key areas

Supported by a changed policy environment, IPGRI decided to become involved in activities that would contribute to the development of *in situ* on-farm conservation strategies. It organised an internal debate to explore the Institute's role in and potential contribution to this emerging field. Various "schools of opinions" have emerged among IPGRI scientists; they demonstrated divergent perspectives with respect to linkages between conservation, research and development, advocacy and ideology. A crucial point of debate was the role of IPGRI in development processes. Based on IPGRI's research mandate within CGIAR, research and collaboration with NPGRPs has been identified as a key area. The output of the debate has been elaborated in a consensus document called IPGRI's strategy for *in situ* conservation (IPGRI, 1996a). This strategy may be considered a basic input to the project.

In the strategy and initial project documents (Brush, 1995b; 1995d; IPGRI, 1995c) four key areas can be identified:

i) Major partners of IPGRI are NPGRPs; they emphasise *ex situ* strategies in their conservation efforts. The project aims at exploring possibilities of initiating initiate *in situ* and on-farm conservation activities within these programmes. However, IPGRI realised that farmers are the "on farm conservers" of agro-biodiversity; IPGRI therefore needed to expand its network of partners and started to include other social actors, such as researchers and development workers at universities, NGOs and CBOs, and above all farmers.

ii) The scientific basis. Since CBD, *in situ* conservation for crop genetic diversity has been given considerable attention in international and national policies, biodiversity conservation and development networks. IPGRI decided to contribute to the strategy's development by

building an international network of activities that aim to achieve *in situ* conservation and focus on the development of scientific methods, tested conservation practices and tools. The IPGRI *in situ* project was founded on the premise that the strategy could be constructed in a scientific manner pursuing an international and co-ordinated research approach.

iii) Crop genetic diversity. This key area covers the study, analysis and monitoring of genetic variation within various crop species in a diversity of agro-ecosystems.

iv) Capacity building. The aim was to create capacities to implement the strategy at international, national and local levels through institutional support to conservation, research and development organisations and training of professionals working within these organisations. With this conservation strategy, links had to be developed with partners at farmer and community levels.

Preparatory phase

Following CBD, IPGRI was keen to take the lead in the establishment of an international *in situ* project. The CBDC Programme (Chapter 13) had been set up by a group of NGOs, NARS and NPGRPs. From its onset CBDC appeared quite closed to collaboration with international organisations such as IPGRI. This situation put IPGRI in a rather difficult position. As an important player in the arena of plant genetic resources, it did not participate in this international initiative. This situation urged IPGRI to explore other possibilities. Representatives of IPGRI and the Swiss Development Co-operation (SDC) discussed the possibility to develop an international *in situ* project. IPGRI embraced the idea and developed a proposal for a preparatory phase that was accepted by SDC (Dick van Sloten, personal communication).

During a preparatory phase, IPGRI defined objectives and research questions, identified national and local partners, and developed an appropriate institutional framework for implementation. A proposal was developed in a comprehensive and consultative process co-ordinated by an external consultant (Dr Stephan Brush). Together with an assigned group of IPGRI scientists, the consultant formulated a list of major research questions. A group of 12 leading scientists and professionals discussed and elaborated strategies for the implementation of the research activities at a technical workshop in Rome. They also identified specific research areas, formulated hypotheses and set criteria for country and site selection. The consultant and IPGRI scientists used the workshop outputs (IPGRI, 1995b) to produce a project prospectus (Brush, 1995c). They subsequently compiled a list of countries in which the project's national components were proposed. These countries were identified applying the following criteria: (i) a high degree of genetic diversity in agriculture, (ii) an operational NPGRP, (iii) on-going, or the potential to initiate *in situ* conservation activities, (iv) existing linkages between various social actors in the conservation of agro-biodiversity (v) potential donor interest in funding a national component; and (vi) complementarity to other components with respect to crops, farming and agro-ecosystems. They identified Mexico, Peru, Nepal, Vietnam, Hungary, Burkina Faso, Ethiopia, Morocco and Turkey as potential countries. The consultant and regional IPGRI scientists visited these countries; they discussed the project with NPGRP-members. Following these country visits, the consultant compiled and confirmed the potential countries and proposed partner organisations.

In 1995, representatives of partner organisations in the above mentioned countries, technical advisors, donor representatives and IPGRI staff participated in the first global participants' meeting in Rome. We regard this meeting the informal start of the project. The project's organisation, objectives, hypotheses, outputs and preliminary activities were discussed and formulated (Brush, 1995b). Subsequently, the consultant prepared a draft proposal (IPGRI, 1995c) in which he suggested the following fields of activities: crop biology, social science of farming systems, decentralised and conservation based breeding, community participation in plant genetic resources conservation, scientific synthesis and international co-ordination.

This proposal emphasised the scientific construction of an "on-farm conservation" strategy, in which emphasis was put on conservationists' design and management of plant genetic research in a number of specific conservation sites. These sites were located in "Centres of Origin", in which farmers still use and maintain on-farm landraces of "original crops". The major objective of the proposal was to study and scientifically construct a conservation strategy and build a network of sites for on-farm conservation of plant genetic resources.

Building the project and national components

With the proposal of the consultant in hand, IPGRI started exploring donor interest in funding the project's international and national components. Once a critical mass of donors had expressed their interest (Switzerland, the Netherlands), IPGRI started the project. In April 1996, Dr Devra Jarvis was appointed by IPGRI as the *In Situ* Conservation Scientist, whose responsibility included project co-ordination. She visited the nine countries and started discussions with representatives of identified partners. IPGRI continued elaborating the project documents in a process of discussions and negotiations with national partners and donors. Along their perspectives and interests, IPGRI revised and adapted the country proposal. Using a general framework and format, it produced one general and nine country proposals and submitted them to various donors. Once a donor organisation committed funding to components, IPGRI and its national partners formalised collaboration and started the project. Annex II presents a list of organisations that currently participate in the project's national components.

12.3 The project's social organisation

Objectives and logical framework

The project's three objectives (Box 12.1) illustrate IPGRI's key areas of interest for the development of the project. The third objective relates to linkages between actors in the institutional and local crop development systems (Section 2.5). Such linkages are necessary to come to *in situ* activities that are sustainable at local levels. A logical framework analysis was performed during the preparatory phase to formulate outputs, activities and

Box 12.1 IPGRI *in situ* project - objectives

1. To enhance and support a framework of knowledge of farmers' decision-making processes that influence *in situ* conservation of agricultural biodiversity.
2. To strengthen national institutions for the planning and implementation of conservation programmes for agricultural biodiversity.
3. To broaden use of agricultural biodiversity and participation in conservation by including farmer communities and other groups.

Source: IPGRI, 1996b

indicators for the project's international and national components. National proposals and frameworks were adapted by IPGRI and its partners to respond to country and donor specific interests and requirements.

National components and their donors

During the preparatory phase, IPGRI decided to establish the project as a multi-donor activity. The initial budget of the project and its components exceeded the potential contributions of one bilateral donor. To "sell" components and global co-ordination as separate modules to donors, IPGRI divided the project into funding "pieces". SDC financially covers global co-ordination and the Vietnam component. DGIS (The Netherlands) finances the Burkina Faso and Nepal components. BMZ/GTZ (Germany) finances the Morocco component and IDRC (Canada) is responsible for the Mexico component. Limited IPGRI core funding and SDC project funding are used to conduct a target research project in Ethiopia. The Hungarian component is implemented with national core funding. Up until early 2000, no donors had been identified to finance components in Peru and Turkey. Until funding has been identified, organisations in these countries are considered observers within the project's network. IPGRI supports the project by means of its logistical facilities and scientific staff who are responsible for scientific and technical backstopping. Governments in participating countries support the project by means of staff availability and basic infrastructure.

Global co-ordination

The institutional framework is complex as it involves a multitude of organisations at international, national and local levels. IPGRI plays the leading role in global co-ordination and management. The *In Situ* Conservation Scientist co-ordinates the project at IPGRI Headquarters. IPGRI has set up a project team that comprises scientific staff of Headquarters and Regional Offices. The team has been complemented by Local *In Situ* Officers recruited specifically for the project. These officers support and monitor components in their regions and are responsible for the project's outreach to NPGRPs in their regions. Being an IPGRI project, it is embedded in the Institute's overall management structure. This means that the project is regularly monitored and reviewed through internal and external supervision and management mechanisms used for all IPGRI and CGIAR projects. Donor organisations monitor and review the progress of "their" components.

A Technical Advisors Committee has been set up to provide (i) technical, methodological and analytical backstopping, (ii) advise on policy issues, (iii) monitor outputs and (iv) advise on the synthesis of results, methods and applications. The Committee's status is informal; its composition is balanced with respect to disciplines and backgrounds. Members will be identified particularly on the basis of their scientific merits. This criterion has resulted in most members of the Committee having an association with CG-organisations or originating from countries in the North. Members participate in global meetings, and serve as the project's main group of resource persons.

With respect to the technical and scientific organisation and focus, global meetings are extremely important. During these gatherings, strategic decisions are taken on research issues, such as data collection and research methodologies, and the mode of operation, such as methods for interactive research and community participation in project implementation. After the meetings, IPGRI is given the mandate to support partners "along the agreed path".

Key-decisions are taken during these meetings, which emphasises the project's collective and interactive nature.

Institutional framework

All project funding and financial flows are co-ordinated and administered at IPGRI Headquarters. IPGRI acts as a contracting party to the project's donors. In preparation for implementation of the components, IPGRI and its partners have signed Memoranda of Understanding (MoUs). In most cases, MoUs shape the general framework for collaboration specifying institutional responsibility, activities and outcomes, evaluation mechanisms and financial arrangements. These MoUs also facilitate collaboration between partners who need formal agreements on the initiation and implementation of multi-institutional *in situ* activities. The flow of funds and reports follows Letters of Agreement between IPGRI and its partners. These Letters cover periods of six months to one year, providing IPGRI with an opportunity to appropriately control, direct and monitor its partners in implementation. The primary function of the structure described above is to ensure a clear contractual agreement between IPGRI and its partners. Other functions of the Letters of Agreement include easing and ensuring the project's scientific, technical and financial accountability towards donor agencies, other partners and the general public.

IPGRI has set up a rather strict, though manageable and transparent institutional project framework. It is responsible for the project and national partners are considered subcontractors. IPGRI has entered into formal agreements with individual partners within the component for the practical reason of avoiding complex flows of funds between organisations. It intends that the National Co-ordination Committee (NCC) controls and directs the financial resources of the national component. Within the agreed framework of the MoU, NCC co-ordinates and is responsible for the components implementation. This management structure enables national partners represented in the NCC to retain ownership of the project. Through the linkage between management and scientific implementation, IPGRI is in a position to influence and monitor research activities. It carries final financial responsibility. This type of organisation may lead partners to consider IPGRI rather a "donor" than a "partner" in the project (Jarvis & Ndung'u-Skilton, 2000).

National co-ordination and implementation

Partners in each component have built their own institutional framework. IPGRI has supported identification of the lead and partner organisations and/or persons for project management and implementation. It has emphasised the inclusion of various local organisations (Rural Extension or Development Departments, and/or NGOs) and the involvement of scientists and professionals of various disciplines.

Often related to the committee in charge of the NPGRP, the NCC has been established to act as the component's governing body. Its mandate is to define focus, research themes and sites. NCC co-ordinates project activities, monitors progress and assures integration of components into the NPGRP. Box 12.2 presents the NCC mandate in the Nepal component. NCC includes representatives from formal research, conservation, scientific training, extension and non-governmental organisations. Farmers or their representatives through Community-based organisations (CBOs) have so far not been represented in the NCCs although IPGRI has insisted on the involvement of representatives of local and farmer organisations.

Box 12.2 NCC and NMDG mandates, Nepal

National Co-ordination Committee

- approval of workplans, activities and budgets
- technical backstopping
- monitoring and supervision
- policy guidance
- linkages
- integration into NPGRP

National Multi-Disciplinary Group

- set and prioritise research agenda related to outputs indicated in the Letter of Agreement
- programme and plan project activities
- monitor and supervise project implementation
- periodically review the project cycle
- analyse, interpret and report technical findings
- facilitate effective project implementation
- ensure standard research methodologies across project sites

Source: Sherchand *et al.*, 1998.

However, involvement of local organisations has facilitated a change in the NPGRP and Project committees that are usually dominated by senior governmental officials. IPGRI stimulates and anticipates a broader and local representation in committees governing NPGRPs. NCC delegates responsibility for co-ordination and day-to-day management to one organisation and project co-ordination, that are supported by the Local *In Situ* Officers stationed at the IPGRI's nearest Regional Office.

National and Local Multi-Disciplinary Groups (NMDGs and LMDGs) have been established for the practical implementation of components. IPGRI and its partners in Nepal have developed this structure (Sherchand *et al.*, 1998). The Nepal component plays an important role in the project, because its organisation is most advanced as far as the level of participation of NGOs, local organisations and farmers is concerned. Box 12.2 provides background information on the functioning of the Nepal NMDG and LMDGs. Members of the NMDG include scientists experienced in crop biology, social sciences and participatory research. The Group is balanced in gender, institutional affiliation (NGOs and GOs) and levels of operation (national, regional and community). LMDGs have been established at three research sites of the Nepal component; they constitute project teams responsible for local implementation. This national component is the most advanced with respect to local representation at all levels because an NGO (LI-BIRD) actively participates in the component's co-ordination and implementation. This country's institutional and political environment facilitates and encourages NGO involvement in the implementation of externally funded projects. In other countries, this situation may be entirely different. NMDGs and LMDGs with a similar balance in representation of social actors have been established at a more gradual pace in the other national components. In Nepal, representatives of CBOs and farmer organisations include members of the LMDGs.

Platforms in the project

An *in situ* project is by its very nature a multi-actor and multi-objective activity, for which partners are found beyond those traditionally involved in an NPGRP or responsible for *ex situ* conservation. IPGRI stimulates the involvement in NCCs and NMDGs of researchers with social science and development backgrounds, and development workers that operate in local organisations (NGOs, development and extension agencies) and farmer groups. With respect to direct participation of farmer groups in the management and research structure of national components, IPGRI has not been successful yet in achieving full representation. However,

Table 12.1 Overview of national components within the IPGRI *in situ* project (status 2000)

Country	Agro-ecology	Farming system	Crops	Geographic scope	Conservation category [1]	Type of partners	Strength & focus	Status
Burkina Faso	arid and semi-arid	rainfed	sorghum, cow-pea, millet, okra, Solenostemon	three deline-ated eco-regions	"on-farm manage-ment" (VI) & *in situ* habitat (IV)	NPGRP, NARS, universities, NGO	genotype * environ-ment interaction in stress environments	on going (5 years funding)
Ethiopia	tropical highland	rainfed, dryland	sorghum	two regions		NPGRP, NARS, universities	time series	targeted project
Hungary	temperate	rainfed	home garden crops	---	*ex situ* conservation on-farm (II)	NPGRP, NARS university	restoration of home gardens	national core funding
Mexico	tropical low-land	shifting cultiva-tion	maize, beans, squash, chili peppers	Yucatan	"on-farm management" (VI)	NPGRP, NARS, universities & CBOs.	PPB, agro-eco sur-veys, farming sys-tems research	on-going (2 years funding)
Morocco	mountain, semi-arid and oasis	irrigated, rain-fed and oasis systems	durum and bread wheat, barley, alfalfa, faba bean	three eco-regions countrywide	"on-farm management" (VI)	NPGRP, NARS, universities, NGOs & CBOs	institutional devel-opment & linking research levels	on-going starting in 1998 (3 years funding)
Turkey	temperate, mountain, semi-arid	irrigated and rainfed	wheat, legumes, (chickpea)	transitional zone	*in situ* conservation habitat (IV) & "on-farm management"(VI)	NPGRP, NARS, University, NGO	agromorphology characterisation and farming systems research	national input no external funding
Nepal	mountain, mid-hills and lowland	irrigated and rainfed agri-culture	rice, barley, buckwheat, fin-ger millet, taro, spunge gourd, pigeon pea	three eco-regions – countrywide	"on-farm management" (VI)	NPGRP, NARS, NGO & CBOs	participatory ap-proaches; genotype * environment in-teraction	on-going (5 years funding)
Peru	tropical low-land	shifting cultiva-tion	cassava, ground-nut, maize, chili peppers	Amazonas	"on-farm management" (VI)	NPGRP, NARS, universities, NGO & IARCs	working with indige-nous people	proposal sub-mitted to donor;
Vietnam	tropical low-land,	irrigated and rainfed, upland agriculture	rice, beans, millet, taro	four eco-regions countrywide	"on-farm management" (VI)	NPGRP, NARS, universities & NGO	agromorphology characterisation and farming systems research	on-going (3 years funding)

[1] See for classification Table 2.2.

increasingly local organisations (such as NGOs) have started to participate in all components. Consequently, the boundaries of NPGRPs have slowly started to change; other and new actors in society have started to become partners. The initiation and establishment of *in situ* and on-farm conservation activities is a complex institutional process in which linkages between a diversity of social actors need to grow and mature. These partners frequently maintain divergent perspectives on conservation and development, which are complicating factors. Formulation of joint activities is therefore often the result of a process of discussion and negotiation. IPGRI has supported the establishment of platforms bringing together social actors in the context of a project. These actors have become engaged in a joint effort to construct an integrated conservation framework that covers various conservation strategies and links conservation and development objectives.

IPGRI plays an important role within the national components to ensure that various parties are working together as a team as far implementation is concerned. IPGRI promotes the involvement of various partner organisations in decision-making as an instrument to encourage joint ownership of the project. Most components have been integrated into NPGRPs, which primarily function within government structures. Inclusion of NGOs, farmer and community organisations in these institutional frameworks is a rather complex and delicate process, because it results in reversing "top-down" flows of decision-making often prevailing among NARSs and NPGRPs. The advantage of the IPGRI project is that it brings together partners in various platforms (NCCs, NMDGs and LMDGs) and engages them in gradual processes of social and institutional learning, negotiation and joint problem solving. At national levels IPGRI specifically contributes to processes of institutional and social change required for local implementation of "*in situ* conservation on-farm".

One of the project's objectives is to support capacity building at local level for the implementation of "*in situ* conservation on-farm" of agro- biodiversity. This concerns strengthening and supporting the establishment of farmer groups for agro-biodiversity management and conservation. However, with the dominant position of government organisations, the project faces many barriers trying to achieve this objective. The Nepal component is considered strong and an example to other components as far as the degree of local and grassroots' involvement is concerned. LI-BIRD combines scientific capacity and interest with a development and grassroots' orientation of its activities in for example participatory plant breeding and varietal selection. The 1999 global meeting was organised in Nepal; experiences were shared with partners from other countries (Jarvis *et al.*, 2000).

Uniformity or diversity of components

Components follow a general format with a set of general and specific objectives and outputs. Based on individual partner's needs, conditions and interests, this international framework has been "translated" into a diversity of approaches and activities at national and local levels. Table 12.1 presents a summarised overview of this diversity.

During the preparatory phase, it was envisaged that national components would cover various crops, breeding systems and agro-ecosystems. When partners began to further elaborate and develop these national components, they often pursued a farming system approach and identified other crops than originally indicated. This change concerned the first modification of the original proposal to study some annual and perennial crops (IPGRI, 1995c). Partners in most components decided to concentrate on major staple food crops, including some minor

or under-utilised crops. Crops included are annuals so that changes in population structures can be measured within the project's 5-year timeframe. The criterion for crop selection was maintained, i.e., crops had to originate from the region ("Centre of Origin") or should demonstrate a genetic diversity ("Centre of Diversity"). Along with the change in crop focus, research issues have been redirected towards more development and action oriented activities, such as participatory plant breeding, organisation of "diversity fairs" and the building of community seed banks. This change has contributed to the international project gradually becoming a collection of diverse components addressing locally relevant issues. These changes have resulted from the use of participatory and interactive approaches during the components' development and formulation. They have gradually developed their unique dynamics. Partners in these components and in the international *in situ* project have agreed on using a common set of methodologies, approaches and parameters in genetic diversity assessments. The critical element of the IPGRI *in situ* project concerns research activities undertaken in six distinct "corners of the earth", linked through common methods and approaches. Partners have interacted in a co-ordinated network. Above all they have benefited from participation as they have obtained access to external funds (up to more than US$1m in five years). Other benefits have included access to publications and information, technical and scientific assistance, contacts with other organisations and training opportunities (Jarvis *et al.*, 2000). In addition, their participation in an international (IPGRI) project has been instrumental in enhancing the status or prestige among senior policy makers and managers of researchers, development workers and farmer communities involved.

An important issue concerning IPGRI's role in the project is its role to enhance and stimulate ownership of the international and more scientific dimensions of the project among national and local partners (Jarvis & Ndung'u-Skilton, 2000). IPGRI played an important and leading role in the initial phase; it is expected that barriers to ownership of international dimensions might be encountered among national and local partners. IPGRI uses two steps to overcome these barriers. An initial step concerns involvement of national representatives in decision making on issues relating to global research orientation; global meetings of partners are crucial fora at which research decisions are taken. A subsequent step taken entails that the representatives disseminate information among organisations in their own countries. In such a two step process, it is assumed that national and local ownership of the project will expand. With respect to local and national issues within the project, a reverse flow of information should emerge, so that IPGRI and other more scientific partners can commit themselves to locally important issues.

12.4 Flows of germplasm, knowledge and information

The project addresses "*in situ* conservation on-farm" at international, national and local levels. Germplasm flows abundantly among partners within national components. Beyond national boundaries, these flows are restricted to information and knowledge. Reciprocal flows of knowledge and information result from the project's focus on research and methodology development.

Flows of germplasm

The system perspective on local and institutional crop development (Section 2.6) helps us to identify specific flows of germplasm in the project. When addressing flows of germplasm in

the construction of "*in situ* conservation on-farm", the link with participatory plant breeding emerge. Many components are currently involved in activities that increase access to and use of genetic diversity. Such activities include participatory plant breeding that is considered to contribute to implementation of "*in situ* conservation on-farm" of agro-biodiversity (Sthapit & Jarvis, 1999). Another link refers to material stored in genebanks. In some components, material in genebanks has been repatriated to original communities (a germplasm flow from genebanks to their original communities). Another element concerns the building of community gene or seedbanks that stimulate flows of germplasm within and among farmer communities. Diversity fairs are being organised; they will contribute to "*in situ* conservation on-farm" of agro-biodiversity and will raise farmers' awareness of the value of genetic diversity. An element not yet addressed concerns the question of how farmers are maintaining access to "their" material being collected and subsequently stored in national genebanks.

Flows of knowledge and information

A fundamental project objective concerns collection of scientific data on farmers' agro-biodiversity management. Local and international dimensions meet in research, therefore information flows among partners who operate at various levels. When analysing such knowledge and information flows, we start to realise that global questions can only be answered by providing local information. The IPGRI *in situ* project has been organised in such a manner that information and data are gathered at local, national and international levels with feedback and exchange mechanisms among various partners (Jarvis & Hodgkin, 1999). The project's management structure supports these flows. Knowledge and information flow back from international to local levels in the form of synthesised research outputs and collaborative publications. It is clear that in an international research project ownership of data and information requires a transparent organisation and recognition of those who have contributed to research. Partners should acknowledge the collective nature of research and recognise all participating researchers and farming communities as co-authors in publications. The relationship between actors in institutional and local crop development systems may be characterised by a flow of information from the local to the institutional system. Based on knowledge and information gathered, the performance of the institutional system to construct and contribute to the development and implementation of the "*in situ* conservation on-farm" approach will be stimulated.

Project and policy frameworks

The project relies in its social organisation on existing institutional frameworks of NPGRPs, often embedded in rather bureaucratic and top-down government structures. In the context of these national policy frameworks, issues related to access to, control over and transfer and ownership of germplasm and related information should be addressed. Such policy frameworks may limit opportunities for developing and exploring alternative frameworks that support flows of germplasm, knowledge and information required for the implementation of "*in situ* conservation on-farm". In some countries however, the NPGRP institutional and policy frameworks still need to be developed. This situation creates opportunities for the project to support the development of more integrated NPGRPs. Such programmes may be integrated to the extent that *ex situ*, *in situ* and on-farm conservation strategies are used, and that conservation is linked to and supports the utilisation of agro-biodiversity. IPGRI holds the view that organising flows of plant genetic resources is a national issue. IPGRI and its

partners recognise the sovereign rights (CBD) of countries over their biodiversity; in fact the project may support or facilitate the development of necessary policy frameworks in these countries.

Policy aspects relating to flows of germplasm, knowledge and information have been addressed to a limited extent. Taking into account the various levels and a diversity of social actors involved in the construction of the strategy, issues relating to access to, transfer of, ownership of and control over germplasm, knowledge and information cannot be ignored. International research projects, such as those developed and implemented by CG-Centres, were assumed to operate in a "neutral" and public arena of research and development. It should be realised that such "neutrality" with respect to germplasm, associated knowledge and information does not exist in given today's appropriation of agro-biodiversity through intellectual property rights.

Through the project, IPGRI is in a position to develop innovative approaches that facilitate *in situ* strategies within national policy and institutional frameworks. IPGRI may also play the role of catalyst in processes of learning and policy development in participating countries. It emphasises the inclusion of local (NGOs), community organisations and other social actors in the project's governing bodies and research groups (NCC, NMDGs) and thereby opening doors to actors that operate at various levels. It also stimulates the development of institutional links and collaboration between actors who operate in the public, private and civil domains. A diversity of actors will become involved in NPGRPs and may also contribute to agro-biodiversity policy development. In the end, IPGRI benefits from such a position in the project, as it will become involved in a number of parallel processes of institutional learning and policy development regarding management and organisation of flows of germplasm, knowledge and information. Lessons can be learnt and that will contribute to a global synthesis.

12.5 Social construction of "*in situ* conservation on-farm"

Site selection, diversity surveys and monitoring

The first step in research that contributes to the construction of "*in situ* conservation on-farm" concerns a selection of research sites. IPGRI and its partners have applied the following criteria: (i) level of genetic diversity and agro-ecological variation, (ii) accessibility to the region, (iii) availability of agricultural extension and development organisations, and, most importantly, (v) local community interest and willingness to co-operate. The actual selection of sites and participating farmers has been undertaken through an interactive process in which conservationists, researchers, local workers and farmer communities have been consulted. However, within the national components NCC had assumed ultimate responsibility for site selection. Box 12.3 illustrates the parameters used for site selection in the Nepal component.

In 1997, IPGRI organised a global meeting to discuss and identify the type of information and methodologies required. Basic data sets, tools for data collection, analysis and research design were discussed. They covered the following aspects of local management of crop genetic diversity: (i) socio-economic, cultural and biological factors, (ii) crop population structures and breeder selection criteria, (iii) natural and human selection, (iv) agro-mor-

Box 12.3 Parameters for site selection, Nepal

Key criteria

i. magnitude of diversity at agro-ecosystem, species and variety levels;
ii. rich intra-species genetic diversity;
iii. diversity of desired agro-ecology (land use, aspects, altitude, soil types and moisture regimes);
iv. socio-cultural/socio-economic diversity;
v. importance of targeted crops in farmer livelihoods;
vi. community interest and co-operation;

Additional criteria

i. landraces under threat and genetic erosion;
ii. existence and capacity of local (research) institutions;
iii. accessibility to the locality (distance from nearest road head);
iv. market opportunities and/or opportunities for improvements.

Source: Rijal *et al.*, 1998

phological characteristics of crop genetic diversity, (v) systems for seeds and germplasm exchange and storage and (vi) farmers' crop genetic diversity and management perceptions. The meeting identified some "common" sets of data and methods for collection across countries, crops and farming systems for the purpose of, to a certain degree, "harmonising" research in the project. The "standards" would cover (i) basic units or strata of measurement, (ii) timing of data collection, (iii) methods of aggregation over space and time, and (iv) methods to measure and analyse these units or strata from (a) farmers' information and (b) researchers' field data. These "standards" may facilitate global synthesis of data collected across the components (Jarvis & Hodgkin, 1998; 1999).

Because detailed information on farmers' management of genetic diversity is still scarce and largely anecdotal, surveys target the analyses to analyse in time series of farmers' knowledge and capacities. A specific element concerns the development of mechanisms to monitor in time series crop genetic diversity and farmers' management. The project's limited time frame poses a barrier to such research. The Ethiopia research component focuses on this aspect; it is based on previous studies of sorghum landraces in farmers' fields in two regions of Ethiopia (Teshome *et al.*, 1999; Teshome, 1999). Surveying genetic diversity and its management over time are crucial inputs to the development instruments for conservation organisations to monitor "*in situ* conservation on-farm". Translation of outputs and methods used in surveys into methods for monitoring is not very difficult, once farmers' management of crop genetic diversity and the characteristics of the genetic diversity will be better understood.

Surveys in studies described above tend to support two types of objectives. The first concerns the researchers' need to gather information and data that may contribute to the formulation of answers to questions formulated by these researchers. When participatory rural appraisal techniques are used for such surveys, they merely become diagnostic tools and cannot be considered "participatory" in the sense that farmers are in a position to influence and set research objectives. Another objective refers to surveys identifying farmers' problems. Such surveys are implemented in the early stages of development-oriented research. However, surveys become open-ended, problems and research subjects may emerge that are of no interest to researchers involved, as in this project with an interest in constructing in "*in situ* conservation on-farm". The two objectives may create some disharmony among researchers, conservationists and development workers. IPGRI and its research partners aim to be transparent to local partners and farmers about the dual objectives of their surveys and

research activities. Gradually the group of partners in the project takes the position that local partners and farmers may benefit from the project in a more indirect manner through its acquired scientific knowledge of agro-biodiversity and its management. This knowledge and information may contribute to the development of sustainable agriculture (Jarvis *et al.*, 2000). Local researchers carry the responsibility to explain conservation and research objectives to participating farmers and communities, thus raising local awareness and understanding of the project's global research and conservation objectives.

Initial research questions

To illustrate a change in the project of perspectives to the social construction of "*in situ* conservation on-farm", we will return to its preparatory phase (1994-1995). The project was initiated with a strong focus on science and conservation. Improvement of the scientific basis of "*in situ* conservation on-farm" and understanding by conservationists of farmers' management of crop genetic diversity were considered crucial to the construction of the conservation strategy. The scientists involved intended to establish a number of *in situ* conservation sites and construct the strategy based on scientific research. They made use of experiences in the development of "blueprints" to implement the *ex situ* strategy. Box 12.4 illustrates this focus in the list of research questions compiled during the project's preparatory phase. Questions that referred to farmers' utilisation of genetic diversity and participatory approaches to research and conservation had not been raised. The list and other project documents (Brush, 1995b, 1995d; IPGRI, 1996b; Jarvis & Hodgkin, 1999) illustrated that *in situ* conservation had been approached as a conservation activity through which agro-biodiversity (landraces) could be conserved on-farm.

A shift to emphasising agro-biodiversity utilisation to support sustainable agriculture

A gradual shift has had been observed in the project with respect to the balance between science, conservation and development. Since 1996, "development elements" have complemented the "conservationist" and "scientific" elements in the strategy's social construction. A link has been established with the utilisation of crop genetic diversity. The change has been

Box 12.4 Initial research questions

- What measures of (*plant*) population structure should be used?
- How useful are tools developed in conservation biology for crop (mainly intra-specific) diversity (e.g. minimum viable population, threshold effect, edge effects, keystone species)?
- What is the relative importance of genetic versus demographic approaches?
- Does "modernisation" represent a succession in agricultural systems?
- What social factors affect the spatial structure of crop habitats?
- What social factors other than crop habitats influence selection?
- How does scale (local/micro vs. regional/macro) affect crop populations?
- What conservation measures are available to affect the population dynamics of crop resources?
- How widespread must conservation measures be?
- How can conservation programmes become self-sustaining?
- Can trade, exchange, and markets substitute for large conservation areas?
- Is colonisation or reintroduction of landraces possible or advisable?

Source: Brush, 1995c

Box 12.5 Evolution of the general objectives of the IPGRI *in situ* project

Preliminary project description (Brush, 1995b)
1. To build a base of theory, methods, and practice for *in situ* programmes.
2. To develop the scientific capacity through training and pilot research in a few countries to plan and implement *in situ* conservation.
3. To plan and implement country programmes for *in situ* conservation in these countries.

Prospectus (Brush, 1995c)
1. To support basic and applied research on *in situ* conservation (on-farm) of agricultural biodiversity in selected countries.
2. To develop generalisable methods to support *in situ* conservation.

Draft proposal (IPGRI, 1995b)
1. To develop a global framework to support *in situ* conservation of agricultural biodiversity.
2. To strengthen national institutions for the planning and implementation of conservation programmes for agricultural biodiversity.
3. To broaden the use of agricultural biodiversity and participation in its conservation to include farming communities and other service groups.

Project summary (IPGRI, 1996b)
1. To enhance and support a framework of knowledge on farmers decision making processes that influence *in situ* conservation of agricultural biodiversity.
2. To strengthen national institutions for the planning and implementation of conservation programmes for agricultural biodiversity.
3. To broaden the use of agricultural biodiversity and participation in its conservation to include farming communities and other service groups.

endorsed by international discussions on the strategy, particularly those during the consultation process that led to the FAO Technical Conference on Plant Genetic Resources, Leipzig, 1996. Elaboration of the components with a diversity of partners also contributed to widening the project's scope and approach to the strategy's construction. The shift has been supported by a group of regional scientists recruited by IPGRI to implement the project. Box 12.5 illustrates the change based on the formulation of and emphasis on the project's second and third objectives. The genetic material (through for example participatory plant breeding) and scientific knowledge and information (generated through research) has been developed and made available to the construction of sustainable agricultural practices in the project's countries and beyond. Thus, the link between conservation and utilisation has been elaborated by placing crop genetic diversity in a context of sustainable agricultural development (IPGRI, 2000).

Interaction between farmers with researchers and conservationists

To illustrate the change to a more development oriented and participatory research approach, but also to reveal the type of interactions between farmers on the one hand and researchers and conservationists on the other, we have used the typology of participation developed by Pimbert & Pretty (1997) and illustrated by Table 3.1. This typology provides an overview of participatory approaches characterising interactions between rural people and external researchers and/or development workers.

In the original setting (preparatory phase), research goals were set by researchers with an

international, scientific and conservation perspective. As a result, interactions may be classified as "participation in information-giving", "participation by consultation" and "participation for material incentives". Farmers provide information and support researchers in answering researchers' questions. These interaction types were inherent to the initial emphasis on science for the construction of the strategy, reflected in the project title.

In the elaboration at national and local levels, this focus and proposed types of interactions appeared and became obstacles to more interactive types of participation that would strengthen farmers' capacity in management of genetic diversity, thus contributing to its conservation *in situ*. With the changed perspective on "*in situ* conservation on-farm", IPGRI scientists and their national and local partners became aware that they had to focus on farmers' management to construct the strategy. In practical terms this farmers' management constitutes "*in situ* conservation on-farm". Using the typology for modes of interaction in participatory research and development, this would mean that interactions move towards the other end of the spectrum, e.g. "interactive participation" and "self mobilisation". These types of interactions are characterised by learning, collective action and self-mobilisation. Rural people's development objectives are given priority over research and conservation objectives. A resultant dichotomy emerges in the project in the construction of "*in situ* conservation on-farm". To find a proper path moving through the spectrum of interactions, achieving the project's research, conservation and development objectives, and accommodating divergent objectives and perspectives of social actors involved poses a real challenge. To be successful in building local platforms and local capacity for "*in situ* conservation on-farm", the type of interactions would gradually have to move towards "interactive participation" and "self mobilisation". To develop an institutional environment that accommodates such interactions, scientists' questions need to be answered. Research answering these questions may require the use of other ("less participatory") types of interactions.

Balance between *in situ* and *ex situ* strategies

The linkage between *ex situ* and *in situ* strategies as in an "integrated conservation approach" is crucial to constructing "*in situ* conservation on-farm" (see also the Bhutan case study; Chapter 10). The role of conservation organisations is to monitor farmers' management of the dynamics of genetic diversity. It may also provide technical support and advice when diversity levels reach a threshold situation in which farmers lose "old" diversity or need "new" diversity. The project addresses the linkage between conservation strategies by developing tools for decision making on the use of various conservation strategies. One of the project's objectives is to build decision-making capacity within NPGRPs on whether or not germplasm should be conserved *ex situ* and/or *in situ*. Most crucially, NPGRPs should realise and understand when it is not sustainable to use *in situ* strategies, and thus focus on *ex situ* conservation. The quality of the *ex situ* facilities and collections in some of the countries participating in the project is however rather poor. Through participation in the project, NPGRPs capacity and infrastructure will be strengthened. However, it is crucial that they balance the use of conservation strategies in their overall NPGRP rather than focus exclusively on the project's subject of "*in situ* conservation on-farm".

The project as an experiment to construct a strategy

The diversity of locations, in which the project's national and local components are implemented, constitutes a diversity of experiments in which groups of actors contribute to the

construction of "*in situ* conservation on-farm". It should also be realised that one component may be stronger as far conservation, scientific research or development is concerned than another, but is that not the beauty and value of an international project? This diversity of projects and experiments provides IPGRI and its partners with a diversity of lessons and experiences that contribute to the construction of "*in situ* conservation on-farm" of agro-biodiversity.

Epilogue: IPGRI *in situ* project in 2000

The IPGRI *in situ* project has been operational for a number of years. The institutional framework with NMDGs and LMDGs has been operationalised and is functioning in Nepal, Morocco, Mexico, Vietnam and Burkina Faso components. Gradually, the components have started to develop their own dynamics, creating local and national ownership of the project; this development has resulted in IPGRI's current less dominant position in the national components. National and local groups have increasingly become platforms in which a range of social actors has become involved in a broad range of activities that have contributed to the construction of "*in situ* conservation on-farm". The current dynamics have resulted in IPGRI starting to concentrate increasingly on project elements that aim to create a global framework and platform for the strategy's construction.

Direct involvement of a diversity of actors in the national components with their diversity of perspectives has resulted in the project adopting a more constructivist approach to the conservation strategy's construction. The project currently distinguishes perspectives of three groups of social actors. The objectives of conservationists/breeders in their effort to realise the *in situ* on-farm strategy are (i) to conserve the processes of evolution and adaptation of crops to their environments, (ii) to conserve diversity at the levels of ecosystems, species and genetic diversity within species, and (iii) integrate farmers into the national plant genetic resources system (NPGRP). Environmentalists/ecologists approach the strategy as a method to conserve genetic diversity as an ecological service critical towards the functioning of the earth's life support system. Development workers and NGOs advocate "*in situ* conservation on-farm" as a means for economic and social development with the objective to (i) improve resource poor farmer livelihoods and (ii) assist farmers in maintaining and increasing control over and access to their genetic resources (IPGRI, 2000). As a joint and collaborative exercise, the project has facilitated this range of perspectives and has translated these into a multitude of activities. Research activities form the core of the globally co-ordinated activities; they contribute to the formulation of answers to the project's original research questions. As contributions, researchers in the national components have collected, started to validate and analyse information farmers' knowledge on and crop genetic diversity management. They have used agreed methods, tools and procedures to collect and analyse empirical data on socio-economic, agro-ecological, genetic and seed system aspects of farmers' management of crop genetic diversity. First research outputs were presented at the 1999 meeting of partners in Nepal. This meeting provided opportunities for partners to present, jointly analyse and integrate data and information gathered. Partners also shared experiences in a broad range of more action and development-oriented activities. These included participatory plant breeding (in all active components), the organisation of diversity fairs, establishment of community seed banks, marketing (studies) of diversity products and development of materials and methods for awareness raising and training in management and use of agro-biodiversity in

sustainable agriculture. Proceedings of the meeting (Jarvis *et al.,* 2000) contain a wide range of collected and analysed data and information, and provide primary information on the project's development activities. The workshop proved an initial step towards linking the project's local, national and global research and development dimensions.

The re-orientation of perspectives and objectives described above, and initial institutional and scientific outputs have demonstrated that the original global and scientific effort to construct the *in situ* on-farm strategy has developed into a scientific and action-research project that is operational at local, national and international levels of agro-biodiversity management. The major shift has been to consider the project as a joint effort that through improved scientific knowledge, information and materials supports utilisation of agro-biodiversity in sustainable agriculture. Emphasis on building national and local platforms including a wide range of social actors has contributed to conservation activities (including *ex situ* conservation) gradually becoming embedded in local and national efforts that support, encourage and facilitate sustainable agriculture. In this manner, the project may be considered to bridge barriers between participating conservation organisations (NPGRPs) with national and local actors who have become involved in sustainable agricultural development, management and utilisation of agro-biodiversity. At local and national levels, barriers between actors within the public, private and civil domains have gradually been bridged. A challenge to IPGRI and its partners will be to translate and synthesise the multitude of lessons and experiences into a scientifically and internationally recognised format that will contribute to bridging barriers that exist among actors operating at the global level of agro-biodiversity management and conservation.

13

CBDC Programme:

Linking global and local dimensions of agro-biodiversity management

The Community Biodiversity Development and Conservation Programme links local, national and global dimensions of "on-farm management" of agro-biodiversity. It is a network of organisations in which a range of activities are undertaken that aim to strengthen farmer and community management of agro-biodiversity. A majority of the CBDC partners are non-governmental organisations with a record in action research, creating public awareness and advocacy, and grassroots development work. The group of partners is completed by a number of government conservation and agricultural research organisations. They have gradually developed their joint framework for collaboration that covers 16 countries and five continents. I approach the programme as a learning and experimental environment in which people work with and study the "on-farm management" strategy.

I present and study the CBDC and focus on its foundations and original ideas, its social organisation, actors involved and the way in which flows of germplasm, knowledge and information are organised. The case study is based particularly on project documents resulting from a period in which I was involved in programme. It is above all based on my experiences and interpretations while participating in various activities. I reflect on the social organisation of CBDC and efforts to link local and global dimensions of research on "on-farm management" and *in situ* conservation. I conclude the chapter with an analysis of two workshops in which groups of partners from various CBDC projects discussed the social construction and social organisation of the "on-farm management" approach. From these discussions, I extract some lessons contributing to the overall framework of the book.

The chapter is a reflection on some specific aspects of the CBDC. I do not intend to cover the entire programme or the diversity of activities that it embodies. It is thus only a partial analysis of the programme. I concentrate on some activities at the global level of CBDC that are of direct interest to this study of the social organisation and social construction of "on-farm management". The chapter is based on my experience in various functions in the programme, and some initial documents. It covers the preparatory phase and the initial years of implementation and covers the period 1992-1997 (the time when I worked in the programme). The chapter does neither cover activities during the conclusion of the first phase nor during the programme's development of second phase. The initial phase is relevant to the present study because it covers the period in which the mode of co-operation between the various actors was negotiated. I consider this chapter my personal reflection on a collective learning experience. My views developed during extremely interesting and stimulating discussions with various CBDC-partners at meetings, workshops and during project visits. But, I want to stress that the perspectives, reflections, analyses and lessons learnt in the chapter remain mine and do not in any form reflect positions of the CBDC programme nor of its partners.

13.1 Keystone: birth of a coalition

In the 1970s and 1980s, the issue of plant genetic resources became a matter of international concern. Not only conservation, but also access to and control over genetic resources and the potential contribution of these resources to agricultural development were discussed in a global arena in which an increasing number of actors appeared. These actors varied from multinational seed companies to NGOs, international research and development organisations, and national research and conservation organisations. On the path that led towards the UNCED, it became clear that conflicts over plant genetic resources at international level needed some accommodation. The Keystone Center is an independent organisation in the United States that aims to settle issues of major concern to society through consensus building discussions; it organised a dialogue series on plant genetic resources between 1989 and 1991. The Keystone Center brought together a diversity of representatives of the actors described above in a series of open discussions. Actors from all over the world participated. Keystone invited senior experts working at national genebanks and within research organisations, NGOs, international breeding and agro-chemical companies, international organisations (FAO, IPGRI, and CG-Centres) and the donor community. The third and final session of the Keystone Dialogue Series on Plant Genetic Resources resulted in a consensus report (Keystone Center, 1991). This report stresses three particular issues relevant to the context of this book: (i) a complementary relationship of *ex situ, in situ* and on-farm conservation strategies; (ii) a recognition of an informal (local) sector complementary to the formal sector of crop development; and (iii) a link between conservation and utilisation of plant genetic resources.

During the Keystone meetings, a group of genebank and NGOs representatives gradually developed into an informal coalition. This coalition jointly defended the interests of farmer communities in discussions with other plant genetic resources conservationists and people representing corporate interests. It was realised that scientific information on farmer management and utilisation of agro-biodiversity was scarce, the group felt it needed such data and information to convince others. During the final meeting, the informal coalition idea put

forward the idea to work together in a research and development programme. The Community Biodiversity Development and Conservation (CBDC) Programme was born as a collaborative research and development programme with the objective to investigate in a global network the management of agro-biodiversity by farmer communities. Founding partners included participants in the Keystone Dialogue. These partners were (i) NGOs (SEARICE - Southeast Asia; CLADES - Latin America, ENDA-Zimbabwe, GRAIN – Spain and RAFI - Canada), (ii) government genebanks (PGRC/E – Ethiopia and CGN - the Netherlands) and (iii) a university organisation (NORAGRIC, Norway).

13.2 CBDC: initial steps

Preparatory phase

During the final session of the Keystone Dialogue, the founding partners requested Jaap Hardon of CGN to act as its leader in the development of the programme. He approached a number of donor-organisations; DGIS (The Netherlands), IDRC (Canada) and SIDA (Sweden) expressed an interest in supporting the initiative. Representatives from above mentioned founding partners took the collective responsibility for the preparatory phase and subsequent proposal. Appendix III provides a list of CBDC partners. CGN elaborated a proposal for a preparatory phase (Hardon & de Boef, 1992), in which the programme would be developed at global, regional, national and local levels. The preparatory phase envisaged the formulation of a proposal and a plan for the programme in a participatory, interactive and decentralised process, and developed mechanisms for collaboration. This phase was implemented in the 1992 - 1993 period. CGN co-ordinated this preparatory phase at the global level. In Latin America, the programme was formulated by CLADES, a network of NGOs that are active in sustainable agricultural development. CET in Chile co-ordinated the CBDC within CLADES. CBDC-Southeast Asia was developed by SEARICE, an NGO based in The Philippines, on the basis of its existing contacts with NGOs and NARS in the region. Two organisations in Africa were founding partners, the Plant Genetic Resource Centre (PGRC/E) in Ethiopia and ENDA (an NGO) in Zimbabwe. Because of the reputation of the PGRC/E in the field of "on-farm conservation" of plant genetic resources, the CBDC-group requested PGRC/E to become the regional co-ordinator for the African Programme. GRAIN (Spain) and RAFI (Canada) were part of the coalition forming the basis for CBDC; they are important policy NGOs active in international biodiversity and IPR arenas. NORAGRIC, a research centre of the Agricultural University of Norway joined the group at the Keystone meeting.

The founding partners developed into a Programme Co-ordination Committee (PCC). PCC's major responsibility in the preparatory phase was to develop CBDC's basic principles. It monitored and guided the process leading to the proposal. The process was co-ordinated by CGN. The basic principles cover (i) development and immediate objectives, (ii) hypotheses, (iii) protocol for collaboration and (iv) organisational structure. These were further refined in an interactive process through consultations, discussions and negotiations with regional, national and local partners. Partners at national level included NGOs, research and conservation agencies, universities, and individual scientists as resource persons. Communities identified to participate in the national projects were also considered partners. Outputs of the discussions and negotiations at local and national levels were presented, compiled and

Box 13.1 CBDC-Programme: objectives

1. To provide direct support to strengthening community innovation systems related to the development and conservation of biodiversity.
2. To investigate and assess selected community innovation systems related to the conservation and use of plant genetic resources.
3. To suggest and, where possible, to support implementation and ways in which the institutional system can better support community innovation systems.

Source: CLADES *et al.*, 1994.

discussed at three meetings of regional partners. Results of these regional meetings were reported to PCC. At the PCC meetings final decisions on the CBDC's principles and components were discussed, negotiated and concluded. These include issues such as programme objectives, protocols, research framework, institutional framework, division of responsibilities and resource allocation. In 1994, the product of this consultation and negotiation process, a proposal for the first implementation phase of the CBDC-Programme, was submitted to its three donors (CLADES *et al.*, 1994). This phase of CBDC started in 1995.

Identification of partners and development of the programme

The PCC formulated the overall objectives at its first meeting in 1993, upon which they were refined to those presented in the proposal (Box 13.1). These objectives were translated by partners at local, national, regional and international programme levels into immediate objectives and research activities for their specific components within the CBDC-Programme. These immediate objectives were elaborated into individual logical frameworks for the various components of the programme.

The programme was organised in three regional programmes (Africa, Latin America and Southeast Asia) and two international thematic programmes (Technical and Policy Programmes). Within the regional programmes, twelve country projects became operational during the first phase. In Africa, country projects were located in Ethiopia, Burkina Faso, Kenya, Sierra Leone and Zimbabwe. The Ethiopia project was closed in 1998 due to organisational and management difficulties. The Latin America Regional programme included Brazil, Colombia, Peru and Chile; the Southeast Asia programme comprised of Malaysia (Sabah), Philippines, Thailand and Vietnam.

During the preparatory phase, regional co-ordinating organisations took major responsibility for the process of national partner identification. In Africa, there was no existing network such as in Southeast Asia and Latin America. CGN, NORAGRIC and IDRC supported PGRC/E (Ethiopia) in the identification of additional partners in Africa. This identification was based on existing formal and informal contacts of founding partners. It was emphasised that partners had to have an interest in and were involved in community biodiversity management.

Two international programmes with a more thematic purpose were formulated. The International Technical Programme (ITP) covered technical and research aspects of community management of agro-biodiversity. ITP was co-ordinated by the A-Team at CGN. The International Policy Programme covered policy and ethical aspects. This programme was co-ordinated by GRAIN and RAFI. Both international programmes were set up to support national partners in the implementation of their projects. The international programmes also aimed to

contribute to the translation of experiences (research, technical and policy) at local, national and regional level to general and global levels.

13.3 Actors: NARS and NGOs

The CBDC group brings together government and non-governmental organisations in one programme. The varied institutional backgrounds of partners is important when analysing the social organisation of CBDC and its effort to contribute to the construction of "on-farm management" as a conservation strategy. The image of the CBDC in the international arena is often associated with the role NGOs play in the programme. CBDC is considered an "international NGO-programme" (see FAO, 1996). This image is explained by the fact that the founding partners include NGOs (with the exception of PGRPC/E, CGN and NORAGRIC) and by the institutional backgrounds of the majority of national partners. Nine projects are co-ordinated by NGOs and three by GOs (Table 13.1). Additionally, within PCC, five of the seven chairs are taken by NGO-representatives and two GO representatives are from northern research and conservation organisations. However, the mixed NGO – GO participation in the programme is actually one of the unique and valuable aspects (Montecinos, 1994; CBDC partners, 1998, Montecinos & Salazar, 2000)

The governmental organisations (GOs) that participate in CBDC include universities, research and conservation organisations. The GO-partners within NARSs and operating within NPGRPs all have an institutional interest in "on-farm management" of agro-biodiversity. Activities of the Ethiopian CBDC-project covered primarily conservation, hence a move towards participatory plant breeding and seed production implied a conceptual step outside its conventional institutional mandate. Breeding and seed supply were the mandate of other, specialised organisations in the Ethiopian NARS. In Vietnam, the project is implemented by a department of the University of Can Tho which is responsible for farming systems research (FSR) and rice breeding in the Mekong Delta. This background is recognisable by activities in the Vietnam Project in the use of FSR methodologies (system approach to analysis, transects). The project has also become involved in breeding and seed production. GOs in CBDC generally operate through links with NGOs or local branches of government extension services at local and grass roots levels.

Non-Governmental Organisations (NGOs) were considered a rather homogeneous group. However, when taking the group of NGOs within CBDC, a broad diversity of organisations is encountered. SEARICE in Southeast Asia and CLADES in Latin America are regional networks. National partners in Brazil and Peru (AS-PTA & CIED) represent national networks. These network NGOs either directly or indirectly work with farmers. They generally implement the project through other local NGOs or farmer organisations. NGO partners in CBDC have an agricultural and rural focus, primarily directed towards promotion of sustainable and ecological agriculture. They are involved in institution building, training, education, research and advocacy. They shared a strong interest in policy issues related to agro-biodiversity management and intellectual property rights (IPR). This interest is reflected in an often prominent role they play in the global, regional and national biodiversity and IPR debates. Most of the NGOs participating in CBDC link advocacy and policy action at global and national levels with local development activities (Montecinos & Salazar, 2000; Daño & Salazar, 2000).

Evaluation of the agenda of activities, elaborated in the proposals and presented at workshops, shows that GO partners of the programme tend to focus their activities more on analysis, whereas NGO partners put more emphasis on grassroots development objectives (CLADES *et al.*, 1994; CBDC, 1998; 1999). Variation has been observed among projects with respect to institutional linkages between NGOs and NARS. Some partner NGOs work very closely with people at national genebanks and research organisations, whereas for others such collaboration seems complex and politically difficult. Most partners in countries where such collaboration is difficult work closely together with individual researchers as technical advisors. In some cases, these advisors function as bridges across existing barriers between NGOs and NARS.

Box 13.2 Hypotheses of the CBDC-Programme

- Local crop development (management and conservation) implies *in situ* survival of genetic variation and may therefore complement the *ex situ* approach to conservation of crop genetic resources. Local crop development and conservation also generate and conserve local knowledge of genetic resources.
- Local crop development and conservation maintain varieties/landraces and secure local seed supply.
- Local crop development and conservation expose crops to natural and artificial selection, which ensures a reasonable adaptation to growing conditions and local needs.
- Local crop innovators are capable of providing high quality seeds with respect to some of the technical criteria of seed quality, but not all.
- In many areas local crop development is limited by lack of genetic diversity. Supply of appropriate genetic materials may enhance local crop development.
- Landraces tend to be location specific; they express a substantial level of phenotype x environment interaction.
- Landraces under specific conditions better satisfy farmers' requirements compared to modern varieties.
- In many cases local crop development is limited by methodological constraints. Scientific knowledge and methods can contribute to enhancement of local crop development.

Source: CLADES *et al.*, 1994

13.4 Original research orientation

CBDC's original idea was to develop a global research programme that would concentrate on community management of agro-biodiversity. It aimed to demonstrate to institutional actors the capacity of farmers and communities to maintain and develop agro-biodiversity. The founding partners expressed a need to increase institutional actors' recognition of the informal crop development system. The partners operationalised this into a need to "assess" community innovation systems, i.e., a description and analysis in scientific terms of farmer and community innovation, management and conservation of agro-biodiversity. This idea constituted the basis for the formulation of the general objectives and hypotheses (Boxes 13.1 & 13.2). The CBDC was proposed as a global effort to link a range of studies and experiments with community agro-biodiversity management in various environments and cultures. Outputs of the studies and experiments would produce more systematic evidence, thereby contributing to a general understanding of community agro-biodiversity management and

Box 13.3 CBDC's original research focus

The programme aims to contribute to a better understanding of methodologies used in crop improvement and maintenance of landraces. It seeks to obtain comparative data and establish:

- Under what conditions and circumstances does local crop improvement provide a comparative advantage over institutional plant breeding?
- What are the comparative advantages of landraces under resource-poor conditions over modern varieties, considering a.o. a relative degree of yield security, ecological and socio-economic sustainability, the relative importance of location specific adaptation, household preferences and cropping systems?

Source: Hardon & de Boef, 1992; pp 11

innovation. A synthesis would generate a body of systematic evidence and knowledge of community innovation systems to prove its value to institutional actors.

The nature and function of the envisaged research in CBDC is reflected in the original proposal for the preparatory phase (Box 13.3). Hardon & de Boef (1992) assumed a direct association between local research as an input to global objectives, analysis and synthesis. The gained understanding of the local system would be summarised and analysed by the CBDC for presentation to actors in the institutional system, which could then be better placed to address farmers' needs. An example of this original research focus co- was the proposed selection of crops and research sites (Box 13.4 and 13.5); they would be identified in such a manner that outputs of country projects could be compared at a global level. The programme would be organised using a matrix structure in which local projects (rows) would cover a set of global research themes (columns), and together contribute to a global synthesis. Data and information would be processed, analysed and synthesised in a joint effort, and consequently provide a systematic information and knowledge base that would answer global research questions. It demonstrated that our perspective (Hardon & De Boef) on the CBDC-Programme was that scientific knowledge available in the institutional sector would benefit and strengthen local systems. This perspective is illustrated by the following quotation from the same proposal:

> "The programme will integrate genetic and technical knowledge into local knowledge systems. Modern agricultural technology generally aims to replace traditional forms of production rather than integrate in and strengthen local knowledge systems. As a result farmers and farmer communities have no choice but either do accept a package of modern technology or reject it in favour of existing traditional systems. The present programme aims to integrate aspects of modern science and technology into traditional systems where such traditional systems have a comparative advantage. This involves training, action research together with farmers and primarily in farmers' fields. It recognises farmers as major partners in technology development" (Hardon & de Boef, 1992: pp. 7).

Box 13.4 CBDC's criteria for crop selection

i. Reproductive/breeding systems: selfing, outbreeding and vegetatively propagated crops;
ii. Type of utilisation: major staple food, minor staple food, minor additional food, non-food (medicinal, green manure, fodder, industrial);
iii. Economic/political relevance: major vs. minor food crops; food crops vs. cash crops;
iv. Variation available in the area (indigenous vs. non-indigenous crops);
v. Level of adaptation of modern varieties to certain environmental factors

Source: Hardon & de Boef, 1992: pp 8

Box 13.5 CBDC's criteria for site selection

"Sites will be selected to represent a variety of climatic conditions, different complexes of biotic and abiotic stress factors, variation in socio-economic factors, and gender related issues. Sites should also cover those where crops originate from, and regions where crops have been introduced and are non-indigenous. Another variable important to the programme should be the level of availability and adoption of modern varieties by resource-poor farmers"

Source: Hardon & de Boef, 1992: pp 8

In discussing the nature of research, divergent perspectives between GO and NGO partners became evident. GO's stressed research to provide information need to "validate" or "assess" community agro-biodiversity management, while NGOs stressed research activities in direct support to community development and empowerment. A final position of the partners is illustrated in the formulation of CBDC's third development objective:

> "To suggest and where possible support implementation and ways in which the institutional system can better support community innovation systems".

This formulation gives a conditional status to the interaction between the local (community) and the institutional system. In the final and agreed programme, partners focused specifically on the community innovation system. The institutional system would be approached when necessary from a local perspective. Consequently, a dichotomy emerged between a global research and a local development orientation. During first years of the CBDC programme it has led to many complex discussions between partners with a "local development perspective" and those with a stronger "global research perspective". In Section 13.7, I further elaborate on this issue in a reflection on the international technical programme.

13.5 Social organisation of the programme

Protocol

Through their experiences, partners share an awareness of issues related to access to, ownership of, control over and transfer of germplasm, associated knowledge and information. These issues are contentious and the development of collaboration among organisations requires a process of interaction to find a common ground and allow development of a joint agenda. The CBDC as a global programme had to establish working relationships among organisations with a shared view pursuing recognition for and support to the local system, but with divergent perspectives on many issues. The partners operate in various countries and at several levels, and in unlike institutional and political contexts. CBDC partners developed a protocol as a guide for their collaboration. It is an evolutionary document regularly reviewed and revised. It is an operational agreement among partners. Box 13.6 presents the rationale to use such a document. An important element of the protocol relates to "institutional integrity". This element outlines the function of the protocol, the role and function of partners, modes of decision-making, ways to settle disputes, procedures for the termination of partnership, guiding procedures for settling conflicts among levels, and financial management structures. The part on "intellectual integrity" intends to assure that rights and responsibilities that relate to germplasm, information, funds, technologies, methodologies and systems are respected.

Box 13.6 CBDC-Protocol; introduction

"This Protocol assumes that Partners have mutual trust, confidence and are willing to co-operate and that a highly-legalistic document is not necessary. It also recognises that other Partners at regional, national and community levels may not know all of their colleagues and therefore, basic working relations should be spelled out adequately. In addition, the Protocol acknowledges that there is an imbalance in the ability of Partners to access germplasm, information and financial resources. The occasional and sometimes long-standing tension between the community and institutional system, and a history of mutual misunderstanding should be taken into account. For these reasons, the Protocol will operate on the assumption that decisions are taken "bottom-up" (from the community to the global level), and that authority will be set, as far as possible, at the community level". Source: CLADES *et al.*, 1994: 13

Particularly partners at global and regional levels participated in the protocol's formulation and negotiation. This process has facilitated the development of a clearly shared position of partners towards surrounding international and national policy environments. No methods or specific instruments for accommodation, negotiation and programme development were used in its formulation; the process can be described as interactive, with decisions taken at global level (PCC), but with frequent consultations of partners at regional, national and local levels. Primary responsibility for structure and organisation of CBDC as is described in the protocol rests with the founding partners.

Global, regional and national co-ordination

The CBDC has been co-ordinated at the global level by CET in Chile. The Programme Co-ordination Committee (PCC) governs the programme. The three regional co-ordinators are members. Four "Northern" partners (RAFI, GRAIN, CPRO-DLO & NORAGRIC) are also represented in the PCC. The composition of the PCC represented CBDC's founding partners. In 1998, three regional programmes were co-ordinated by CTDC (Africa), CET (Latin America) and SEARICE (Southeast Asia). A regional co-ordination committee, in which national partners and technical advisors were represented, governed the regional programmes. At the national level, one organisation was given the responsibility for co-ordinating and implementing (sometimes in co-operation with other organisations) the CBDC project.

Donors

DGIS (the Netherlands), IDRC (Canada) and SIDA (Sweden) funded the first implementation phase. The donor organisations have a contract with CET in its capacity of Global Co-ordination Unit of the CBDC-Programme. CET is also responsible for the technical and financial reports. CBDC funds are channelled to partners through this unit. The three donors can be considered part of the network constituting CBDC. These donors are considered progressive in the international development scene. They have actively participated in the preparation, but also in the implementation and continuation of the programme. This involvement shows their strong commitment to this NGO-NARS initiative.

A diversity of projects and activities

An interactive and decentralised process of programme development resulted in a "CBDC-basket" consisting of dissimilar and often unique local projects. The CBDC-Programme is

based on a joint perspective as a starting point for a decentralised process of project development. The CBDC united a group of actors with a diversity of institutional backgrounds (NGOs, NARS, universities and genebanks) and countries (16 countries on five continents). All partners provide in one way or another support to local management and conservation of agro-biodiversity.

Table 13.1 illustrates the diversity of projects in CBDC. The table shows that the majority of projects primarily work with genetic diversity of major staple crops. Examples include Brazil with maize and beans, Peru with potatoes, Sierra Leone with rice, Zimbabwe with sorghum, millets and cowpea and projects in Asia with rice, root and tuber crops. The project in Kenya with its emphasis on indigenous vegetables addresses the species level of biodiversity. Projects in Chile and Colombia concentrate more on the systems level of biodiversity; they cover both natural (indigenous forests) and agricultural biodiversity.

Most projects have to some extent been involved in activities that relate to conservation, plant breeding, variety selection and seed supply. In addition to research on crop development activities, they were involved in activities to raise local awareness of issues related to agro- biodiversity. An example is the Colombia project that worked closely together with schools in raising awareness of biodiversity issues at household level. Diversity fairs were used by projects in Peru, Brazil, Zimbabwe and Asia to raise awareness among farmers and communities about diversity maintenance. Diversity fairs were used as a diagnostic tool to survey and monitor diversity within and between species. In Asia, the projects used farmer field school methods to enhance farmers' capacity in conservation of local varieties, breeding, varietal selection and seed production as elements of integrated crop management. Policy activities of individual projects aimed to create rural people's awareness of critical issues, such as intellectual property rights, access, control and transfer of germplasm, related knowledge and information. Practical local experiences gained in CBDC-projects was used for the purpose of awareness raising and advocacy at national and international levels (CBDC, 1999).

Distinct phases of research could be distinguished. In the initial years, partners implemented diversity surveys. Farmers' practices in management of diversity, including aspects of use of local and improved varieties, seed supply, storage and processing and indigenous knowledge of varieties were studied. These surveys were followed by local conservation activities (seed banks), varietal selection experiments, support to and strengthening farmers' capacity in seed production. Individual projects show considerable variation in focus and approaches used (CBDC 1998; 1999). Differences and variation in approaches have limited opportunities for comparison and synthesis of data and experiences. Initial emphasis on assessment and synthesis has been modified to identify a range of ways to support farmers' and communities' agro-biodiversity management. Being organised in a decentralised and interactive manner, CBDC did not seem to be the appropriate entity to systematically gather local information for a global comparative assessment of "on-farm management".

13.6 Protocol: organisation of flows

CBDC partners clearly express their position with respect to access to, control over, ownership of and exchange of germplasm, knowledge and information (Montecinos & Salazar, 2000; CBDC, 2000b). The position can be considered a reaction to a changing global agro-biodiversity policy environment, and relates to debates on these issues in various inter-

Table 13.1 Characterisation of the CBDC national projects (status 1998)

Country	Agro-ecology	Crops	Level of diversity	Type partner	Strength & focus
Burkina Faso	arid and semi-arid	sorghum, millets, vegetables	crop genetic	NARS	farmer management of local varieties
Kenya	tropical low and highland	indigenous vegetables	crop species	NGO	integrated approach to utilisation and support to indigenous vegetable marketing
Sierra Leone	tropical lowland	rice, sorghum	crop genetic	NARS	farmers' strategies to manage and conserve varieties in periods of war; plant breeding strategies
Zimbabwe	semi arid	sorghum, millets, vegetables	crop genetic	NGO	focus on local seed supply and organisation of diversity fairs
Brazil (Paraná)	subtropical lowland	maize and beans	crop genetic	NGO	focus on farmers' empowerment regarding access to and management of local varieties
Chile (Temuco)	semi-temperate lowland	beans, wild species	species & system	NGO	focus on Mapuche management and utilisation of biodiversity
Colombia (Valle del Cauca)	tropical highland	wild species	species & system	NGO	linking with school in diversity management
Peru (national)	mountain	potatoes	crop genetic	NGO	network of small conservation projects
Philippines (Bohol)	tropical lowland	rice, root & tuber crops	crop genetic	NGO	diversity surveys, strengthening local seed supply; PVS, farmers training in agro-biodiversity management
Malaysia (Sabah)	tropical lowland	rice, root & tuber crops	crop genetic	NGO	diversity surveys, link to indigenous peoples' management of biodiversity
Thailand (Nan Province)	tropical lowland	rice, vegetables	crop genetic	NGO	farmers' training in agro-biodiversity management
Vietnam (Mekong Delta)	tropical lowland	rice, root & tuber crops	crop genetic	University	FSR approach to supporting agro-biodiversity management, link with formal breeding and seed programmes

Sources: CBDC, 1999, 2000a; 2000b; Jusu, 1999; Catalán & Pérez, 2000; Montecinos & Salazar, 2000, Sánches & Pompeyo, 2000.

governmental and national fora. The CBDC protocol can be considered an experimental instrument of partners to respond to and distinguish them from the surrounding agro-biodiversity policy environment. For the purpose of collaboration, partners have developed alternative mechanisms for the organisation of germplasm, knowledge and information flows. An experimental regulatory framework for collaboration between farmers, local NGOs,

national conservation and research organisations has been developed for the implementation of "on-farm management". This output of the programme may also be an input to the development of mechanisms to implement farmers' rights. I particularly reflect on PCC's discussions during the development of the protocol.

Organising flows of germplasm

The CBDC-partners have organised the germplasm flow within the programme, following the subsequent statement:

> "Plant genetic material (and information) is the right and responsibility of the community that has developed and nurtured it" (CLADES *et al.*, 1994).

Partners thus acknowledge farmer and community rights over germplasm and associated information. CBDC takes up the position that transfer of germplasm from communities cannot be undertaken without the "source community's prior informed consent"; the elaborated mechanism grants "source communities" the right to control germplasm flows. The protocol (CLADES *et al.*, 1994) states that:

> "Any partner who has been granted the right to have or distribute material from a community, will provide a report to the source community on any change of the status of the germplasm involved at any time".
>
> "No partner has the obligation to transfer germplasm from a source community at the request of a third party".
>
> "Source communities should be clearly identified for germplasm and information"

The protocol takes up a strong position with respect to the location to store genetic materials originating from the "source community". Box 13.7 presents some articles of the protocol that refer to these "source communities". This position has resulted in some NGOs and communities to become involved in *ex situ* conservation. The main reason for setting up such local genebanks has been to increase community autonomy in agro-biodiversity management. Various authors indicate that such an option is not as cost effective as storing germplasm in central genebanks (Lenné & Wood, 1999; Maxted *et al.*, 1997c). The question emerges how a "community genebank" could remain operational. In some projects, therefore linkages with "formal" genebanks have been explored.

SEARICE discussed with representatives of the organisation responsible for rice research and germplasm conservation in the Philippines (PhilRice) the storage of community germplasm in its facilities under a "black box arrangement". Such an arrangement entails that while the material is stored in the facility, documentation on the collection and even the key to the "box" remains with the "source community". SEARICE and PhilRice have elaborated this arrangement, and materials of various communities are now stored in "black boxes" in the PhilRice genebank (Bertuso *et al.*, 2000). SEARICE acts as an intermediary between the source communities and the genebank. A subsequent step with respect to this type of interaction would be for communities to store their material directly under "black box" arrangements in national genebanks. Consequently genebanks would open some kind of deposit department for communities to store specific materials. The genebank as a public entity would thus start to provide another "banking" function; i.e., services to actors in the civil domain. This service would be an addition to their current services provided for actors, who operate in the private and public domains of agro-biodiversity management.

Box 13.7 CBDC-Protocol: source communities, conservation and access

i. "The partners agree to the principle that plant genetic material should be stored within the source community or as close to the community as is technically and economically possible. If appropriate storage facilities are not available, Partners will work to the best of their capacities and possibilities to make them available".

ii. "Therefore, unless otherwise determined by the source community, genetic material will be held at the community level. If appropriate storage arrangements are not available, the community may request support to obtain proper facilities. Partners will respond to such a request to the best of their ability, providing that the request is technically sound and financially feasible".

iii. "Communities or national Partners, or others at their request, have the right to obtain genetic material that originates at their respective level, from national, regional, and international institutions and agencies. This material must be provided promptly and without expense to the community or national Partner. It is understood that a requirement to repatriate germplasm should not endanger the survival of the material involved. All Partners, at all levels, will be prepared to assist in ensuring that the genetic materials are made available".

Source: CLADES *et al.*, 1994: pg. 14.

Another issue emerging from the relationship between genebanks and communities concerns access to materials stored in genebanks. The protocol draws specific attention to repatriation of germplasm to source communities (Box 13.7; #iii). With this article in the protocol, CBDC partners responded to the limited access of communities and farmers to genebank germplasm collections. The policy of genebanks to provide samples for "bona fide" users was considered unclear, particularly with respect to the status of farmers in this context. Do farmers have direct access to material stored in genebanks? Are they considered "bona fide" users in the context of the guiding document for genebanks, such as the FAO International Undertaking of Plant Genetic Resources? However, it should be realised that genebanks can only provide small samples of accessions to clients. In practical terms, these samples are sufficient to cater for the needs of genebanks' current clients, plant breeders and researchers. CBDC in its protocol emphasises that farmers should be considered and treated as clients of these genebanks. In the context of the programme, the Biodiversity Institute in Ethiopia has repatriated germplasm to the original communities, and the Can Tho University in Vietnam has supported farmer conservation efforts. NGO partners have assumed a facilitating role in overcoming farmers' limited access to germplasm in NPGRP genebanks.

Another important discussion relates to the question whether community seed banks should be considered genebanks. Divergent views emerged during one of the CBDC workshops. An initial conclusion referred to the socio-cultural aspects whether communities have a tradition or not to share a seed storage facility. This point shows that local communities show divergent perspectives on the issue of local gene or seed bank establishment.

With respect to the relationship between "source communities" and genebanks, the protocol even goes one step further; it actually reverses the relationship. The protocol does not state that farmers or communities "own" their germplasm; it indicates that farmers have a right to control access to "their" germplasm, not because the partners perceived control rightful, but because they did not and still do not find another mechanism to counteract IPR trends in the private sector.

The protocol grants exclusive rights to "source communities" to control access to collected materials. It places genebanks more in a function of stewards than actual owners. In the spirit of this argument, at one of the PCC meetings the idea was put forward to establish a "people's genebank". The rationale behind this idea is based on people's rights to agro-biodiversity. In such a "people's genebank" a farmer community, as a civil entity, would be given the exclusive right to exercise access to and control over "their" materials. "People's genebanks" would be an alternative to the current "government genebanks". They could also be seen as an "institutionalisation" of the CBDC protocol. The idea illustrates the divergent interests of actors who operate in the public and civil domains of agro-biodiversity management.

Discussion on the status of partner genebank collections

Some CBDC-partners have a national mandate for germplasm conservation. During the development of the protocol, representatives of these national conservation organisations and NGOs expressed conflicting perspectives on the access of corporate companies to material maintained in genebank collections. NGO representatives advocated restricting access for those corporate companies that aim at "monopolistic control over and exploitation of plant genetic resources". Box 13.8 presents a modification in the formulation used in the protocol. The change was necessary to allow participation of these national conservation organisations. The NGO-representatives were strongly advocating an "anti-monopolistic and anti-corporate" position. The first version of the protocol (Box 13.8) illustrates this. Jaap Hardon as director of CGN, and thus responsible for the Dutch germplasm collections could not make a commitment to such articles. Limitation of access to any user, whether corporate or not, could not be accepted by CGN and the other national conservation organisations. This formulation would undermine the position of national genebanks as public and governmental organisations. CGN's major clients are breeding companies and research agencies which indeed through plant breeders rights and intellectual property rights benefit financially from using CGN germplasm (Chapter 9). CGN operates in accordance with the FAO International Undertaking of Plant Genetic Resources and thus provides access to all "bona fide" users. A consensus has been reached when the article was reformulated and referred only to "materials and information related to and derived from the CBDC-Programme" (Box 13.8). It can be concluded from this discussion that the CBDC positioned itself as a programme with a strong civil orientation in the organisation of the germplasm flows. The discussion described above illustrates a barrier in co-operation between public oriented government and more civil oriented NGOs.

Box 13.8 CBDC Protocol: changes in articles referring to access to germplasm collections by private industry.

Addis version:

"The Partners should have clear germplasm exchange policies against monopolistic control and exploitation of germplasm resources."

"The Partners should not promote and/or encourage plant genetic resources flow to corporate companies."

Source: CPRO-DLO *et al.*, 1993a

Buga and Barcelona versions:

"The Partners confirm that they will not apply for or permit third parties to patent or monopolise any of the materials and information related to or derived from the Programme."

Source: CPRO-DLO *et al.*, 1993b

Flows of knowledge and information

The CBDC protocol indicates that knowledge and information are integral part of plant genetic resources. The protocol provides a number of articles that refer to provision of information on germplasm to "source communities". However, emphasis on farmer or community control over germplasm and related information, and a concern for the possibility of expropriation for commercial interests have emerged as arguments to regulate and limit information exchange. The major argument for this was to prevent "outside" researchers from coming and extracting information from local people and subsequently publish it as "their" findings. Another argument was to avoid situations where "outsider" scientists extract information from field workers involved in rural development processes and local research and subsequently publish it under their own name.

CBDC: an alternative organisation of flows

CBDC aims to strengthen farmer and community management of agro-biodiversity. These farmers and communities emerge as major actors in the implementation of *in situ* conservation strategies. The public research and conservation systems with the emerging mechanisms for intellectual property protection and their increasing market orientation need to be balanced with civil dimensions of farmer agro-biodiversity management. Because of these IPR trends, partners in CBDC had to establish a protocol to protect the interests of the participating communities as reaction to a changing legal agro-biodiversity environment. CBDC had to set up mechanisms to control access to germplasm within communities, even though it realised that local seed and variety networks extend beyond what may be defined as a community. Considering such an organisation of flows, CBDC recognises that the international foundation for the conservation and utilisation of plant genetic resources developed under the FAO International Undertaking of Plant Genetic Resources is no longer valid. Plant genetic resources are not considered "a heritage of mankind (...) freely available for use, for the benefit of present and future generations" (FAO, 1986). The current political and economic environment calls for a revision of the organisation of flows. CBDC emphasises local arrangements that safeguard community interests. CBDC is one of the first programmes that organises flows of germplasm, knowledge and information among actors that operate at various levels in the interface between the public and the civil domains in agro-biodiversity management. A question remains whether or not mechanisms developed in CBDC will protect communities against those entities operating in the "private domain". Partners realised that the protective mechanisms developed by CBDC are in fact in conflict with local seed and variety networks, which traditionally operate on the basis of free exchange (Catalán & Péres, 2000; Sánches & Pompeyo, 2000).

It can be concluded from CBDC's more civil oriented (community) approach towards agro-biodiversity conservation that public conservation organisations in their social organisation of the *in situ* conservation strategies should include elements of CBDC's organisation of flows. Within the Convention on Biological Diversity and the FAO Global Plan of Action (FAO, 1996) such a framework has been elaborated as "farmers' rights". Individual projects within CBDC may be regarded as a range of experiments in which *in situ* conservation and also efforts for a more civil organisation of local agro-biodiversity management have been developed. However, the question remains whether or not these mechanisms can be elaborated beyond the scope of the individual projects and have general application.

13.7 ITP workshops: linking global and local research objectives

Background

During the elaboration of the programme, the primary activity of the CGN in CBDC in the context of the International Technical Programme (ITP) concerned the organisation of a series of four workshops during the first four-year phase. The A-team members (see Preface) co-ordinated ITP and organised these workshops. Technical people working with communities on a day-to-day basis were the key participants, as they form CBDC's operational research cadre. The A-team had learnt during an inventory among the projects that the technical staff to a limited extent had been exposed to global dimensions of agro-biodiversity management. The A-team members drew a conclusion that local research staff had limited access to relevant knowledge and information to implement research in a creative manner. The staff was considered to be limited in their capacity to employ participatory and scientifically sound research. The A-team proposed a series of four global workshops, in which it aimed to fill this gap between global research objectives on the one hand and local practice on the other. It envisaged that during these workshops collaborative research activities and research methodologies could be developed. These collaborative efforts could then contribute to a synthesis of results envisaged in CBDC's preparatory phase. With this series of workshops local CBDC-researchers would meet each other regularly, so that a collegial relationship could develop. The researchers would have an opportunity to observe the development and progress in each other's projects. Through these workshops, the A-team aimed to contribute to the establishment of CBDC as a global platform of local projects, and thus constitute a basis for exchange of experiences and learning together.

Two workshops

The A-team organised two of the four ITP workshops during the first implementation phase. The first was hosted by CGN and organised in Baarlo (the Netherlands) in 1996, the second in Brazil in 1997 was organised with and hosted by AS-PTA in Paraná and EMBRAPA in Rio de Janeiro. The two workshops were organised in a manner that they would stimulate interactions between projects; in fact CBDC researchers acted as major resource persons for each other. The discussions covered the following five areas: (i) function of agro-biodiversity in agriculture; (ii) conservation strategies with an emphasis on *in situ* conservation and "on-farm management" of agro-biodiversity; (iii) participatory plant breeding and varietal selection; (iv) local seed supply system; and (v) methods for research design, planning and analysis. Participants shared their experiences and perspectives. The workshops were lively, but also complex events, because it remained difficult to find a balance between local and global objectives of the CBDC-Programme, i.e., the balance between development and research discussed in Section 13.4.

Emphasis of the A-team on a synthesis in the organisation and planning of the workshops was perceived by many participants as limiting factor in their local development and grassroots orientation towards their practical work and research. The A-team, but also a group of participants, was hampered in its capacity to elaborate the workshop programme to one that would accommodate the diversity of local activities and interests of the various participants. It was also difficult to focus on more general and global research issues that had been a foundation to the CBDC.

During the mid-term review meeting of the first phase following the second ITP-workshop, PCC decided to cancel the two remaining workshops. A major argument for this decision was that the two previous workshops had failed to cater the need of local projects and CBDC-researchers involved. The global objective to contribute to a general body of knowledge of community management of agro-biodiversity through a systematic gathering of information and subsequent synthesis or comparison of local results was considered to undermine the development and research orientation of national projects. The major part of the ITP budget (originally budgeted for the workshops) was returned to CBDC's Global Co-ordination Unit and utilised to bridge the two phases, and formulate the second phase of the programme.

Barriers linking global and local research objectives within the context of ITP

The fact that the workshops have not come up to the expectations of partners and organising team illustrates that bringing partners together in a meeting could not bridge barriers between local and global objectives. It is clear that the A-team itself contributed directly or indirectly to some of the barriers encountered. A range of barriers has been identified.

a) Most partner organisations in CBDC are NGOs rather than research organisations. Their activities are primarily directed at development, action and advocacy, and only to a limited extent involved at research. This focus had direct implications for the professional attitude and perspective on research of many people working in CBDC projects. Research bringing together some scientists, activists and development workers can be characterised as interactive research (Bunders *et al.*, 1991). However, this type of research concentrates on local and development issues and to a much lesser extent on general issues of a general and global dimension.

b) Local and national partners in CBDC have expressed only a limited ownership over global research objectives. The need for globally co-ordinated research objectives and activities may have been clear to some of the founding partners and the A-Team. However, at the practical level at which most activities of their projects are undertaken, these objectives may appear hypothetical and abstract. These divergent perspectives had already become apparent in the formulation phase (Section 13.4). I realise that only time and regular exposure of CBDC partners to both local and global dimensions could bridge this barrier. CBDC as a global platform needed to be further developed at local and national levels before more global and general research questions could be addressed and local activities could be linked on a path to global synthesis (i.e., using a decentralised bottom-up process). Development of national projects has resulted in the above-described "basket" of individual projects. The process of decentralised project development has been undertaken with limited cross-regional, thematic and global co-ordination. Any effort to stimulate use of common methods and standards in research was perceived to be in conflict with the programme's "bottom-up" organisation. Most partners have started their projects with surveys covering genetic diversity and farmer management. This appeared in line with the global objective to collect data on these issues. These surveys were primarily conducted in service of action research, rather than for compilation and comparison of farmer management of genetic diversity in various settings. As a consequence opportunities for comparative analysis among projects were limited.

c) In the first plan for CBDC, an assessment of local knowledge and capacity of the informal crop development system was emphasised. With such an assessment (or in the original terms "validation") the partners indicated that scientific and technical value could be attached to

farmer's agro-biodiversity management. However, for such assessments partners needed to jointly develop "alternative" or unconventional research methodologies.

d) In the international research agenda of the mid-1990s, the issue of assessment or validation of local knowledge was translated or transformed into an interest in participatory research. In the approaches local knowledge was advanced or assessed in its own merits without attempting to validate it in a scientific context. This shift also modified the programme's focus with direct implications for its global research objectives. The A-team as responsible for the co-ordination of the ITP, maintained its interest in the assessment of farmer management of agro-biodiversity and global synthesis. Many of the individual projects in fact adopted the described trend of participatory and development-oriented research.

e) Collaboration in research between local organisations from five different continents proved not an easy task to accomplish. Intercultural, but also social barriers exist among African, Asian, European, North and Latin American researchers. Languages and distinct attitudes in discussions are often ignored in the international scientific and agricultural research arena, but when bringing together local researchers for conceptual discussions such as in CBDC, they can not be ignored. In the context of ITP, the A-Team had underestimated these differences in the design of the workshop programmes. Another and crucial barrier relates to the North-South origin of partners. Some of the technical partners from the North expressed global research objectives, whereas most partners from the South expressed a more local and development interest. Proximity of and working relations with donors may also have played a role in the development of these barriers.

13.8 Social construction of *in situ* conservation

In this section, I reflect on CBDC-projects' individual efforts to construct *in situ* conservation of agro-biodiversity. This reflection is based on discussions of *in situ* conservation held during the two ITP-workshops, in which participants tried to combine a diversity of approaches in one overall framework. Individual activities that were considered to contribute to *in situ* conservation were inventorised, compared and discussed. In this manner, participants jointly discussed the strategy's social construction. I analyse the divergent perspectives that existed among CBDC partners (CBDC, 1998; 1999).

Definition and boundaries: shift towards a constructivist perspective

The term "*in situ* conservation" is used in CBDC to accommodate a variety of perspectives and activities. The ITP-team aimed at actual activities to avoid talking about *in situ* conservation mainly in abstract terms. During the first workshop in The Netherlands, the group learnt that partners use the term in different ways. To explore some commonalties, partners in the three regional programmes each tried to elaborate common frameworks for *in situ* conservation. An overview of CBDC-Africa illustrated that one project maintained a strict conservation perspective on the strategy, whereas other projects approached the strategy more in a development oriented approach with links to local seed supply and promotion of species diversity utilisation. In Southeast Asia, the projects translated *in situ* conservation into supporting farmers' access to and utilisation of a diversity of local varieties. Projects in Latin America approached *in situ* conservation initially more as a biodiversity conservation activity and emphasised biodiversity conservation and utilisation within farmers' livelihood systems.

During the presentation of the regional overviews it became clear that no single perspective on *in situ* conservation existed; perspectives and related activities varied too much among regions, individual countries and workshop participants to achieve a common approach (CBDC, 1999).

At the Brazil workshop, the group upheld the outcome of the previous *in situ* discussion. The group agreed not to aim for a single CBDC definition of *in situ* conservation. Participants have chosen this direction as the projects addressed various levels of biodiversity (genetic, species and ecosystem diversity), use different approaches and work in various sectors of agriculture and development. Rather than a positivist approach aiming for one definition for *in situ* conservation, the group pursued a constructivist approach that accommodates divergent perspectives and working definitions (CBDC, 1998). Boundaries and definitions used for *in situ* conservation in the discussions described above were depended on partners' mandates, interests and objectives. In fact, the group took another step, and decided to approach *in situ* conservation in an actor-oriented manner. The group decided to refer to "conservation by farmers", instead of "on-farm" or "*in situ*" conservation.

Farmer and conservationist control

During the first workshop, a distinction between actors directing and managing agrobiodiversity in *in situ* conservation was an important topic of discussion. The discussion focused on the following question: "Who is in control of the process of conservation: farmers or conservationists?" This discussion may be illustrated by two examples of *in situ* conservation activities in the CBDC-Programme (Box 13.9). In the Ethiopian case, the genebank conservationists control cultivation of accessions. The implication for such control was that the social component of local crop development is frozen. The only modification from conventional *ex situ* conservation (in a genebank) is that the material is regenerated in the area

Box 13.9 On-farm conservation: conservationist and farmer managed approaches

The Biodiversity Institute in Ethiopia was involved in on-farm multiplication of accessions of landraces. Sites for such activities were identified and farmers were contracted to multiply and cultivate accessions of the genebank. Conservation officers of the Institute gave instructions to farmers on the cultivation of landraces. In this manner, these landraces were multiplied in the original farming system from which they had been collected. These farmers were providing land and labour; they further did not influence the conservation activity. A contractual arrangement existed between conservationists and farmers. This practice appears an extension of *ex situ* conservation; regeneration was implemented on-farm in a fashion controlled by conservationists. Cultivation of accessions was not incorporated in the local crop development process, as decisions on management, selection and utilisation are made by conservationists, not by farmers (Worede *et al.*, 1999; Demissie, 1999).

A variation of *in situ* conservation Ethiopia was implemented in some of the CBDC-projects in Southeast Asia. CBDC projects were involved in establishing farmer conservation groups. Farmers were trained and supported to conserve landraces; they became farmer curators associated to one project. The varieties were withdrawn from the original crop development processes. In fact, this practice became a type of *ex situ* conservation on-farm. The major issue is that farmers or communities themselves assume responsibilities for ex *situ* conservation. These projects subsequently started to use a more dynamic approach, where farmers were supported in variety maintenance and selection (Bertuso *et al.*, 2000). The difference with the activity in Ethiopia was that farmers or the community managed the conservation of landraces.

where it has originally been collected. Farmers continue to cultivate the material in some form of contractual arrangement with conservationists. As long as conservationists subsidise landrace cultivation or compensate farmers involved for differences in yield or economic gain, landrace conservation may be secured. In an institutional context such on-farm conservation practices are generally considered unsustainable (Almekinders & Demissie, 1999). The other example from CBDC Southeast Asia covers another approach. Farmers were directly in charge of conservation activities (Box 13.9). The landraces are conserved using genebank-like protocols. This type of on-farm conservation was based on the perspective to conserve landraces within the "source community" and to protect these landraces through farmer agro-biodiversity management from the wider political and institutional environment.

During the second workshop's discussions on *in situ* conservation the position with respect to this issue of control over and management of *in situ* and on-farm conservation was refined. It was concluded that:

> "*In situ* conservation takes place in community innovation systems, this means that other sectors can only support, not integrate" (CBDC, 1998).

Participants in the discussion group, even those working in NGOs, considered themselves components of the institutional crop development systems. An important implication for this position was that crop development organisations can only support community innovation systems by contributing to *in situ* conservation and utilisation. This position confirms the statement that *in situ* conservation can be considered an umbrella under which a range of activities is undertaken that aim to strengthen local crop development and enhance farmers' utilisation of agro-biodiversity. The group concluded that conservation could only be considered as a spin-off of such activities (CBDC, 1998).

Target locations and crops

Participants in the discussion during the first workshop disagreed with respect to the question of whether or not *in situ* conservation should target only crops in their respective "Centres of Origin". Two distinct perspectives emerged; they are presented in Box 13.10. One group of participants held the view that *in situ* conservation should only target crop genetic diversity in locations in which they have been domesticated or developed as a crop. *In situ* conservation in these areas allows continued exchange of genes between the wild and crop species, thus focusing on the continued crop evolution. Participants who are more involved in development activities and plant breeding presented another view. To explain their view, I use the example of maize in Brazil and Ethiopia. This crop is important in both countries and has a relatively long history of cultivation. Even though the maize's Centre of Origin is located in Mexico and Central America, a remarkable diversity is found in both countries. Farmers and plant breeders appreciate this diversity. Following the first view, *in situ* conservation activities should not address maize in Brazil and Ethiopia. However, landraces of maize with specific traits have developed in both countries. The second group thus focused on both natural and human factors that contribute to this diversity in their approach to *in situ* conservation.

The two perspectives were based on different interpretations of the following part of CBD's definition of *in situ* conservation:

> "(...) in the case of domesticated or cultivated species, in surroundings where they have developed their distinctive properties."

Box 13.10 ***In situ*** **conservation only in "centres of origin"?**

A recurrent issue in the debate on conservation strategies is whether or not *in situ* conservation of genetic resources as a conservation strategy can only be applied to crop genetic diversity in their "Centres of Origin", or also beyond. A difference in perspective is illustrated comparing the views of two participants during the first ITP-workshop.

The first presented *in situ* conservation as conservation strategy that can only be applied in those areas where crops originate. The participant followed a strict interpretation of *in situ* conservation defined in the CBD. He had a conservationist perspective on crop development and the strategy. His view postulates that *in situ* conservation activities should only be undertaken in areas considered "Centres of Origin". Therefore, *in situ* conservation activities in Ethiopia or Zimbabwe should only address such crops as sorghum, which originated in these countries. Maize diversity encountered in countries such as Ethiopia, Zimbabwe, Brazil or the Philippines should not be addressed.

Another participant put forward an argument based on his experience with maize landraces in Brazil. He reasoned that *in situ* conservation activities could very well address crops in regions where they do not originate, but where distinct traits have developed. He articulated an additional argument to maintain a diversity of genepools as developed in their respective agro-ecological environments. His interpretation of the CBD definition was much broader. He maintained a more dynamic perspective on *in situ* conservation, considering a dynamic process in which crop development plays an integral role. This perspective is shared by most development organisations. He broadened the perspective to genetic diversity and approached crop development and the strategy in a more integrated manner, thereby approaching *in situ* conservation in a less location specific context (CBDC, 1999).

These interpretations have resulted in divergent views on the location of conservation activities. The second position takes a much broader perspective on *in situ* conservation; it targets at social as well as natural factors of crop development. These factors constitute the "surroundings" as mentioned in CBD's definition.

The link with participatory varietal selection and supporting local seed supply

Variation was also observed among CBDC-projects regarding the linkage of plant breeding and varietal selection with *in situ* conservation. Did partners collect materials in the communities to be stored in genebanks? Did they disseminate new materials? During the first workshop, the Southeast Asian group indicated that it considered activities linked with plant breeding and varietal selection evident parts of its *in situ* conservation work. The African group in its overview of *in situ* conservation activities included a cluster on germplasm enhancement. A more dynamic perspective on conservation *in situ* appeared, collecting materials for *ex situ* conservation and at the same time disseminating materials to farmers increasing their access to agro-biodiversity. Participants from the Latin American programme during the first workshop maintained a stricter division of conservation, breeding and seed supply when they compiled their overview of activities they intended to contribute to *in situ* conservation. At the second workshop, the group of participants confirmed the link between participatory varietal selection (PVS) and *in situ* conservation. It was emphasised that PVS and the introduction of other materials could increase farmers' access to agro-biodiversity and thus contribute to the process of local crop development and *in situ* conservation. Participatory approaches to plant breeding were considered to create a learning environment that improves farmers' skills in selection of varieties and breeding. The group reached the conclu-

sion that conservation and breeding can not be separated from a process-oriented approach to *in situ* conservation. The group stressed that the fact that genetic erosion and variety displacement are common elements of local crop development.

Activities related to seed supply are part of CBDC projects in all three regions. During the workshops, the establishment of community seed banks, seed technology, maintenance breeding, harvesting and seed processing, but also seed exchange were considered components of *in situ* conservation. These activities are based on the assumption that if farmers' seed management is strengthened, conservation *in situ* of the landraces is supported. Where participatory varietal selection and plant breeding may target specific farmer groups or individual "farmer breeders", seed production and seed supply are issues relevant to all farmers.

Diversity surveys and the role of monitoring

All national partners within CBDC started their projects with surveys to address genetic diversity, farmer agro-biodiversity management and related local knowledge, and to assess genetic erosion and loss of biodiversity in particular. Most projects adopted a holistic approach to their surveys; they did not only focus on the genetic aspects of agro-biodiversity, but also addressed the social components. These surveys may be considered a starting point for monitoring in a time series agro-ecological and social processes that have an impact on genetic diversity and farmer management. The surveys' outputs can subsequently be used for assessment of the impact of interventions. Participants stressed the complementarity of the relationship between *in situ* and *ex situ* conservation. The gradual development of linkages between local and grassroots activities and conservation organisations was considered crucial to the implementation of *in situ* conservation. The group came to the conclusion that support to agro-biodiversity utilisation (PVS) will also result in displacement of local varieties and thus contribute to genetic erosion. Therefore monitoring the dynamics of the system was identified as crucial element of an integrated conservation approach. Taking into account that activities within CBDC had just started when both workshops were held, the proposed approach to use monitoring as a binding element between *in situ* and *ex situ* conservation could not be reviewed yet.

Linkages among various institutional actors and farmers

Linkages between actors seemed to have become a recurrent theme in the *in situ* conservation discussions. In activities, CBDC-partners encountered problems related to limited access to (scientific) knowledge and germplasm. Most projects implemented by NGOs have technical advisors working in NARS or universities. These advisors assist in overcoming such these problems and serve as bridges between projects grassroots and development activities and formal crop development organisations.

The group discussing *in situ* conservation during the second workshop specifically addressed the linkage between farmers and institutional actors. In the discussion it was questioned whether or not conservation and research organisations are in a position to work directly with farmers and communities. It was suggested that in most cases these organisations tend to work through intermediary organisations such as government extension agencies and NGOs. The group indicated that it was necessary to develop such stepwise linkages between conservation, research, development organisations and farmers (CBDC, 1998). Section 13.3 indicates that in most countries where CBDC projects are implement institutional boundaries

complicate such collaboration. Involvement of researchers and other professionals working in formal organisations in CBDC's learning environment was considered to contribute to changing institutional systems. This was illustrated by the "bridging" role of most technical advisors, researchers and breeders play in supporting on a personal basis individual NGOs projects. At the same time, these advisors can contribute to institutional change within their own organisations based on their personal CBDC experiences.

CBDC and the construction of a conservation strategy

During the initial years, CBDC held the view that the central players in *in situ* conservation were farmers, other actors could only support or strengthen farmers in the process of local crop development. During the discussion of *in situ* conservation in the second workshop participants indicated that the strategy should not be approached as a conservation activity in the strictest sense. The group started to adopt a constructivist approach that accommodated the diversity of perspectives and cover the multitude of activities that contribute to the strategy's development.

CBDC-partners focus their *in situ* activities on the human dynamics and to lesser extent on the genetic and ecological dynamics of agro-biodiversity. This focus can be traced back in the objectives of the CBDC-Programme, which refer to the community innovation system. The focus of CBDC is to strengthen local (community) organisations, to build capacity and to directly link with farmer and community livelihood strategies. In doing so, the programme covers a distinct niche within the international plant genetic resources arena.

In CBDC, *in situ* conservation emerges as an umbrella covering a multitude of activities. The underlying assumption is that these activities contribute to empowerment of farmers and strengthen the process of local crop development. Local maintenance is strengthened by the emphasis on local seed supply. Supporting the marketing of biodiversity products and introduction of "new" genetic diversity (PVS) strengthens utilisation of genetic diversity. With the human and development focus, the CBDC distinguishes itself from organisations with a stricter conservation perspective to *in situ* conservation. The primary interest of such conservationist's concerns the continuation of dynamics at genetic levels (Chapter 3). CBDC has broadened its focus on the strategy to a range of crops, locations and activities, thereby applying a broader interpretation of the definition of *in situ* conservation elaborated in the Convention on Biological Diversity. But above all, partners contributed to the construction of a strategy linking conservation and development objectives and thus assisted in achieving to one of the Convention's objectives.

CBDC: an institutional experiment and learning environment

CBDC with its diversity of partners and strong local basis is a clear example of a learning environment. The diversity of actors has contributed to complex and lively discussions at various meetings and workshops. Only discussions in the preparatory phase and first years of implementation have contributed to my experiences and current perspective. CBDC with all its debates and conflicts created many opportunities for learning about interactive research linking scientific and conservation organisations and action and development organisations in a joint programme. CBDC operates as a global platform that hosts a multitude of small projects, with people and organisations with divergent perspectives on many issues but united by an interest to support farmer and community management of agro-biodiversity.

Using the adaptive management perspective when reflecting upon CBDC, barriers between the global and local dimensions as encountered should be considered opportunities for social and institutional learning. Partners created their own framework for co-operation based on shared perspectives on organising flows of germplasm, knowledge and information. Lessons learnt in CBDC are generally relevant to development of the "on-farm management" and *in situ* conservation strategies. Partners engaged themselves in a global institutional experiment in which the major objective was to strengthen farmer and community management of agro-biodiversity. They developed an interactive and bottom-up framework to support farmer management of agro-biodiversity. Their experiences may be considered inputs to the development of strategies that cover various levels and domains of agro-biodiversity management.

Epilogue[1]: CBDC in 2000

In 1999, the programme completed its first phase, and the members of the programme undertook a partly assisted self-evaluation with respect to institutional and technical outcomes. The following institutional outcomes were recognised. Having a common overall motivation did not guarantee a coherent global programme. Initially, programme members mutually respected each other's priorities and approaches, and collaboration in the programme was restricted to an exchange of information. During the implementation programme, partners developed a shared vision on the role local communities play in the development of genetic resources and the support required to sustain this role in the future. As a result, the CBDC programme only partially succeeded in linking community knowledge with an institutional understanding and with global issues on biodiversity management. The programme contributed substantially to community empowerment. As technical outcomes of the programme, a "basket" of results included surveys of plant genetic resources and indigenous knowledge, selection and adoption of plant varieties, a revival of under-utilised species, and increased knowledge of farmer management of biodiversity.

The second phase of the programme will capitalise on the common understanding that joint planning of projects and development of methodologies will strengthen the programme. Therefore, it will emphasise collaboration along thematic issues rather than in regional networks. The programme has been divided into the following six themes: (i) seed supply systems; (ii) participatory variety selection and plant breeding; (iii) wild and under-utilised biodiversity; (iv) policy; (v) gender; and (vi) "mainstreaming". By mainstreaming the programme will attempt to incorporate experiences in and successful approaches to local communities' role in managing biodiversity in formal and informal training programmes.

The CBDC programme can be distinguished by its strong community orientation; it is organised bottom-up. Also, the programme recognises that agrobiodiversity is the product of human action, and that technical and social development objectives cannot be separated. CBDC-Partners therefore refer to the programme as follows:

> "The CBDC programme is about people. It is about farmers and their plants."

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1 The Epilogue is derived from CBDC (2000a).

Part IV

Conclusions

14

Grounded theory: Learning about socio-ecological perspectives

In this book, I have used adaptive management and the ecological knowledge system as emergent perspectives that combine agricultural, ecological and social sciences. A meeting point of the two perspectives concerns their reference to areas of application where social and ecological dynamics are interconnected and where management and practice have met problems that could not be solved with "normal" science. The two perspectives link policy, management, research and practice to support local practices and institutions. A common element is their emphasis on learning. The perspectives share a focus on patterns of action and processes of interaction between social actors involved. This focus and the fact that these perspectives approach society and ecology as one whole facilitated their use as learning and normative perspectives.

Box 14.1 Key research questions (V)

i. In what way is "on-farm management" of agro-biodiversity as strategy constructed?
ii. What is the social organisation for the development of the "on-farm management" strategy?
iii. What are the implications for the institutional frameworks that support farmer management of agro-biodiversity of using an adaptive management, a soft system and an ecological knowledge system perspective?
iv. What can be learnt about adaptive management and the ecological knowledge system while using them as socio-ecological perspective in the study of institutional aspects of agro-biodiversity management?

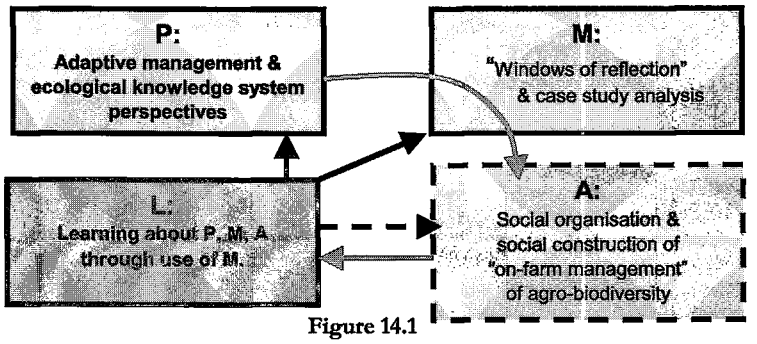

Figure 14.1
Research framework (IV)

Agro-biodiversity management is an area of application foreign to those for which the perspectives had originally been developed. The use of the two perspectives provided opportunities to learn about them, to gain new insights and to contribute to their theoretical development. Adaptive management and the ecological knowledge system have become learning perspectives that have been further developed in a framework of "grounded theory". Thereby, the fourth research question is answered (Box 14.1). Within the framework of "experiential learning" (Figure 14.1) "grounded theory" refers to the arrow from L to P and M. In this chapter, I reflect upon both perspectives and subsequently elaborate some issues that are critical to their theoretical development. I start the chapter drawing some initial conclusions that contribute to the formulation of answers to the third research question. I thereby learn some initial lessons about "on-farm management" of agro-biodiversity by making use of the socio-ecological perspectives (the dotted arrow between L and A in Figure 14.1).

14.1 Socio-ecological perspectives and "on-farm management"

"On-farm management": an emergent property

Reflecting upon and analysing some of the discussions and efforts in the projects to construct the "on-farm management" strategy, I started to realise that one of the barriers conservationists encounter is that in their attempts they pursue a "hard system approach". I realised that they wanted to conserve a human activity system that by its very nature is unpredictable and cannot be controlled. Hard system approaches have proven to be limited in dealing with human activity systems such as local crop development or farmer agro-biodiversity management (Section 6.2; Engel, 1997). If soft system thinking is applied to the social construction of the "on-farm management" strategy, linkages will be established among actors such as farmers, conservationists and other crop development organisations. They jointly define the boundaries for action. Within these boundaries, they form a "soft system" or "agro-biodiversity system". Through joint actions they establish a "platform for agro-biodiversity management". Subsequently, "on-farm management" as a conservation strategy becomes "an emergent property" of the soft system that social actors have decided to form. Rather than a conservation strategy, "on-farm management" is the output or emergent property of joint activities strengthening, supporting and monitoring farmer agro-biodiversity management. The soft system perspective illustrates that for conservation and other crop development organisations to contribute to "on-farm management" of agro-biodiversity, they need to use

interactive approaches and build such local agro-biodiversity platforms. For its social organisation, platforms emerge as obvious and inevitable.

"On-farm management" of agro-biodiversity: building agro-ecosystem resilience

Using the adaptive management perspective in the social construction of the "on-farm management" strategy, I realised that not only the nature of farmer management, but also agro-ecosystem's ecological dynamics, are unpredictable. These ecological dynamics are of interest to the strategy's construction and organisation. The dynamics are further "complicated" by the social dynamics, and become more complex by socio-ecological interactions. If crop genetic diversity is available, farmers use the diversity as component of an "adaptive" strategy to deal with these dynamics. Agro-biodiversity as an ecological service provides them with opportunities to respond to and adapt their management to these complex and unpredictable dynamics. Crop diversity becomes a property of building agro-ecological resilience. It may be considered a property of sustainability, by increasing farmers' capacity to respond to socio-economic and ecological variations. "On-farm management" does not only emerge as a conservation strategy; above all it facilitates agro-ecosystems to provide the ecological service referred to as crop genetic diversity. In addition, "on-farm management" links conservation and the use of crop genetic diversity with sustainable agricultural development. With the modernisation of agriculture, the provision of this ecological service to farmers has been replaced by a scientific and technological service using the global germplasm pool in breeding and plant genetic research, and providing farmers with the resulting technology (modern varieties). Agro-biodiversity is utilised by breeding programmes as an ecological service at a global level. It is alarming that with the rise of intellectual property rights, parts of this service are being appropriated, thereby restricting access to farmers who can afford the service. With "on-farm management", we partially reverse the process of global use and appropriation of crop genetic diversity. With an emphasis on "on-farm management", the local value of agro-biodiversity as an ecological service is recognised, and through its practice re-established. When implementing the strategy within an integrated framework, the reversal is partial, because farmers continue to benefit from the advancement of plant breeding and genetic research (if not embedded in rigid institutional and property rights frameworks). They acquire or maintain access to the global genepool. The challenge is to link local and global strategies for crop development and agro-biodiversity management in the most appropriate manner. The construction of such links refers in particular to the creation of adaptive institutional frameworks that link the various levels of agro-biodiversity management.

Adaptive management and conservation of agro-biodiversity

The social organisation of the "on-farm management" strategy links conservation, research and development organisations in platforms with farmers and their organisations. As a result of the diversity of the organisations involved, interactive and participatory approaches characterise these activities. Both farmers and conservation organisations act as managers of agro-biodiversity in these platforms, while responding or adapting to variation learning emerges as a crucial attribute of management. Diversity and learning contribute to enhancing the adaptive capacity of organisations forming the system. It strengthens the joint ability to go through the phases of the adaptive cycle of renewal (the "lazy eight" of Holling; Figure 5.1). This is, for example, translated into an adaptive if not most effective use of strategies utilising and conserving agro-biodiversity. Conservation and management practices are continuously

revised and reviewed, as are the functions and positions of various organisations. Monitoring of management and conservation practices both at practical and institutional levels is an important component of such an adaptive strategy. It guides policy makers and "agro-biodiversity managers" in deciding what strategy (*in situ*, *ex situ*, on-farm) to use where and when, and to indicate who is responsible for implementation.

An important lesson using socio-ecological perspectives reflecting on the social organisation of "on-farm management" is that the strategy should not be perceived solely as a conservation activity. It emerges as a strategy that supports and strengthens farmers' use of crop genetic diversity within a context of adaptive agro-biodiversity management and sustainable agricultural development. The socio-ecological perspectives and "on-farm management" link the practical level of farmer utilisation and management of crops and landraces with the more abstract national and international levels of agro-biodiversity management and conservation.

Building an adaptive management system

Adaptive ecosystem management described by Holling and colleagues (Chapter 6) focuses on the formation of platforms to establish linkages between management organisations, policy makers and citizens. Accordingly, these actors form the triangle through which adaptive management is realised (Figure 14.2). Policy and management organisations can only perform within the triangle if empowered by a social contract with citizens with whom they form the triangle. Citizens are not regarded as single actors, but represent civil society. Management organisations are those actors that in one way or another manage, make available from the ecosystem, resources and services and benefit economically from these activities. Policy organisations create an institutional framework for management organisations to operate. Within the triangle of adaptive management, researchers and their organisations (i) translate policies into management practices; (ii) translate management outputs to review the impact of policies; (iii) contribute to making policy and management organisations responsive to socio-economic interests (citizens) and ecological change (ecosystem); (iv) continue the social contract of policy and management with citizens (democracy); and (v) facilitate learning in management and policy making, and (vi) shape adaptive management within the triangle. Research thus forms a cycle within the triangle (Figure 14.2). Policy and management are parts of a continuous process of learning and experimentation. In addition, adaptive management increases the human capacity to sustain the ability of the ecosystem to provide ecological services and renewable natural resources. The boundary of the soft system forming the triangle has been defined by the ecosystem that has been agreed upon to be managed in an adaptive manner. In the most prominent cases where adaptive management has been successfully used (Colombia River Basis, Everglades, Rhine River, San Francisco Bay), these boundaries were drawn by water systems (watersheds,

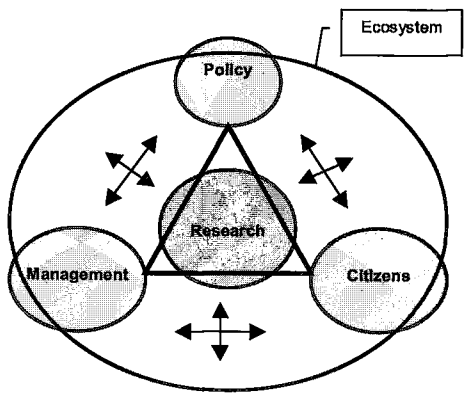

Figure 14.2
Triangle of adaptive ecosystem management

lakes and coastal regions) or geographically (valleys) or institutionally defined systems (nature reserves) (Gunderson *et al.*, 1995a; Roe *et al.*, 1999).

Figure 14.3 translates the triangle into adaptive agro-biodiversity management, in which policy organisations, conservation and crop development organisations, and farmers and farmer organisations form the triangle. Similarly, research links the various components. Research is implemented or commissioned by the various organisations that shape the triangle; it is thus not necessarily implemented by specific research organisations. Defining the boundaries of the agro-biodiversity system is a complex process, due to the multiple levels at which many actors operate and the mobile nature of agro-biodiversity. The boundaries of such an agro-biodiversity system are much more diffuse, particularly due to the multiple linkages with other systems at the same or other levels. For the purpose of joint management, these boundaries can be drawn making use of ecological criteria. The boundaries of an agro-ecosystem are considered boundaries of the agro-biodiversity system.

Within institutional frameworks and projects described in the case studies, boundaries have been defined using geographic, political and socio-economic criteria. Local (community), national and international agro-biodiversity management systems have been formed. These systems are social constructs; they only exist because partners agree to join. The "trigger" for the formation of these platforms is the shared realisation that agro-biodiversity management and conservation are emergent properties of the agro-biodiversity system that institutional crop development actors form together. Conservation and management can only be achieved by joint and not isolated efforts. A shared concern or awareness is a prerequisite for actors joining such a system. In the 1970s and 1980s a concern was expressed within the biodiversity arena by various social actors and was translated in 1992 into the CBD that created an institutional and policy environment in which platforms at various levels could be established. In this book, I have reflected upon the first steps towards their establishment and placed these in a theoretical framework.

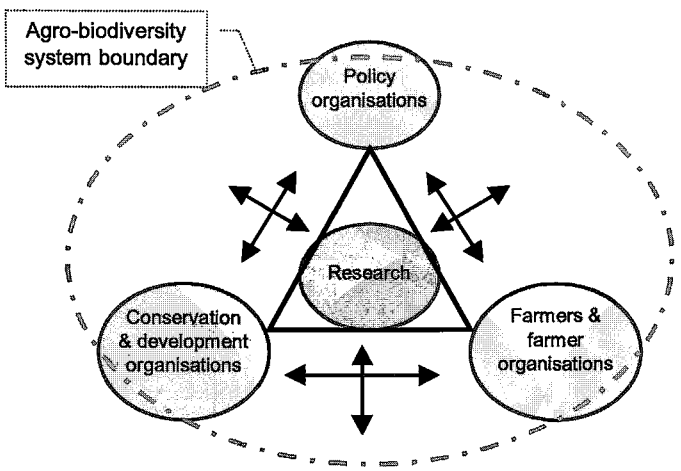

Figure 14.3
Triangle of adaptive agro-biodiversity management

14.2 The ecological knowledge system

Röling & Jiggins (1998) developed the ecological knowledge system as an alternative to the dominant perspective that sustainable agriculture could be realised merely by using technical solutions. Röling & Wagemakers (1998) indicated that issues in the social sphere of agricultural development are crucial for the development of sustainable agriculture. The ecological knowledge system emphasises five dimensions: farmer practices, learning, facilitation, supportive institutions and conducive policies. In the study of institutional aspects of agro-biodiversity management, the following topics have emerged that are related to and may contribute to further development of the ecological knowledge system:

a) No just technical and scientific construction. An important lesson that could be learnt from some of the case studies (CBDC, IPGRI *in situ*) was that technical approaches did not result in the construction of "on-farm management" as conservation strategy. Research and development activities initially focused on the scientific and technical construction of the strategy. However, activities were added that strengthen local organisations and networks and support farmer management and utilisation. This indicated that the rationale for adding social and institutional dimensions to the development of the ecological knowledge system also applies to the development of the "on-farm management" strategy".

b) "On-farm management" of agro-biodiversity: a human activity system. The realisation by actors in the institutional crop development system that "on-farm management" is a human activity system, a system that limits opportunities for using hard system approaches, is crucial. "Hard system" approaches have gradually been replaced by "soft system approaches" in the construction of the "on-farm management" strategy. This shift is associated with a change in conservation paradigms. No "blueprints" for the "on-farm management" strategy could be developed. "Process" approaches have been proposed that focus on local capacity building, experimentation and learning instead.

c) Resource management instead of resource exploitation. The change in the position of conservation organisations puts them in a new framework for resource exploitation and management. NPGRPs and genebanks have been established to maintain and make accessible plant genetic resources. Their mandate has been developed according to an exploitation objective, to make genetic resources available for breeders and researchers. The actors and projects described in the case studies approach agro-biodiversity much more in a context of sustainable resource management and agricultural development.

d) Changing mandates of organisations. In some cases, we learnt that in the construction of the "on-farm management" strategy a link has been developed between conservation and development. Originally, the strategy had merely been perceived as a conservation activity. Conservation organisations widened their scope and took up a more active position within the institutional crop development system, promoting the use of agro-biodiversity.

e) Flows of germplasm, knowledge and information. The perspective has guided me to concentrate on flows of germplasm, knowledge and information. Studying these flows, I obtained a better understanding of interactions that shape innovation and improve the performance of conservation, research and development organisations in meeting their joint objectives. The focus on flows has stressed the relevance of addressing policy aspects such as access to, control over and ownership of germplasm and associated knowledge and information.

Current trends in the global policy arena necessitate such aspects to be covered in the social organisation of the "on-farm management" strategy.

f) Focus on institutional aspects instead of farmer management. With this point, I also meet an important limitation in applying and thereby contributing to the development of the ecological knowledge system perspective. I have not addressed the link between institutional and farmer levels of agro-biodiversity management. Emphasis has been put on the development of enabling or learning environments at institutional levels.

14.3 Adaptive management

Adaptive management has been developed by ecologists involved in management of large ecosystems (Holling, 1986; Gunderson *et al.*, 1995a). It is founded on the realisation that management based on "normal" practices and a technical perception of the problem could not respond to complex and unpredictable ecological and social dynamics. Through its focus on the "ecological sphere" of natural resource and ecosystem management, adaptive management complements the "social sphere" in which the ecological knowledge system has been developed. The approach emphasises continuity and feedback mechanisms among policy, management and citizens. They are the components of one adaptive management system (Figure 14.2). The following issues have emerged that refer to elements of adaptive management.

a) Emerging actors in agro-biodiversity management. Conservation and management are no longer perceived as concerns or responsibilities of some professional organisations only. Agro-biodiversity management is increasingly addressed as a component of sustainable agricultural development. It thereby becomes an issue in the hands of various actors in society who only through joint action may be achieved.

b) Global attention resulting in local action and policy barriers. The "on-farm management" conservation strategy has been emphasised at a global level (CBD). It resulted from a global concern for genetic erosion and loss of agro-biodiversity. However, the strategy can only be implemented through local practice. Therefore, conservation and crop development organisations have to link with farmers (citizens in the triangle; Figure 14.2) to achieve their "new objectives". The institutional frameworks in which conservation organisations have been embedded, but also "normal" agricultural policies have emerged as barriers to strengthening farmer management or utilisation of agro-biodiversity. Actors involved in the development of the "new approaches" need to link and provide "feedback" for the policy level and promote the institutional changes required for mainstreaming strategies and practices.

c) Monitoring and feedback. Another aspect of research on adaptive management is its function to monitor ecological dynamics, management practices and facilitate feedback between policy, management and citizens. The projects described in the case studies have emphasised surveys; monitoring mechanisms have barely been elaborated. It should be realised that the projects had only recently been initiated and that monitoring mechanisms can only be developed over time. Another constraint concerns the project nature of activities that provide partners with a more restricted timeframe of operation.

14.4 Learning about perspectives

Some critical issues have emerged that may be reflected upon in the context of further building the socio-ecological perspectives in the context of agro-biodiversity management.

a) Ecological perspective on agriculture and agro-biodiversity management. Adaptive management has been developed and is applied in the management of large ecosystems. Major emphasis is put on human managed ecological systems that provide ecological services and renewable natural resources for society. The approach is applied when human activities threaten or undermine essential ecological functions and services that result in loss of ecosystem resilience, i.e., ecosystems losing their capacity to respond to ecological and/or human change. Adaptive management has been developed to change the management of the ecosystem in such a manner that ecosystem maintains its adaptive capacity. Agro-biodiversity is considered an ecological service and component to maintain or (re-) build resilience in agro-ecosystems. In the case studies, partners often put "on-farm management" in a context of sustainable agricultural development. However, the projects and organisations involved approached farmer management of agro-biodiversity with political (community empowerment), institutional, scientific and conservation rather than ecological objectives. This point demonstrates that ecological aspects of agro-biodiversity management are still perceived by actors to be of secondary importance. Therefore a translation of ecological principles needs to be given further attention in agricultural research and agro-biodiversity management.

b) System boundaries. In adaptive management and the ecological knowledge system it is important to define system boundaries. A system may also be defined using soft system thinking, i.e., actors define and negotiate the boundaries of a system they wish to manage in an adaptive and ecologically sound manner. In the case studies, boundaries for "on-farm management" have been socially constructed. Because of the mobile and reproductive nature of crop genetic diversity, linkages with other levels cannot be ignored. Global and national levels of management impose management regimes or appropriation mechanisms at regional or local levels, thus creating "cross-level conflicts". A soft system approach may be used to design systems at various management levels. A crucial issue to be addressed in the link between these different soft systems for "agro-biodiversity management". The adaptive management perspective could be used by its emphasis on perceiving policies as learning experiments, and putting research in a position to link the system components and assist in the development of mechanisms to link the various management levels.

c) Platforms, facilitation and institutional frameworks. Both perspectives emphasise the use of interactive approaches into research, management and conservation. It has become clear that actors with dissimilar objectives though with a mutual interest in agro-biodiversity join in management, research or conservation. Such collaboration is not easily initiated. Projects have been established with external funding, often involving researchers who acted as "neutral" facilitators. With these external resources and facilitators, actors started to become involved in "institutional experiments". The soft system notion of forming a platform for resource management in which actors through resource negotiation come to joint management and learning, also applies to agro-biodiversity management. "On-farm management" of agro-biodiversity becomes an emergent property of the soft systems formed by these actors. These platforms may link to higher levels of management. In addition, they may have an impact on

policy organisations that shape the conditions in which they are operating. However, intermediary organisations play facilitation roles in such processes of change. It can be concluded that adaptive management as a guiding perspective on agro-biodiversity management cannot be isolated on one level; adaptive management of agro-biodiversity can only be achieved by an approach that facilitates the establishment of linkages between actors operating at various management levels. Efforts to involve development and farmer organisations in NPGRPs have illustrated the opportunities for change within existing frameworks. However, the institutional crop development frameworks also demonstrated to be rather rigid in their organisation. Many barriers should be bridged before institutional crop development frameworks can be transformed into frameworks that support farmer management of agro-biodiversity. In adaptive management, research is placed central in the triangle forming the management system (Figure 14.2). Research is crucial to the facilitation of learning and adaptation of management practices and policies. A question remains in what way and when researchers may take up such facilitation roles. It is clear that they play a role in organisational development moving from constrained to rational and emergent action. If I reflect upon our own role in the A-Team, CBD as a global framework created such conditions for rational action. In this context we were able to gather actors in platforms, creating new institutional frameworks and enter into processes of learning in various innovative projects. The challenge that currently needs to be faced is to mainstream outputs of these innovative and experimental projects. Thus to use the lessons learnt for building enabling institutional frameworks that support farmer management.

15

Towards a new praxeology: Building institutional frameworks that support farmer management of agro-biodiversity

In this concluding chapter, I return to the starting point of the activities described in the book, the Convention on Biological Diversity. It has been an incentive to the creation of enabling institutional frameworks that support farmer management of agro-biodiversity. I place the activities of the A-team and DGIS within this context of building frameworks for learning about "on-farm management". Because the book is based on the activities of the team, I briefly revisit the research process. In the following sections, I continue the "path" entered in the previous concluding chapter in answering the research questions. In a focus on NPGRPs and the "on-farm management" strategy I aim to answer the first three questions

Box 15.1 Key research questions (VI)

i. In what way is "on-farm management" of agro-biodiversity as strategy constructed?
ii. What is the social organisation for the development of the "on-farm management" strategy?
iii. What are the implications for the institutional frameworks that support farmer management of agro-biodiversity of using an adaptive management, a soft system and an ecological knowledge system perspective?
iv. What can be learnt about adaptive management and the ecological knowledge system while using them as socio-ecological perspective in the study of institutional aspects of agro-biodiversity management?

(Box 15.1). Using the socio-ecological perspectives, I take the following step in learning about and building institutional frameworks that support farmer management. I refer to the development of an adaptive configuration of crop development and conservation and the establishment of agro-biodiversity platforms at various levels bringing together actors and coming to joint management. In the subsequent chapter, I place the interest in "on-farm management" and projects described in the book in a wider policy context. In the final section an adaptive perspective on institutional change and renewal is elaborated that puts the book and the activities described in a historic perspective and explores its contribution to future agro-biodiversity management.

15.1 Convention on Biological Diversity: creation of an enabling framework

UNCED: breaking point between concern and action

The United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro, 1992 was an international milestone linking development and sustainable environmental management. The two decades preceding UNCED can be described as an era in which a growing number of citizens and scientists expressed their environmental concern. I consider the Conference a breaking point between this time of concern and an era in which policymakers and management organisations together with citizens and scientists started to translate their concerns into joint action and practice. UNCED's outputs have contributed to the development of international, national and local frameworks within which groups of actors have started to experiment with "paths" leading towards sustainable development. Agenda 21 and the Convention on Biological Diversity (CBD) are two of UNCED's important "outcomes". With these international agreements, governments have committed themselves to support and become engaged in sustainable development and biodiversity conservation. However, between international commitments and local actions there is a "path" at which many barriers need to be bridged. I have studied some efforts that have been initiated following CBD aimed to translate these commitments into action at various levels. I have focused on one field covered by CBD, the development and implementation of a conservation strategy referred to as "*in situ* conservation". In the context of conservation of agricultural biodiversity it is referred to as the "on-farm management" strategy that targets at farmers' continued utilisation and management of crop genetic diversity (Section 2.5). The international and national commitments on the one hand and local implementation on the other requires the development of institutional frameworks that support interactions between actors who operate at various levels and within various domains. This situation provided me with unique opportunities for the study of interactions between these actors and relate them to building an institutional framework that may support or facilitate such interactions at the international level.

CBD: linking conservation and development

CBD has created an international framework to counteract the increasing loss of biodiversity and to link conservation and development. Its principles are (i) conservation, (ii) sustainable utilisation and (iii) fair and equitable sharing of benefits. It further stresses the complementarity of *ex situ* and *in situ* conservation strategies and emphasises the potential contribution of biodiversity utilisation to sustainable development. *In situ* conservation and "on-farm management" returned on the agenda of plant genetic resource conservationists. Through

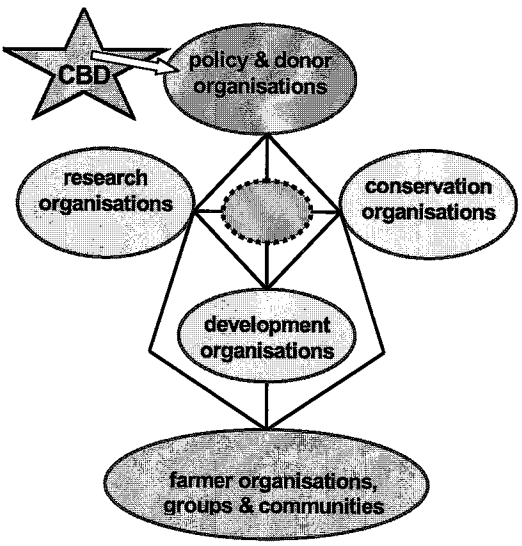

Figure 15.1
Institutional frameworks supporting "on-farm management" of agro-biodiversity

"on-farm management" efforts, farmer communities who in fact manage and maintain agro-biodiversity "on-farm" should be strengthened in their agro-biodiversity management and should benefit more directly from its utilisation. "On-farm management" of agro-biodiversity is increasingly approached as a strategy to link local agro-biodiversity management with sustainable agricultural development.

CBD: building institutional frameworks that support "on-farm management"

Governments that have ratified CBD committed themselves to the formulation and implementation of a national biodiversity strategy and action plan. Even though CBD emphasised the complementary nature of various conservation strategies, their coverage in policy frameworks and translation into practice lags behind. Particularly the integrated character of the convention has created barriers in linking nature management with environmental management, agriculture, trade and other policy fields (Bragdon, 2000).

More direct incentives for on-farm strategies have included substantial financial resources that have become available for their development and implementation. At multilateral level, the Global Environment Facility (GEF) supported "biodiverse" countries such as Ethiopia, India, Peru and Turkey to accomplish their CBD commitments to *in situ* conservation. Bilateral donors allocated substantial financial resources to *in situ*/on-farm and agro-biodiversity projects. Major financial resources have been made available by DGIS (Netherlands), SIDA (Sweden), SDC (Switzerland), IDRC (Canada), and more recently by BMZ (Germany) and DFID (UK). A large part of these resources has been allocated to projects that study farmer management of agro-biodiversity. But by being "development funds", these bilateral donor agencies emphasise that the projects need to link conservation with research and development. A diversity of organisations started activities linking agro-biodiversity conservation and development. Figure 15.1 illustrates the institutional framework within which these activities have been initiated.

15.2 Building a foundation

The interface of organisations illustrated in Figure 15.1 and subsequently linking organisations that operate at international, national and local levels, has been the arena in which the Agro-biodiversity Team (A-Team) of the Centre for Genetic Resources, The Netherlands (CGN), operated in the 1990-1998 period. The book describes and reflects upon some of the A-Team's experiences, while facilitating the initiation, development, establishment and initial

implementation of "agro-biodiversity projects" in the years following Rio. I have described and analysed in a broader context the translation of international commitment to *in situ* conservation into international, national and local actions. The A-Team has operated in a range of initiatives that brought together a diversity of social actors. The initiatives and projects became learning environments or "institutional experiments". I have used these "experiments" to study the social organisation and construction of the "on-farm management" strategy.

DGIS, the A-Team and agro-biodiversity projects

The Netherlands Directorate General for International Co-operation (DGIS) in its international development policies has committed itself to CBD. DGIS provides major support through multilateral agencies, such as FAO, UNEP and GEF. At the international policy level, it co-finances international policy processes such as the FAO Technical Conference on Plant Genetic Resources (Leipzig, Germany, 1996) and components of the Conferences of Parties, responsible for CBD implementation at international level. DGIS specifically supports NGOs such as GRAIN and RAFI that play critical roles representing civil society in international biodiversity fora. International organisations such as IPGRI and IUCN operating in the biodiversity arena also receive DGIS funding. More specifically, DGIS financially supports two country components in the IPGRI *in situ* project (Chapter 12). Another important international interactive agro-biodiversity programme supported by DGIS is the CBDC Programme (Chapter 13).

DGIS decided to strengthen national and local organisations active in linking agro-biodiversity conservation and development, user interactive approaches and maintain strong links with local and grassroots organisations (Jorritsma, 2000). However, it concluded that few proposals had been submitted that met these criteria. DGIS therefore requested the A-Team to assist in the identification of projects and to support organisations in developing countries in their formulation and design (Preface). The experience of developing CBDC and A-Team's network was used as an input. Appendix I provides an overview of the A-Team's activities and its outputs (1990-1998).

DGIS, together with the Netherlands Environment Ministry, contributes to the implementation of the Sustainable Development Agreement (SDA) between The Netherlands and Benin, Bhutan and Costa Rica. The Agreement was initiated during UNCED (Box 9.5). The ABC project in Bhutan (Chapter 10) has been financed by the programme resulting from this agreement. SDA has also supported activities in The Netherlands. Funding was allocated to a Diversity Project in which discussion platforms have been established to explore ways to enhance utilisation of agro-biodiversity in Dutch agriculture. Activities of a farmer organisation, Zeeuwse Vlegel were also supported by SDA-funding. The Diversity Project and Zeeuwse Vlegel have been discussed in Chapter 9. In conclusion, DGIS, through the Royal Netherlands Embassies in various developing countries, supports a number of biodiversity projects, for example, the CBUD project in Ghana (Chapter 11).

All case studies described have directly or indirectly received DGIS support. The A-Team has played an active role in the inception of projects described in three cases. It is important to realise that through its close linkage with DGIS, the A-Team has been operating within a "donor-driven" context. The donor link has influenced our work and partnership with many organisations; we became a "donor instrument". We were put in a position and became

involved in a range of activities that contributed to the creation of institutional frameworks supporting farmer management of agro-biodiversity.

15.3 Context of the book

Within the A-Team, I have been involved in various initiatives and efforts to establish and implement projects that aim to contribute to CBD's objectives. This position has given the unique opportunity to learn more about efforts to construct "on-farm management" and to contribute to the creation of institutional frameworks that support its realisation. I operated as a practitioner, facilitator and project co-ordinator and provided services for groups of local, national and international partners. Through my work I received much exposure, gained insight and acquired knowledge that I used in an experimental or intuitive way taking next steps in my work or supporting new initiatives. In most cases, DGIS provided financial resources to facilitate in these processes. I want to emphasise that during this work, I did not hold the position of a researcher who institutional aspects of the "on-farm management" strategy.

In the institutional framework, we (the A-Team) frequently operated as facilitators in the interface between donor, research, conservation and development organisations. Our position in this framework is visualised by the dotted circle in Figure 15.1. I have not been a "neutral researcher" (if that exists at all) in studying organisations and projects. My research outputs were "shaped during the course of the inquiry by interactions of the investigator and the object of inquiry" (Guba & Lincoln, 1994: pp. 99). And in my research, I have not been in a position to act as an "outside or neutral investigator"; in fact I have been a part of the "objects of inquiry". I used my (and the co-authors') records and experiences as basic information to write the five case studies. These studies may be perceived as subjective and biased. At the same time, I probably was one of the few people in the world who has had an opportunity to participate in (and study) a diversity of unique and innovative projects initiated since Rio. Through my involvement as "learning and emerging social scientist" in the organisations and projects described above, I have been able to follow and record interactions between agro-biodiversity actors. In addition, I could learn about and study patterns of social interactions that shape praxis and theory.

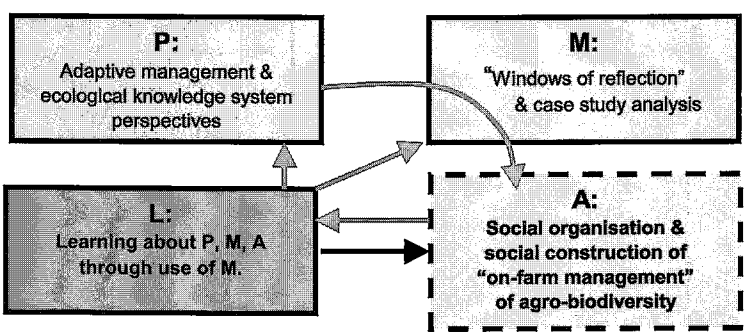

Figure 15.2
Research framework (V)

The methodological setting of the book is based on the research framework of "experiential learning" described in Section 4.5. In the current chapter, I draw conclusions on the institutional aspects of the social organisation and construction of the "on-farm management" strategy. Within the framework of "experiential learning" as illustrated in Figure 15.2, this chapter refers to the arrow between L and A.. I translate the lessons learnt into a theory that informs practice. With this praxeology, I aim to contribute to the creation of institutional frameworks that support farmer management of agro-biodiversity.

15.4 Terminology: "*in situ* conservation" and "on-farm management"

First attempts to construct *in situ* conservation of crop genetic diversity focused on maintenance in its original environment. Conservationists have emphasised continued cultivation of landraces in farmer fields and conservation of crop wild relatives in their original habitats. *In situ* conservation projects addressed crops and their wild relatives in their "Centres of Origin. This was the result of the ecological and genetic perspective of the conservationists that were involved in the construction of the strategy (Maxted *et al.*, 1997a; Brush, 1999).

When referring to "on-farm conservation", strategies have been proposed in which farmers have been contracted by conservation organisations to continue the cultivation of landraces. This approach was elaborated by the Ethiopian Genebank (Demissie, 1999; Worede *et al.*, 1999). Long-term continuation of conservation efforts has been questioned. Concerning the sustainability of the conservation strategy, such an approach to *in situ* will continue to rely on (public) funding in a similar manner compared to *ex situ* conservation (Almekinders & Demissie, 1999). Emphasis is put on crop genetic diversity and interaction with the natural environment. However, this "conservationist managed" approach to *in situ* conservation has been rejected by many crop development and conservation organisations involved in the above described agro-biodiversity projects. In discussions on conservation strategies in both the CBDC programme and the IPGRI *in situ* project, partners replaced the above described "control" approach to *in situ* conservation by a "process" approach. They came to this conclusion, because the latter approach addresses the dynamic social and agro-ecological components of crop genetic diversity and farmer management, and links conservation with development. Emphasis was not conserving particular landraces but on conserving genetic diverse agricultural systems.

In addition a more conceptual argument has been formulated. An important objective of "*in situ* conservation on-farm" is to continue and strengthen processes of evolution, domestication, adaptation and farmer utilisation of local varieties. Ecological and social dynamics have been emphasised; thus conservationists have become interested in farmer management of landraces. The strategy's emphasis has not only been put on the maintenance of landraces or crop genetic diversity in farmer fields but also on keeping farmer knowledge, practices and skills alive. In such a context, farmer knowledge, crop genetic diversity and its management are considered one whole not to be separated. Therefore, farmer management is emphasised in "on-farm management" of landraces; i.e., the process of local crop development that includes crop cultivation, seed selection, seed processing and storage, and local seed and variety exchange networks. Conservationists are faced with the dilemma that a dynamic human and ecological process simply can neither be controlled by them nor conserved. An important lesson learnt from discussions on conservation strategies in various projects

discussed concerns that such terms as "*in situ* conservation" and "on-farm conservation" do not capture the dynamic element of farmer management. Along with other players in the arena, the A-Team and its partners started to use a term introduced by FAO (1996): "on-farm management". I decided to also use "on-farm management" of agro-biodiversity for the strategy, because it better describes what it attempts to achieve when referring to farmer (continued) management of crop genetic diversity.

15.5 NPGRPs and the "on-farm management" strategy

New actors and agro-biodiversity projects

Key players in plant genetic resource conservation are organisations that contribute to the implementation of National Plant Genetic Resources Programmes (NPGRPs). Since the early 1970s, these programmes and associated conservation organisations have been established in many countries. They focus on *ex situ* conservation while maintaining germplasm in storage facilities and providing researchers and plant breeders with access to "plant genetic resources".

The number of *in situ*/on-farm initiatives taken by NPGRPs lags behind international and national policy commitments. Other organisations have demonstrated a stronger interest, have embraced the idea of *in situ* conservation and have been more successful in obtaining financial resources for their projects. I refer to these initiatives as "agro-biodiversity projects". National and international agricultural research organisations, universities, NGOs, development and farmer organisations have joined in these projects. These organisations associated their strategies to a wide range of activities to support farmer agro-biodiversity management. As a result, new actors appeared in the plant genetic resources arena.

Some representatives of conservation organisations or NPGRPs originally perceived these new initiatives, emerging actors and shifts towards development-oriented conservation activities with scepticism. They regarded this shift as undermining the mandate and responsibility of NPGRPs (Zeven, 1996; Wood & Lenné, 1995; Maxted *et al.*, 1997c). Their attitude demonstrates that these formal conservation organisations had become disconnected from and hampered their capacity to respond to new developments and initiatives. NPGRPs and conservation organisations had been established and further developed within institutional frameworks that have created various institutional, scientific and professional barriers to adequately respond to these new trends and thereby adhere to CBD's more integrated principles and strategies.

NPGRPs and institutional barriers

As a result of these institutional frameworks and their narrowly defined mandate, most conservation organisations and NPGRPs appear hampered in their capacity to initiate activities that contribute to farmer agro-biodiversity management. This was illustrated by the Ghana case study. The national genebank is financed by the national crop breeding programme. Through its institutional framework, but above all because of the allocation of its (financial) resources, it is not in the position to start *in situ* activities and work with farmers. It relies on external agencies such as CBUD or NGOs to support farmer utilisation (Chapter 11). The NPGRP in the Netherlands is bound to conservation within its institutional mandate as formulated by national policy makers (Chapter 9). This programme is embedded in a

research framework that can be characterised as highly specialised, disconnected from the farming sector and moving from the public towards the private domain. The plant genetic resources programme in the Netherlands is therefore limited by its institutional environment and its available resources, to play a more active role in supporting and increasing farmers' access to, and utilisation of, agro-biodiversity.

NPGRPs and the institutional crop development system

Most NPGRPs and conservation organisations have been established within an institutional framework characterised by a linear and top-down process of technology development (De Boef *et al.*, 2000a). Crop development organisations develop and produce varieties, seeds and planting materials disseminated as (bio) technological inputs to farmers, who are increasingly perceived as passive clients or "components" of the agro-industrial chain of food production (Pistorius & Van Wijk, 1999). NPGRPs are often regarded as synonyms for genebanks because of their focus on *ex situ* conservation (Pistorius, 1997).

The link between conservation organisations and farmer or rural development organisations, required for the implementation of the "on-farm management" strategy has major institutional implications. The change encompasses more than just "scientific" or "technical" construction of a conservation strategy. I therefore conclude that the interest in *in situ* conservation cannot be isolated from general criticisms on and trends in agricultural research and development. It suggests the need for transformation of agricultural research and development organisations into learning and facilitating agencies that contribute to sustainable agricultural development (Pretty, 1994; Scoones & Thompson, 1994; Röling & Wagemakers, 1998).

Professional barriers to the implementation of *in situ* conservation

People working in conservation organisations have encountered professional barriers to become involved in *in situ* and on-farm conservation activities. Their professionalism has developed along the implementation of *ex situ* conservation and maintains strong linkages with plant genetic research and plant breeding. This was based on the use of a conservation paradigm that emphasises "blueprint approaches" and control over natural processes (Section 3.2; Pimbert & Pretty, 1997). Following Holling (1986; 1995), this paradigm fits within the "control management" perspective elaborated for ecosystem management (Chapter 5). The "blue print" approach leaves limited room for conservation professionals to deal with the unpredictable ecological and social dynamics of landraces or crop genetic diversity managed by farmers on-farm. Including *in situ* and on-farm strategies in the conservation programmes resulted in conservation officers experiencing barriers associated with their paradigm and "normal" professionalism (Chambers, 1993; Pretty, 1994). Therefore the step from *ex situ* to *in situ* and on-farm conservation strategies is not easy to take. It would imply a change in conservation paradigm and professionalism.

Ex situ conservation is an example of a conservation strategy based on "blueprint" conservation and "control" management paradigms. To achieve ultimate "control" over natural processes, conservationists use standard procedures. This approach is effective for *ex situ* conservation of germplasm of seed crops. Such control appears an illusion when working with farmers in the implementation of the "on-farm management" strategy. In fact this strategy's objective is to sustain natural and human dynamics that contribute to the develop-

ment, generation and adaptation of crop genetic diversity or local varieties. In other words, the objective concerns the continuation of a process. Basic to the strategy's development and implementation is that conservationists must develop a partnership with farmers and other organisations, and support human and natural dynamics they want to sustain. There are no standard procedures or blueprints for such conservation activities, instead conservationists increase farmers' capacities in management, provide access to germplasm and information, and, if necessary, assume facilitation or monitoring functions. To change their professionalism and achieve their conservation objectives, conservationists need to engage themselves in learning processes. The ultimate goal appears to be that conservationists enhance utilisation of agro-biodiversity through partnership with farmers, farmer groups, research and development organisations, and thereby contribute to conservation *in situ* of agro-biodiversity.

Case studies: building institutional frameworks that support "on-farm management"

In their effort to construct and implement *in situ* conservation and "on-farm management", conservation organisations are encouraged to establish linkages with farmers and other crop development actors. The group of partners in its conservation work covers actors beyond its original clients, breeding and research organisations. As a result, the institutional framework within which conservation organisations are embedded needs to be opened up to new partners and reorganised to such an extent that it can better link conservation and development. The IPGRI *in situ* project stimulates involvement of local and development organisations in NPGRPs. In CBDC, most NGOs link community organisations with individual scientists in research and conservation organisations, who may indirectly facilitate change within NPGRPs.

Attention to agro-biodiversity has increased with the growing interest of farmers, consumers, researchers and policy makers in organic and sustainable agriculture. As a consequence, other actors than plant breeders and researchers approach conservation organisations for access to collections and for support in using biodiversity in agriculture. The association between organic farming and agro-biodiversity was illustrated by the Dutch case study. The Ghana case study illustrated NGOs, farmers and local foresters who have expressed an interest in materials maintained by a genebank. It can be concluded that "on-farm management" and the growing interest in agro-biodiversity in a context of organic agriculture created new demands on conservation organisations that need to be accommodated in their mandates, institutional frameworks and activities.

For the implementation of the "on-farm management" strategy, NPGRPs are stimulated to use interactive and participatory approaches. The IPGRI *in situ* project emphasises this aspect, it support NPGRPs in using participatory research approaches and stimulates these programmes in becoming more open to local and farmer involvement. It should be realised that the project is successful for this aspect in Nepal, where an NGO plays a significant role in the implementation. In other countries, the IPGRI projects emphasises that its national partners engage in more participatory and interactive research, establish linkages between GO and NGO partners, and start activities such as participatory varietal selection. Much reluctance is encountered. Cross country exposure within the IPGRI *in situ* project is an important tool facilitating such difficult changes.

The Netherlands case study illustrates that CGN has been hampered by its institutional framework and conservation mandate, and by the reluctant attitude and professional skills of

conservation officers, to establish linkages with new partners and become involved in more participatory activities. This case study illustrates that conservation organisations have become disconnected from farmers and practical agricultural production. The Ghana, CBDC and IPGRI in situ case studies also illustrated this gap. Conservation organisations have been established as genebanks and are primarily embedded in a research and breeding framework, associated with dominant actor networks in high-input and commercial agriculture. Within this framework, conservation organisations are located at the lead of the crop development chain. Farmers are located at the other end. The Netherlands case study features a conservation organisation embedded in actor networks with a strong association to plant breeding and research. In the most recent years, the institutional environment in which CGN is embedded moved away from agriculture and increasingly concentrates on strategic plant genetic research (biotechnology). A conclusion can be drawn with respect to the relationship between NPGRPs and farmers. This linkage is required for the implementation of the "on-farm management" strategy, it adds entirely new dimensions to conservation organisations, the associated professionalism and practices.

15.6 Building an adaptive crop development system

Supporting local crop development

Key players in the social organisation of the "on-farm management" strategy are farmers and communities. Conservationists are particularly interested in the process in which farmers maintain and utilise crop genetic diversity. I refer to this process as local crop development. The following questions emerge: In what manner can conservation organisations link to, support and strengthen this process? And what roles do conservation organisations play in the construction and organisation of the strategy?

Discussions on the strategy in IPGRI's *in situ* project and the CBDC Programme revealed that institutional actors can only support the utilisation and maintenance of crop genetic diversity by farmers. They are not in a position to control or direct the process. But they may stimulate the use of diversity and strengthen its management, or increase farmers' access to local and improved germplasm through participatory varietal selection. They may raise awareness of farmers on the value of diversity organising diversity fairs. Variety maintenance may strengthen the local seed system and by establishing community seed banks. The role of conservation organisations in the social organisation of the "on-farm management" strategy was explored in both international projects, but also in the proposed projects in Bhutan and Ghana. It has been emphasised that conservation organisations within the new social organisation increase access of farmers to *ex situ* collections, stimulate and facilitate linkages with other actors, and monitor farmer management of agro-biodiversity.

Steps towards building one system

The central objective of the "on-farm management" strategy became continuation and strengthening of local crop development. I emphasise the human component of agro-biodiversity that complements the genetic and ecological components. By addressing social interactions related to these human components, instruments developed for knowledge system analysis (RAAKS) may be utilised. I concentrated on identification and analysis of actors, and flows of germplasm, knowledge and information. Addressing these flows in the

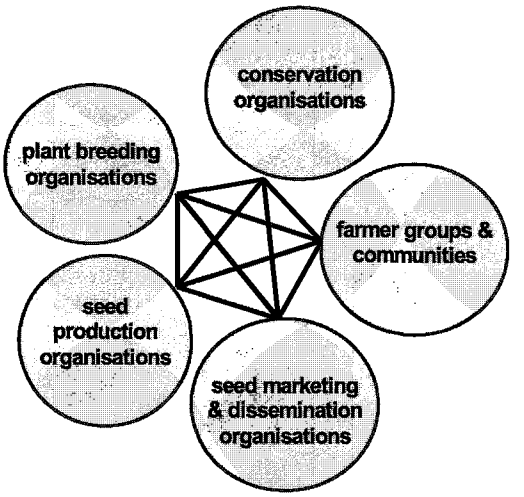

Figure 15.3
Adaptive organisation of the crop development system

case studies, I have come to the conclusion that in the social organisation of the "on-farm management" strategy, the distinction between local and institutional systems becomes rather arbitrary. However, case studies illustrated the remaining presence of many barriers between the systems, particularly those related to institutional and regulatory frameworks.

A new configuration of actors can be designed with intensified and reciprocal flows of germplasm, knowledge and information. Figure 15.3 illustrates this new configuration, as an evolution of the two systems (Figures 2.2 & 2.3) into one crop development system. Boundaries between conservation, plant breeding, seed production and dissemination may be reduced with implications for the position of various organisations and experts. For example when a breeder becomes involved in participatory varietal selection, he or she enhances farmers' access to germplasm and farmers' knowledge of variety selection, but also speeds up dissemination of improved varieties (Witcombe *et al.*, 1996). Similarly, seed technologists supporting farmers' maintenance and seed storage technologies contribute to farmers' capacity in variety maintenance (Almekinders & Louwaars, 1999). I would like to stress that these specialists should remain experts in their own fields –breeders are trained in breeding -, but at least at local level their activities should become more integrated. The position of farmers and rural communities as actors shaping the adaptive crop development system is changing. Rather than clients at the end of the institutional chain, they become partners in crop development, conservation, plant breeding, and seed production and dissemination. By strengthening links and relying on the capacity of the local seed supply system, the effectiveness of the institutional system to respond to farmers' needs in marginal environments may increase (Almekinders *et al.*, 2000). This illustrates the complementary and interdependence of institutional and local components in an adaptive crop development system.

The IPGRI *in situ* project refers to a partnership between farmers and institutional actors as follows: "farmers and communities become members of the national plant genetic resources system" (IPGRI, 2000). The CBDC project approached the local system and the link with the institutional system differently. Farmer or community innovation systems are approached as systems on their own. CBDC holds the view that linkages between the community and institutional systems can be established only if appropriate or required from a community perspective (CLADES *et al.*, 1994). As a defence against corporate interests (intellectual

property rights), CBDC had to maintain or construct boundaries between communities and crop development organisations in the institutional system.

Boundaries of an adaptive agro-biodiversity system

When constructing adaptive systems for agro-biodiversity management, one issue remains pending. It refers to the following questions: In what way are system boundaries drawn? Have socio-economic or political criteria been applied? What are the geographic boundaries of local crop development? Have ecological or agro-ecological criteria been applied to define the boundaries of local and adaptive systems? Do they correspond to agro-ecosystem boundaries? Looking at the extensive local variety and seed exchange systems, the following question emerges: To what extent is local local in agro-biodiversity management?

Through variety exchange networks farmers obtain or purchase landrace or improved variety seeds from other "local systems". They cultivate and may start to disseminate the new varieties, and after some seasons these "new" varieties become local within the community and beyond. Farmers may experiment with the materials and may engage in some selection and adaptation. Thus, the local system is dynamic in itself, but also in a complex manner interacts with other local systems, and with actors in the institutional system. For example, wheat farmers in Brazil are linked to wheat farmers in Pakistan and China. Through breeding and seed programmes in these countries, and have become members of a global network of wheat programmes associated with CIMMYT in Mexico. Another dimension has been observed that farmer's seeds flow easily and quickly from one local system to another, and if a variety performs well, it spreads quickly across regions, countries and continents. The institutional system remains important supplying new materials that are disseminated through the local seed supply system.

15.7 Agro-biodiversity platforms

Agro-biodiversity management and particularly the construction and implementation of "on-farm management" is a field in which a diversity of institutional actors meets a diversity of farmers. Platforms are appropriate instruments to facilitate collaboration and engage various actors in participatory learning and action approaches to research, conservation and development. Platforms are "democratic fora" where social actors with different interests meet and through negotiation and mutual accommodation come to a joint agenda for action. A crucial element in the formation of platforms is that the social actors concerned are aware that solutions can only be developed through joint action and learning (Röling & Wagemakers, 1998). In the current section, I discuss the types of platforms established in the projects and organisations described in the case studies and explore their contribution to the social construction and social organisation of the "on-farm management" strategy.

CBDC and IPGRI *in situ*: establishing platforms at various levels

The two global projects (IPGRI *in situ* and CBDC) form different platforms; they are quite specific and successful in the formation of platforms at global, regional, national and local levels. However, it should be realised that within the CBDC Programme as well as the IPGRI *in situ* project considerable institutional, human and financial resources have been invested in their formation. The IPGRI *in situ* project through its larger scale of operations provides substantial (financial) resources for project partners. At global level, the IPGRI *in situ* project

operates as one network, global meetings are important to the establishment of linkages between different countries. The fact that the particularly individual country components contribute directly to the project's scientific output enhances the IPGRI *in situ* project as a platform operating at global level. An important asset of CBDC as a global platform is that it brings together local organisations from different regions that support and study community agro-biodiversity management. However, this asset had not yet been explored in the first phase. The programme focused on the local and regional establishment and implementation. This global aspect of CBDC will be strengthened through thematic collaboration between individual projects as has been proposed for CBDC's second phase. The IPGRI *in situ* project particularly contributes to the establishment of collaboration of NPGRPs with local (GO and NGO) development and farmer organisations. At institutional (national) and practical (local) levels, groups of partners (platforms) implement the project. IPGRI is co-ordinating the project in a manner that strengthens formation of these more integrated platforms. By operating within government structures (NPGRP), the IPGRI *in situ* project contributes to the formation and strengthening of platforms within government organisations. This is in contrast with the CBDC-Programme that in most of its partner countries is operating primarily within an NGO context. Another important issue comparing both international projects is that IPGRI is playing a much stronger co-ordinating role emphasising institutional aspects and collaboration. CBDC is co-ordinated in a collegial and decentralised manner, with a high degree of regional and local autonomy in the implementation. The basis for the established platforms in CBDC is locally stronger compared to the more institutional platforms established in the IPGRI *in situ* project. Through the NGO background of most CBDC partners, organisational platforms rely on external funding. Through their independent position they are better able to support (independent) platforms at grassroots and community levels. However, it should be realised that many *in situ* activities with the NPGRPs implementing components of the IPGRI *in situ* project have only been initiated because project funding has became available. Therefore a similar reliance on international funding exists within this project. The global projects vary in their organisations and types of platforms formed. Through these institutional aspects, but also in their approaches, they are complementary to each other and contribute each in its own way to the development of "new" institutional frameworks that support farmer management of agro-biodiversity.

Ghana, Bhutan and the Netherlands: establishment of agro-biodiversity platforms

In the Ghana case study (Chapter 11), platforms are proposed as crucial elements to assemble various actors in the development of biodiversity products and to facilitate chain development. CBUD will be set up as an independent organisation at the interface of community, conservation, research, development and commercial organisations. A board in which various actors (GOs, NGOs and private companies) are represented governs the centre. It acts as some kind of "National Biodiversity Product Development Platform". It should guarantee the organisation's facilitating position. In its first year of implementation, the CBUD project initiated many product projects. However, the formation of platforms for product development lags behind. The institutional and professional culture among staff and organisations responsible for project implementation results in an emphasis on practical or technical rather than institutional aspects of product development. Thereby, the establishment of platforms for product development as institutional conditions is avoided when starting the project with more practical activities.

In the Bhutan case study (Chapter 10), the project proposal emphasised the formation of a national platform to bridge barriers between agencies responsible for nature conservation and agricultural development within the Ministry of Agriculture. The project will be implemented in the context of the National Biodiversity Programme. Local platforms have been proposed as means to include various local actors in the government system for the implementation of the project in a decentralised and integrated manner. Preparatory activities have focused on the project's technical aspects. An important point raised with respect to the formation of platforms and use of interactive and decentralised approaches concerns the establishment of the Centre within Bhutan's government structures. The use of platforms and interactive approaches would involve a remarkable shift in the institutional organisation of the Ministry and its executive agencies that primarily operate in a linear and top-down manner. I therefore conclude that the proposal has been developed with a strong orientation towards the principles of the donor agency (DGIS, SDA) that are foreign to the Bhutanese agencies that will implement the project.

A similar but also tentative conclusion can be drawn for the use of platforms in the project in Ghana, where a similar drive for interactive approaches was emphasised by the donor. Reflecting upon my own position as team leader during the formulation of both projects, I have acted with a strong donor perspective and was inspired by experiences and opportunities for innovative projects (such as CBDC). The questions remain whether or not these platforms for product development will be established in Ghana and whether or not the local agro-biodiversity platforms will become integral parts of the conservation system in Bhutan. Both projects are still too "young" to reflect upon the success of the proposed approaches.

The Netherlands case study illustrates the importance of the NPGRP being governed by a platform with representatives from various organisations with an interest in agro-biodiversity. Currently, the NPGRP, with CGN as the executive organisation, is operating within a weak institutional framework, in which such a platform only operates as an advisory body. As a result, CGN is restricted in responding to various trends in its institutional and research environment that seem to weaken the Centre's profile as a public organisation. The case study illustrates how in the mid-1990s, the Centre was hampered in its institutional and professional capacity to respond to changes in society with implications for conservation and utilisation of agro-biodiversity. Until 2000, CGN has increasingly tried to be responsive to these trends through various, often informal, linkages. However, these changes have not yet been "translated" into the Centre's institutional framework. A national "agro-biodiversity management platform" may guarantee the public position of NPGRPs particularly within increasingly less public oriented research organisations. Through participation of various actors in the platform, the capacity of conservation organisations to adequately respond to these institutional but also social changes may increase.

Agro-biodiversity platforms: panacea

A general conclusion can be drawn that the formation of platforms of actors involved in agro-biodiversity conservation and development is an important component of the social organisation of the "on-farm management" strategy. A prerequisite is that actors have an interest in collaboration and are aware of the fact that only through joint action and learning, i.e., within the platform, they may achieve conservation, research and development objectives. When working through foreign funded projects, the establishment of these platforms may be

advocated. However, actors' reluctance to share responsibility within and ownership of the project may constrain the establishment and functioning of such platforms. These platforms may not be entirely congruent with the institutional (or political) setting and the dominant professional culture in which they have been established. Success of the project can be measured when the platform provides opportunities for or incentives to facilitate institutional change and renewal in directions agreed upon by actors forming the platform. A constraint may be the dominant professional culture within which platforms have been established. In the case of government organisations, the bureaucratic and top down structure may be in conflict with the more interactive and democratic platforms as intended by foreign donors in "their" agro-biodiversity projects. In some cases, parallel structures (projects, NGOs) with only informal participation of government officials have been built. From these cases, I draw the conclusion that within project frameworks, platforms may easily be established, but wonder to what extent such platforms will sustain as organisations, if that is the goal. Various projects described in the case study may be considered "institutional experiments" or "learning environments", in which the various actors may learn. They may have a temporary status. A general conclusion emerges that platforms are crucial as they link actors in an interactive approach to attaining joint agro-biodiversity management, conservation and utilisation. Facilitation by outsiders may contribute to bridging barriers between actors who have a mutual stake in agro-biodiversity management and conservation. The work of the A-Team in agro-biodiversity projects and the role of IPGRI in country components of its *in situ* projects demonstrate how facilitation by "outsiders" paved the way for interactive approaches to and establishment of platforms at various levels. Facilitation may contribute to creating a basis for taking joint responsibility for agro-biodiversity management. However, I would like to emphasise that platform formation and facilitation should not be considered as a panacea to attaining interactive and more effective agro-biodiversity management. I follow Nathalie Steins (1999) in one of her conclusions in a study on the use of platforms in common-pool resource use negotiation. She concluded that "platforms are not a panacea for solving perceived problems, they are merely instruments for the mediation of problems". Similarly, agro-biodiversity platforms are components of a whole of activities and should not be considered the sole and key elements in the social organisation of the "on-farm management" strategy.

Platforms for adaptive agro-biodiversity management

Agro-biodiversity platforms have been established for conservation and management at global, national, eco-regional and local levels. It is interesting to note that through the construction of the "on-farm management" strategy, local platforms are emphasised as components of regional and national agro-biodiversity management systems. Many efforts have been undertaken to build a global plant genetic resources system (FAO and CBD), form regional networks, such as the ECP/GR in Europe (Chapter 9) and the PGR network in SADC region, and set up national systems that gather various organisations in one programme (NPGRPs). Other such efforts have been undertaken through collaborative programmes or projects operating at global (CBDC, IPGRI *in situ*), regional (particularly CBDC), or national levels (ABC, CBUD, IPGRI *in situ*). These initiatives and networks form management systems at higher levels of agro-biodiversity management. A challenge in all programmes has been to accommodate and create enabling institutional frameworks that support farmer agro-biodiversity management. A general lesson drawn from the organisations, projects and

experiences described in the case studies is that the organisations involved engage themselves in the formation of local platforms. Their function is to facilitate the formation of these platforms, thus strengthening the formation of local groups and mechanisms to address flows of germplasm, knowledge and information. Thus we arrive at the heart of this book, the creation of enabling and adaptive institutional frameworks that support farmer agro-biodiversity management. In the case studies, I have described many barriers encountered in linking conservation and development, and in facilitating interactions between various levels of agro-biodiversity management. In the final section of this chapter, I particularly address these barriers and relate them to models of institutional development and change within the adaptive management framework.

15.8 Policy trends and "on-farm management" of agro-biodiversity

CBD and other fora

Interest in agro-biodiversity and efforts to construct the "on-farm management" strategy can be considered "catalysts" for the renewal of institutional crop development frameworks. I will therefore take a more historical perspective, putting this attention, and organisations and projects described in the book in a wider policy context. CBD provided a framework for working on *in situ* and on-farm conservation strategies. It has been the starting point for activities described. However, other international policy fora are linked to CBD. Most important are the FAO Undertaking on Plant Genetic Resources (IU/PGR) and the Trade Related Aspects of Intellectual Property Rights Agreement (TRIPS), an output of negotiations of the World Trade Organisation (WTO). These international fora and resulting agreements relate in a supportive but sometimes conflictive manner to various CBD components. Therefore, the debate on conservation strategies cannot be viewed in isolation from other policy trends with an impact on agro-biodiversity conservation, management and utilisation.

Appropriation of and decreasing access to agro-biodiversity

One of the CBD objectives refers in indirectly to intellectual property rights (IPRs). CBD proposes the development of mechanisms for fair and equitable benefit sharing. It aims to compensate for IPR development supported by TRIPS. Mechanisms for the appropriation of genetic material have been developed and installed that facilitate the growth of the biotech and breeding industries. These mechanisms have resulted in a reorganisation of flows of germplasm, knowledge and information. This process has been strengthened by the transformation of organisations that before operated in the public sphere of research and breeding into entities that primarily operate in the private domain. This trend is not unique; other once public entities in society (e.g., water and energy supply, telecommunication) follow similar trends. The process of globalisation enforces the resulting dynamics, national boundaries dissolve, and in many cases only few internationally operating companies remain and control the market (e.g., the multinational life science conglomerates). This trend has been clear in crop development; where since the 1970s breeding companies have become part of conglomerates. The trend of globalisation, privatisation and concentration of breeding and plant genetic research has had a major impact on the international policy arena. The Agreement on TRIPS is an important instrument for these conglomerates to open up new markets (when IPR regimes have been installed) for their products or technologies. However, the trend has not occurred without a reaction from society.

The "on-farm management" strategy: in compensation to IPR trends

Already in the 1970s, individuals, research organisations and particularly NGOs (from the North as well as the South) warned against the concentration of plant breeding and genetic resources in the hands of a few companies. Through action, advocacy and raising public awareness, they influence policy makers and critically monitor companies in their operations. But above all, they aim to influence policy makers at national and international levels, particularly opposing the appropriation of genetic material and the dramatic concentration of control over and implicit limitation of access to biodiversity. In FAO, CBD and other international fora, NGOs have been placing civil (farmers' and consumers') interest "on the table". They also advocated the balance of interests of the North and South in these discussions. Their views have been adopted by some governments from the South and sometimes by governments from the North. The conservation and development link in "on-farm management" and mechanisms for fair and equitable sharing benefits were developed as means to "balance" above described trends.

It is important to reflect upon these debates and policy trends in relation to the social construction and organisation of the "on-farm management" strategy. First, *in situ* conservation or "on-farm management" appeared on the agenda as a means to safeguard genetic and ecological processes, but by politicising the debate in the biodiversity arena, it became a North/South and industry/farmer issue. Where CBD and FAO link conservation and development, the strategy emerges as a method to compensate farmers for the appropriation of genetic material by private enterprises. Activities under the "umbrella" of "on-farm management" of agro-biodiversity appear to become instruments that contribute to a fair and equitable sharing of benefits of biodiversity. Multilateral and bilateral development funds have been allocated to biodiversity conservation, and include resources for *in situ* conservation of agro-biodiversity. Thus a strong development link and a method for compensation have emerged in the frameworks to implement the strategy. Both CBD and FAO have elaborated multilateral, international and national mechanisms to support conservation and development. However, these international discussions have resulted in few practical outputs. More practical outputs with respect to the "on-farm management" strategy remain at project or programme levels, the type of outputs described in the current book.

"On-farm management" of agro-biodiversity: looking for alternatives

What can be concluded from these international discussions and resulting policy frameworks over the past two decades is that *in situ* conservation and "on-farm management" were drawn into international IPR and biodiversity debates. The strategies did not only emerge on the international agenda for technical or conservationists' arguments, the interest seemed above all to be politically motivated. Attention to on-farm strategies has been strengthened by the civil reaction to changing boundaries between public and private domains of agro-biodiversity management. The growing articulation of civil society representatives and their participation in various fora is crucial in this context. The CBDC programme with its foundation among some of the most articulated international NGOs operating in the agro-biodiversity arena (RAFI, GRAIN, SEARICE and CLADES) has its roots in a movement to present civil society in policy fora. It thereby links local practice and farmers' or citizens' "realities" with international and national agro-biodiversity policies.

With the management and utilisation of agro-biodiversity, Pistorius and Van Wijk (1999) consider the interest in local strategies a reaction to the ever-increasing industrialisation and globalisation of agricultural production, and thereby the diminishing role of farmers in primary production. Zeeuwse Vlegel in the Netherlands is an illustration of a farmer's response to this trend. It looks for local and more ecologically sound, but economically viable alternatives to arable farming. The Netherlands case study illustrated numerous barriers in dominant actor networks and institutional frameworks. Zeeuwse Vlegel has been rather effective in translating the often abstract policy issues into rather practical terms, as has been illustrated by the case of the return of *Sunnan* on the Variety List (Box 9.3).

In an international, but also national context, it is quite logical that interest groups representing farmers groups and consumers concerned have put much emphasis on "on-farm management". Not primarily because they are concerned with conservation, but more because the strategy is linked with more ecologically sound and regionally based modes of agricultural production. Therefore, it is not surprising that in all case studies, efforts to construct local conservation strategies end up by supporting farmers' utilisation of agro-biodiversity, often in a context of sustainable agricultural development. A most prominent illustration of this link can be found in the development of the IPGRI *in situ* project. It was initiated with a conservation and scientific perspective on the strategy's construction. It has gradually developed into a project that emphasises the science and practice of local agro-biodiversity management in a context of sustainable agriculture.

The cases have indicated that in the practical implementation of activities to contribute to conservation of agro-biodiversity, the policy issues with respect to control over, ownership of and benefit sharing remain rather abstract. They are important, as has been demonstrated in the Netherlands case (Zeeuwse Vlegel; *Sunnan*), but they need to be addressed in a wider context of agricultural development. In this context the CBDC programme is an important experiment because of its strong civil orientation in the organisation (protocol) of flows of germplasm, knowledge and information. CBDC can be considered a new type of collaborative project, in which "alternative" platforms for agro-biodiversity management have been established parallel to formal or government dominated platforms. I conclude that the current international and national policy trends have necessitated partners in agro-biodiversity platforms (such as CBDC) to address these issues. They thereby develop alternative systems for the organisation of agro-biodiversity management. Through a focus on local management, these systems support the link between social and ecological dynamics that is crucial to the development of sustainable agriculture.

15.9 Renewal of institutional frameworks

NPGRPs and actors in various domains

From the previous section it can be concluded that politicisation of the agro-biodiversity arena has resulted in the need for a strict organisation of flows of germplasm, knowledge and information. In the case studies, we have seen that CGN as an NPGRP is only providing access to its collections to users that sign a "Material Transfer Agreement". CBDC uses a protocol and for CBUD and ABC similar protocols have been proposed. It is important to note that such an organisation of flows does not only refer to germplasm but also the associated knowledge and information. These efforts bring us back to public, private and civil

organisations that are involved in crop development, and in particular to the position of NPGRPs in society.

NPGRPs have been established as public organisations. They are embedded in the institutional system of crop development and focus on the use of the *ex situ* strategy increase access of plant breeding companies and research organisations to crop genetic diversity. We should consider NPGRPs as service organisations cater for the needs of actors who primarily operate in the public and private domains. Through their policies of access to any "bona fide" user elaborated in the FAO-IU/PGR, NPGRPs by definition operate in the public domain.

As described in the previous section, the institutional and political environment in which NPGRPs operate has changed dramatically over the past two decades. In a country such as The Netherlands, plant breeding and associated research have moved from national organisations in the public domain to globally oriented breeding and research programmes. Where national public and private breeding programmes were the original clients and partners of NPGRPs, these partners have become programmes that are parts of these conglomerates. At the same time, the surrounding institutional research environment is moving from a public to a market oriented research organisation. This institutional and strategic change is rather strong in The Netherlands, but is also encountered in other industrialised countries (Pistorius & Van Wijk, 1999).

In developing countries, NPGRPs are generally operating within NARSs. But only few countries have recognised the importance of conservation and built the necessary physical and institutional infrastructure (e.g. Brazil, Ethiopia and India). However, in many developing countries (particularly in Africa), NPGRPs are barely operational. If they exist at all, they have also established close links with or within breeding programmes (see Ghana). Due to absence of a commercial sector in breeding of many food crops, public breeding plays an important role. These countries increasingly rely on international breeding and conservation programmes (CGIAR). Concerning conservation, such reliance is not in line with CBD that has emphasised national responsibility for conservation biodiversity.

Changing institutional frameworks

If we consider NPGRPs as agro-biodiversity platforms, the above described trends in the policy and institutional setting of crop development and conservation strengthen the link of conservation programmes with actors in the private sector. Policy NGOs start to question to what extent NPGRPs remain public entities. Similarly, the interest in "on-farm management" at national level demonstrates that NPGRPs have partners and clients in the civil domain. The IPGRI *in situ* project uses the strategy of linking NPGRPs with local development organisations and NGOs. In the Netherlands case study, it became clear that NPGRPs are embedded in such an institutional framework, which makes it very difficult to work at practical level for and with civil organisations.

Various case studies describe how projects turned out to become learning environments for conservation organisations and conservationists in the interface between conservation and development. I have described the barriers they have encountered. However NPGRPs have been established as programmes with strong technical and often narrowly defined conservation mandates, which constitute crucial barriers. I concluded that social construction and organisation of "on–farm management" implies a shift in the conservation paradigm. Where

NPGRPs have been set up and are embedded in institutional frameworks that generally operate along "normal" science lines, the change appears rather dramatic, but not unique. It results from general trends focusing on the use of participatory and interactive approaches to agricultural research and natural resource management. It is clear that NPGRPs can learn from the experiences and draw on similar approaches developed in participatory plant breeding, supporting local seed supply; integrated pest and natural resource management.

"On-farm management" and the "social contract"

The changing position of NPGRPs in society and link with farmers or civil society emphasise what Jiggins & Röling (2000) refer to as the "social contract". As public organisations, NPGRPs are directly responsible for operating with a "social contract"; they are socially and also politically accountable for their actions. This applies to local, regional, national and international crop development and conservation organisations that operate in the public domain. So far NPGRPs have a "contract" with actors who operate in public and private domains. As demonstrated in previous sections, NGOs that represent civil society interests, play an important role in monitoring public conservation organisations at international and national levels. They thereby balance or counteract the move of conservation and research organisations. NGOs may also facilitate links between NPGRPs and civil society, to pursue the former becoming more responsive to demands made by farmers and farmer groups. Processes of institutional change are difficult and require considerable time. But if successful, they will contribute to renewal of the social contract between farmers and public conservation organisations.

The ongoing discussion on genetically modified organisms demonstrates that this social contract also applies to the relationship between consumers and farmers, with both public and private organisations involved in agro-genetic research. The GMO debate shows that genetic research has "estranged" itself from society, thereby risking the loss of its social contract and risking social acceptance of biotechnology products. This value of the social contract has been clearly demonstrated by the current shifts of Monsanto in the GMO and biotechnology debate. It had become clear that the company's shareholders have become concerned about Monsanto's social contract with stakeholders in society (Economist, 25 March 2000).

Paths of institutional change and learning

With the adaptive cycle of renewal, Holling (1986; 1995) has provided an exciting perspective to identify patterns of development of ecosystems and associated management. The cycle can be used to reflect upon changes in agro-biodiversity systems at various levels. The four phases in the cycle represent stages that vary in the degree of connectedness of the system components and the quantity of stored "capital" in the system. The phases are exploitation, conservation, release and re-organisation (Section 5.1). I have used the cycle to present developments in the global biodiversity system over the past decades (Figure 15.4). Two cycles move from modernisation of agriculture and the green revolution (exploitation; Square A) to interest in *in situ* conservation and "on-farm management" and agro-biodiversity projects described in the book (renewal; square H). It should be realised that placing these projects in square H is rather optimistic. In such a scenario, projects such as CBDC, IPGRI *in situ*, CBUD and Zeeuwse Vlegel may act as catalysts to change agro-biodiversity management. A more pessimistic scenario places them as parts of square G (release) with still a long path to

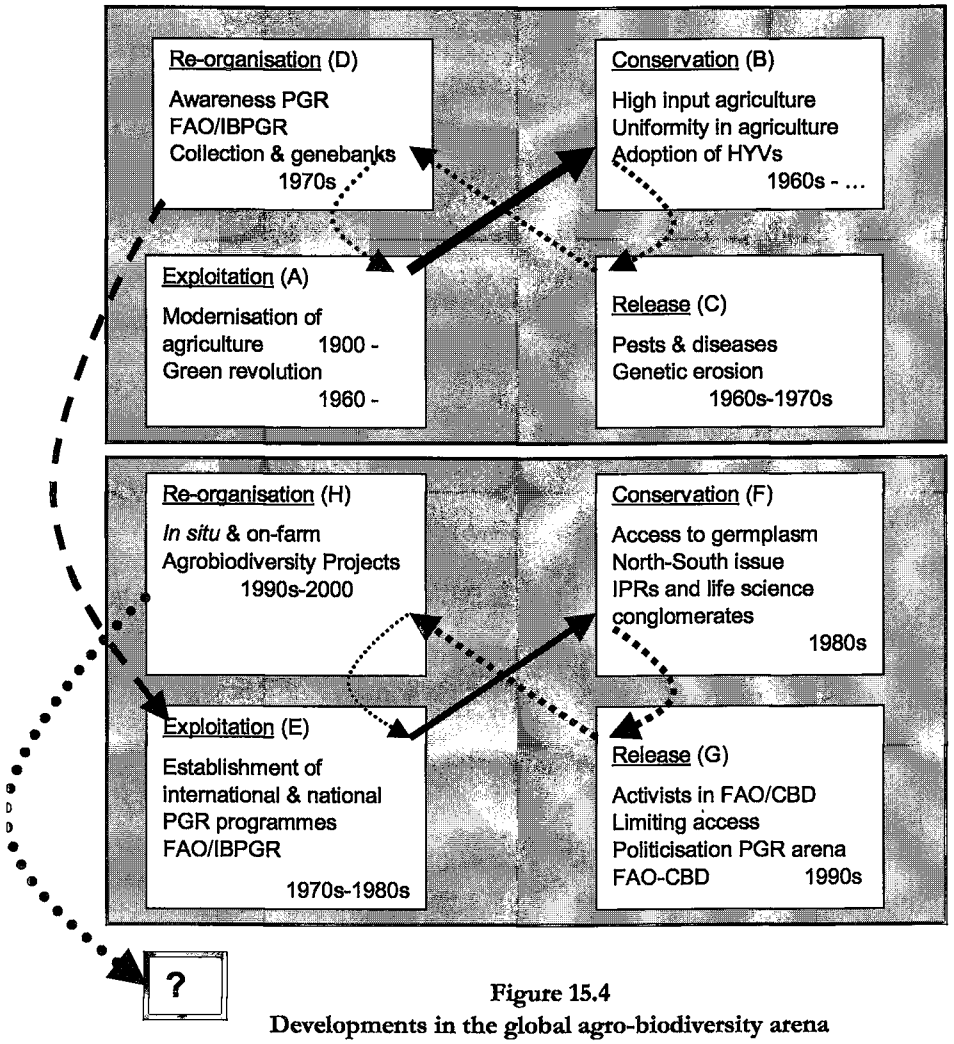

Figure 15.4
Developments in the global agro-biodiversity arena using the renewal cycle

go leading towards mainstreaming their approaches. The efforts described are relative small and isolated. The 70 hectares of Zeeuwse Vlegel are just a bit more than the average field crops farm in the Netherlands. CBDC works all over the world, but with few farmer communities in each country. IPGRI *in situ* is active within the national system in five countries. These projects are few of the initiatives taken following CBD in 1992. Together with Conny Almekinders, I have compiled in the book "Encouraging diversity" a total of 80 cases of conservationists, breeders, seed specialists, development workers, policy makers and farmers who encourage the use of genetic diversity in farming both in the North and in the South (Almekinders & de Boef, 2000). In addition to an encouraging diversity of experiences and activities in line with activities described in the current book, "Encouraging diversity" illustrates alarming situations of local or regional "agro-biodiversity systems" "flipping" to

irreversible loss of agro-biodiversity and associated agro-ecosystem resilience (Basilio & Razon, 2000; Mercer & Wainwright, 2000). It should therefore be realised that, following the original model of the adaptive cycle, the renewal phase (square H) is critical in keeping a (eco) system in the adaptive cycle.

Within each transition from one phase to another in the adaptive cycle, Gunderson *et al.* (1995b) identified groups that play a dominant role. These players have been characterised in Section 5.3. With ecosystems moving through the phase, Gunderson and colleagues identified that (i) bureaucrats are dominant in the change from exploitation to conservation, (ii) activists play an important role in the move from conservation to release, (iii) catalysts are crucial to the move from release to reorganisation, and (iv) strategic decision makers are crucial moving back from re-organisation to exploitation. Figure 15.5 illustrates more in detail the cycle of adaptive renewal for the period covered in this book. In this figure, I have included the three types of action identified by Hurst (1995) in his translation of Holling's ecocycle into an organisational management model. The "lazy eight" moves through phases of constrained, rational and emergent action, each with specific management instruments to guide organisations through these cycles. Applying the adaptive cycle to social organisations, Hurst added human rationality. If we put CBD in square G closing the phase of creative destruction, it has created opportunities for rational action moving to a phase of renewal, thus move away from the constrained actions in the right side of the loop. Within the loop leading from square G to H, I have put projects that I have described in the book. And with the above described

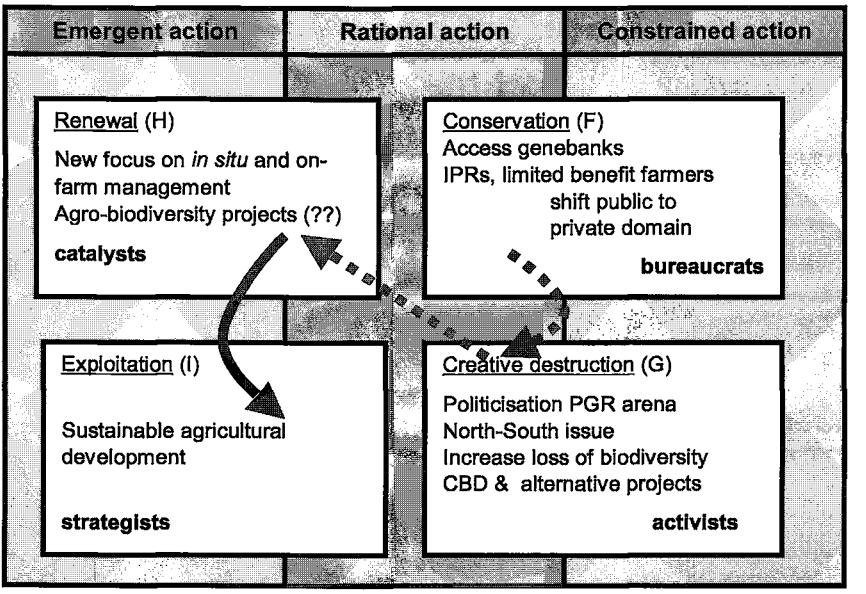

Figure 15.5
Renewal in the agro-biodiversity arena and dominant groups contributing to the social construction and social organisation of "on-farm management"
based on Gunderson *et al.*, 1995; Hurst, 1995

optimistic scenario, the projects form elements of the renewal phase. In various case studies, I have used the adaptive cycle and typology of dominant groups to explore patterns of interactions within projects or organisations playing a role in agro-biodiversity management. If we look at the position of the A-team, I realise that we have been moving as activists from creative destruction to catalysts in renewal, i.e., the formation of new or experiential frameworks. Whether that actually has been our role in the global agro-biodiversity system can only be reflected upon in the years ahead. The model is very illustrative to reflect on the past, but cannot be used to predict the future. The model is useful in developing strategies to manage and respond to change in the present. The extent, to which our efforts to construct the "on-farm management" strategy, in the years following CBD, has contributed to conservation of agro-biodiversity and to development of a more sustainable agriculture, depends on many complex and unpredictable factors. An important factor is the extent to which institutional crop development frameworks will start to support farmer management of agro-biodiversity and sustainable agricultural development. But above all, it will depend whether or not, we will find a way to learn about and build upon the unpredictable social and ecological dynamics that shape agro-biodiversity as an ecological service crucial to agriculture.

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SUMMARY

In 1992, the Convention on Biological Diversity (CBD) was signed by a large number of countries in Rio de Janeiro. This Convention constitutes a framework linking biodiversity conservation and development. CBD also emphasises the *in situ* strategy for biodiversity conservation. In the years following CBD, the strategy and agro-biodiversity management received much attention. This book reports on some of the initial efforts to develop and implement *in situ* conservation through the support of farmer management of agro-biodiversity. Because of the dynamic nature of the human and natural components of agro-biodiversity the strategy aims to maintain, it is referred to as "on-farm management" of agro-biodiversity. While studying efforts to develop the strategy, social and institutional aspects of the strategy's development are addressed; these are referred to as the strategy's social construction and social organisation.

The book reflects on experiences of a team that worked at the Centre for Genetic Resources, the Netherlands between 1990 and 1998. The team was involved in the development of agro-biodiversity projects in many developing countries. The experiences of the author, the team and their colleagues from the South form the foundation to the book.

The strategy has been studied within a framework of experiential learning. Two socio-ecological perspectives have been used to provide the theoretical framework for reflection. These perspectives are used for the development of "windows of reflection" that guide and structure five case studies on agro-biodiversity projects and organisations.

Adaptive management is the first socio-ecological perspective used. It has been developed by ecologists involved in the management of large ecosystems. Policy and management organisations form a triangle with citizens in an adaptive framework for ecosystem management. Research provides feedback between the management system and the ecosystem and facilitates linkages between components. Social learning is considered an important attribute to adaptive management, as it strengthens management and policy organisations and citizens in their capacity to adapt management practices and policies to the managed ecosystem's ecological and social dynamics.

The second socio-ecological perspective is based on the ecological knowledge system. It addresses the social and institutional aspects for the development of sustainable agriculture. Its dimensions are farmers' practices, learning, facilitation, supportive institutions and networks and conducive policies. The book uses these perspectives in an area application foreign to the field in which they have been developed. The perspective's dimensions have been used in the development of four "windows of reflection" that have guided the organisation of information gathered. The four "windows" guide and focus the case studies on (i) actors involved; (ii) flows of germplasm, knowledge and information; (iii) the social organisation of projects, organisations and the strategy's development; and (iv) the social construction of the strategy and efforts to link conservation and development.

The first case study is located in the Netherlands, the author's home country. Institutional aspects of CGN as the National Plant Genetic Resources Programme (NPGRP) or "gene-

bank" have been described. Zeeuwse Vlegel is introduced; it is a farmer organisation involved in the production of more ecologically sound and regional bread. In the case study, an attempt to establish linkages between the "genebank" and a farmer organisation is analysed. The study reveals that both actors are operating at the far ends of a crop development chain. CGN is not in a position to directly support a farmer organisation in its search for appropriate wheat varieties. It illustrates how dominant institutional frameworks and actor networks limit actors to collaborate and promote utilisation of agro-biodiversity. This situation is worsened by the gradual shift of agricultural research from the public to the private domain and by the unclear CGN's institutional framework.

The second case study describes a project to establish an Agro-Biodiversity Centre in Bhutan. It emphasises an integrated conservation approach to the development of an NPGRP. Important elements include the use of agro-biodiversity surveys as tools for prioritisation of conservation strategies (*in situ*, *ex situ* and on-farm), and targeting conservation actions at crops and locations. Another element is a decentralised organisation. It was proposed to develop local and regional agro-biodiversity platforms. The third case study stresses the formation of platforms in the development of biodiversity products. It describes a project to establish a Centre for Biodiversity Utilisation and Development in Ghana. This Centre plays a facilitation role in the initiation of activities and establishes linkages between social actors necessary for development of and marketing biodiversity products. Both the Bhutan and Ghana case studies are primarily based on formulation missions and only cover to a limited extent the projects' initial activities.

The fourth case study describes and analyses institutional aspects of the *in situ* project of the International Plant Genetic Resources Institute (IPGRI). It undertakes activities in nine countries across the world and has been set up as a global effort to strengthen the scientific basis of *in situ* conservation on-farm. The project is implemented within the framework of NPGRPs, which through participation of NGOs and farmer groups are gradually opened up to new partners. The case study reveals that during the project's initial years IPGRI and its partners have added a strong development orientation to the project. The chapter also illustrates in what way the focus has shifted from science and conservation to utilisation of agro-biodiversity within a context of sustainable agriculture.

The fifth case study describes and analyses efforts of the Community Biodiversity Conservation and Development (CBDC) Programme to develop and construct the *in situ* and on-farm conservation strategies. This programme is implemented by a group of NGOs complemented by some governmental genebanks, research organisations and university groups. It is operational in 16 countries on five continents. CBDC's focus is on strengthening community agro-biodiversity management. The case study illustrates CBDC's effort to develop a protocol for collaboration linking a diversity of organisations in one programme. It also illustrates attempts to link global and local objectives to support farmer management of agro-biodiversity. It is concluded that the programme in its initial years emphasised local capacity building and community empowerment. In its local orientation, CBDC is complementary to the IPGRI *in situ* project that operates within national frameworks and focuses on globally co-ordinated research. CBDC is above all considered an institutional experiment bringing together a diversity of locally operating organisations in an interactive and "bottom-up organised" programme.

Conclusions have been drawn on the socio-ecological perspectives and institutional frameworks that support farmer management of agro-biodiversity. A key output is that "on-farm management" of agro-biodiversity should be considered by actors in the institutional crop development system an emergent property of an agro-biodiversity system formed by farmers and other actors involved. In the initial technical efforts, conservationists had considered it difficult to develop the strategy. When considering "on-farm management" a human activity system, it is evident that these conservationists were constrained by their "hard" and technical approach. The ecological perspective on agro-biodiversity as an agro-ecological service has been recognised, when placing agro-biodiversity in a context of increasing agro-ecosystem resilience. An important lesson is that "on-farm management" should not only be perceived as a conservation strategy but rather as a strategy that supports and strengthens farmer management and utilisation of crop genetic diversity.

In an application of grounded theory, some lessons can be learnt about adaptive management and the ecological knowledge system as socio-ecological perspectives. An important lesson learnt is that rather than ecological objectives emphasised in both perspectives, political, institutional, scientific and conservation objective should motivate actors in agro-biodiversity projects. A second lesson refers to the boundaries drawn for the application of both perspectives on agro-biodiversity management. When using soft system thinking, actors socially construct system boundaries. Because of the mobile and reproductive nature of agro-biodiversity, system boundaries may be defined at various local levels. In an application of adaptive management, each agro-biodiversity system may construct institutional frameworks in which management, policy and citizen organisations are linked. Various case studies illustrate that the establishment of agro-biodiversity platforms and facilitation in processes of social learning and joint experimentation are prominent components in an adaptive organisation of agro-biodiversity management.

NPGRPs' opportunities to support farmer management have been explored. Interactions with other actors involved in crop development have been elaborated. Barriers into institutional frameworks and professionalism are described. Some of the case studies explore the ways in which these barriers can be bridged. It is further emphasised that the flow of germplasm, knowledge and information within the institutional crop development system should be modified from a linear to an integrated organisation in which conservationists, breeders and seed specialists link with farmers' local systems. When building an agro-biodiversity management system, the boundaries between institutional and local (farmer) crop development fade away. Farmers become crop development organisations' partners in conservation, breeding and seed supply.

Efforts to construct "on-farm management" and its social organisation are placed within context of current policy trends and changes in institutional agro-biodiversity frameworks. It is evident that the Convention cannot be isolated from other policy fora such as the FAO-IU/PGR and WTO/TRIPS. In this context, attention to the strategy may be viewed as a reaction to processes of "appropriation" of and limiting farmers' access to agro-biodiversity. The strategy emerges as a civil reaction to a decreasing public and increasing private presence in agro-biodiversity management. With respect to the institutional frameworks, the social contract between NPGRPs as public entities within society is emphasised. Conservation, but also other public and private organisations can only operate through a social contract with

civil society; they are socially and politically accountable to civil society. This issue links this book with the current GMO debate in which the modern biotechnology's social contract is a major issue.

Based on the adaptive management perspective, the activities described and analysed in this book are placed within a historical perspective on institutional renewal in the agro-biodiversity arena. A preliminary conclusion can be drawn that the activities and projects described should be considered to open up a path to a more adaptive approach to agro-biodiversity management and more ecologically sound agriculture. However, it is too early to draw conclusions whether or not they form alternative projects or comprise initial attempts that contribute to a new configuration and organisation of agro-biodiversity management and crop development. The book describes and analyses projects initiated shortly after the Convention was signed. It is considered too early, to analyse their impact on and potential contributions to the processes of institutional renewal required for institutional frameworks more actively to support farmer management and utilisation of agro-biodiversity.

SAMENVATTING

Verhalen over het onvoorspelbare. Leren over institutionele kaders voor de ondersteuning van het beheer door boeren van landbouwbiodiversiteit

In 1992 tekende een groot aantal landen in Rio de Janeiro de Biodiversiteitconventie (CBD). Deze Conventie schept een kader, waarbinnen een verband gelegd kan worden tussen biodiversiteitbehoud en ontwikkeling. Verder ligt de nadruk op de *in situ* strategie voor het behoud van biodiversiteit. Deze strategie en het beheer van landbouwbiodiversiteit hebben in de daaropvolgende jaren veel aandacht gekregen. Dit boek kan worden beschouwd als een verslag van de eerste pogingen om strategieën voor *in situ* behoud te verwezenlijken door het ondersteunen van het beheer van landbouwbiodiversiteit. De term "boerenbeheer" wordt gebruikt omdat landbouwbiodiversiteit dynamisch is door menselijke handelen en natuurlijke processen. Zulke processen kunnen niet behouden oftewel geconserveerd worden. Daarom wordt gesproken van beheer in plaats van behoud. In het boek worden de institutionele aspecten van deze strategie bestudeerd.

In het boek is een terugblik op ervaringen van een team dat tussen 1990 en 1998 heeft gewerkt op het Centrum voor Genetische bronnen, Nederland (CGN). Dit team heeft zich bezig gehouden met het opzetten van landbouwbiodiversiteitprojecten in ontwikkelingslanden. Het boek is gebaseerd op de ervaringen van de auteur, dit team en hun collegae in het Zuiden.

Het onderzoekskader van het boek wordt omschreven als "leren door ervaring" (*experiential learning*). Hierbij zijn twee sociaal-ecologische perspectieven gebruikt die een theoretisch kader vormen. Op basis hiervan zijn "ramen" ontwikkeld waardoorheen teruggeblikt kan worden (*windows of reflection*). Deze ramen zijn gebruikt om de case studies over landbouwbiodiversiteitprojecten en –organisaties te structureren.

Het eerste sociaal-ecologische perspectief wordt omschreven als adaptief beheer. Het is ontwikkeld door ecologen, betrokken bij het beheer van grote ecosystemen. Burgers, en beleid- en beheerorganisaties vormen een driehoek voor een adaptief beheer van een ecosysteem. Tussen de componenten in de driehoek enerzijds en tussen de beheerders en het ecosysteem anderzijds is terugkoppeling mogelijk door onderzoek. Sociaal leren is een belangrijk onderdeel van adaptief beheer omdat het burgers, en beheer- en beleidorganisaties ondersteunt in het voortdurende aanpassen van praktijk en beleid aan de sociale en ecologische dynamiek van het ecosysteem.

Het tweede sociaal-ecologische perspectief is gebaseerd op het ecologische kennissysteem dat zich richt op de sociale en institutionele aspecten van de ontwikkeling van duurzame landbouw. Boerenpraktijk, leren, facilitatie, ondersteunende instituties en netwerken, en stimulerend beleid vormen de dimensies van het ecologische kennissysteem. In het boek worden de twee perspectieven gebruikt in een veld dat buiten het veld ligt waarbinnen zij zijn ontwikkeld. De sociale en ecologische dimensies worden gebruikt in tijdens de studie van de institutionele aspecten van boerenbeheer van landbouwbiodiversiteit. Op basis van deze dimensies zijn de vier "ramen" ontwikkeld die een leidraad zijn voor het verzamelen van gegevens. De

vier ramen dienen als een soort gids voor het schrijven, de analyse en het lezen van de case studies. De "ramen" beslaan (i) betrokken sociale actoren; (ii) stromen van genetisch materiaal, kennis en informatie; (iii) de sociale organisatie van projecten, organisaties en de ontwikkeling van de strategie; en (iv) de sociale constructie van de strategie en pogingen om een verband te leggen tussen behoud en ontwikkeling.

De eerste case studie speelt zich af in Nederland. Er wordt een beschrijving gegeven van de Institutionele aspecten van het CGN als Nationaal Programma voor Plant Genetische Bronnen (NPGRP) of "genenbank". Voorts wordt de Zeeuwse Vlegel, een boerenorganisatie, beschreven. Deze houdt zich vooral bezig met regionale en milieuvriendelijke broodtarweproductie en de marketing van "Zeeuwse Vlegel brood". Een poging wordt beschreven en geanalyseerd om samenwerking tussen CGN en Zeeuwse Vlegel tot stand te brengen. De studie toont de plaats van beide actoren aan de uiteinden van de keten voor gewasontwikkeling. Het CGN blijkt in een beperkte mate in staat te zijn om de Zeeuwse Vlegel als boerenorganisatie te ondersteunen bij het zoeken naar aangepaste tarwerassen. Dit geeft aan dat de dominante institutionele kaders en actornetwerken deze spelers beperken in het komen tot samenwerking en het bevorderen van gebruik van landbouwbiodiversiteit. Deze situatie is verslechterd door een geleidelijk heroriëntatie van landbouwkundig onderzoek van het publieke naar het private domein en door het onduidelijke institutionele kader waarbinnen CGN opereert.

De tweede case studie beschrijft een project waarin een Agrobiodiversiteitscentrum (ABC) in Bhutan werd opgezet. De nadruk ligt op een geïntegreerde aanpak van de ontwikkeling van een NPGRP. Belangrijke elementen van deze aanpak zijn landbouwbiodiversiteitsurveys. Deze worden gebruikt voor het vaststellen van welke conserveringsstrategieën (*in situ*, *ex situ* en boerenbeheer) voor welk gewas gebruikt kunnen worden en waar. Een ander element van de geïntegreerde benadering betreft de voorgestelde decentrale aanpak. Lokale en regionale platformen voor landbouwbiodiversiteitbeheer spelen hierbij een belangrijke rol. Ook in de derde case studie zijn platformen belangrijk. Hier worden ze gebruikt ter bevordering van de ontwikkeling van biodiversiteitproducten. Deze case studie beschrijft een project in Ghana waarbij een Centrum voor Biodiversiteitgebruik en –Ontwikkeling (CBUD) werd opgezet. Dit centrum heeft een faciliterende rol in het initiëren en tot stand brengen van samenwerking tussen een aantal sociale actoren in projecten waar producten, worden ontwikkeld, en tevens een keten voor productie en marketing wordt opgezet. De Bhutan en de Ghana case studies zijn gebaseerd op formuleringsmissies en gaan in beperkte mate in op de huidige activiteiten.

De vierde case studie beschrijft en analyseert institutionele aspecten van het *in situ* project van het Internationale Instituut voor Plant Genetische Bronnen (IPGRI). Dit project omvat activiteiten in negen landen, verdeeld over de gehele wereld. Het is opgezet in een poging om wetenschappelijk onderzoek te doen op wereldniveau om zodoende de *in situ* conserveringsstrategie te ontwikkelen. Het project wordt voornamelijk uitgevoerd binnen het kader van NPGRPs. Door deelname van NGOs en boerengroepen aan nationale componenten van het project, worden deze nu ook geleidelijk aan betrokken bij de uitvoering van NPGRPs. Deze case studie heeft aangetoond hoe IPGRI en haar partners gedurende de eerste jaren een ontwikkelingsgerichte benadering hebben toegevoegd aan de oorspronkelijke wetenschappelijke oriëntatie. Verder wordt meer nadruk gelegd op gebruik van landbouwbiodiversiteit in een

context van duurzame landbouw, dan op wetenschap en behoud zoals oorspronkelijk het plan was.

De vijfde case studie beschrijft en analyseert pogingen van het Community Biodiversity Development and Conservation (CBDC) Programma om *in situ* conservering en boerenbeheer als strategieën te ontwikkelen. Het programma omvat een groep van NGOs en enkele nationale genenbanken, onderzoeksorganisaties en universiteiten. CBDC is actief in 16 landen op vijf continenten. Het programma benadrukt versterking van de capaciteiten van boerengemeenschappen in biodiversiteitbeheer. De case studie toont aan hoe binnen CBDC een protocol werd ontwikkeld dat wordt gebruikt om binnen een verscheidenheid aan organisaties samenwerking te bewerkstelligen. De studie beschrijft eveneens pogingen van CBDC om een verband te leggen tussen doelstellingen die op wereld- en lokaal niveau geformuleerd zijn. Het programma richtte zich in de eerste jaren op capaciteitsopbouw en *empowerment* van boerengemeenschappen. Door haar lokale oriëntatie is CBDC complementair aan het IPGRI *in situ* project dat vooral opereert binnen het nationale kader en waarin onderzoek op wereldniveau wordt gecoördineerd. Het CBDC kan met name beschouwd worden als een institutioneel experiment waarbij talrijke lokaal opererende organisaties samenwerken in een interactieve en *bottom-up* georganiseerd programma.

Geconcludeerd kan worden dat de sociaal-ecologische perspectieven en het institutionele kader, boerenbeheer van landbouwbiodiversiteit ondersteunt. Een belangrijke uitkomst is dat de strategie door de actoren in het institutionele gewasontwikkelingsysteem beschouwd kan worden als een *emergent property* van het landbouwbiodiversiteitsysteem (als *soft system*) dat door boeren en andere actoren wordt gevormd. Dit is belangrijk voor conserveringexperts die problemen hebben gehad met de ontwikkeling van de strategie, omdat ze deze met een "*hard system*" benadering en op een technische wijze aanpakten. Als we landbouwbiodiversiteit plaatsen in een context van toename van buffercapaciteit (*resilience*) van agro-ecosystemen dan wordt het erkend als een agro-ecologische dienst. Boerenbeheer over landbouwbiodiversiteit wordt dan niet alleen beschouwd als conserveringstrategie maar als een strategie die het beheer en gebruik van gewasgenetische diversiteit ondersteunt en versterkt.

Door gebruik te maken van de *grounded theory* kunnen enkele lessen geleerd worden over adaptief beheer en het ecologische kennissysteem. Een belangrijke les is dat actoren in landbouwbiodiversiteitprojecten in hun activiteiten niet op voorhand ecologisch gemotiveerd zijn, maar vooral politieke, institutionele of wetenschappelijke argumenten naar voren brengen of conservering gebruiken als motivatie voor hun activiteiten. Een tweede les die geleerd kan worden betreft het belang van het vaststellen van systeemgrenzen. Grenzen van systemen (*soft systems*) worden sociaal geconstrueerd door actoren. Zij dienen op verscheidene niveaus vastgesteld te worden omdat landbouwbiodiversiteit uitermate mobiel en ook nog reproductief is. Door toepassing van adaptief beheer worden binnen elk landbouwbiodiversiteitsysteem institutionele kaders ontwikkeld die beheer, beleid en burgers met elkaar verbinden. Uit verschillende case studies blijken dat de nadruk in die processen ligt op sociaal leren en gezamenlijke onderzoeksuitoefening. Landbouwbiodiversiteitplatformen en facilitatie zijn belangrijke componenten van een adaptieve organisatie binnen landbouwbiodiversiteitbeheer.

Andere lessen hebben betrekking op de institutionele kaders die boerenbeheer van landbouwbiodiversiteit ondersteunen. Deze lessen hebben met name betrekking op pogingen

van NPGRPs om boerenbeheer te ondersteunen en hierdoor bij te dragen aan de uitvoering van de conserveringstrategie. In de case studies zijn verschillende barrières met betrekking tot institutionele kaders en professionalisme beschreven. Ook wordt voor enkele van deze barrières een beschrijving gegeven hoe deze overwonnen kunnen worden. Belangrijk is hierbij dat de stromen van genetisch materiaal, kennis en informatie tussen boeren en actoren in het institutionele systeem gewijzigd dienen te worden van een lineaire tot een geïntegreerde organisatie. Dit houdt in dat conserveringexperts, plantenveredelaars en zaadspecialisten nauwer samen moeten werken met boeren. In de context van gewasontwikkelingsystemen wordt de grens tussen wat door institutionele actoren wordt ondernomen en wat boeren doen in het lokale systeem steeds vager. Boeren ontwikkelen zicht tot partners van deskundigen op het gebied van conservering, plantenveredeling en zaaizaadvoorziening.

Pogingen om boerenbeheer als strategie te ontwikkelen en de hiervoor benodigde sociale organisatie dienen geplaatst te worden in een samenhang van de huidige politieke tendensen en veranderingen in institutionele landbouwbiodiversiteitkaders. De Biodiversiteitconventie kan niet losgekoppeld worden van andere internationale fora zoals de FAO-IU/PGR en WTO/TRIPS. Aandacht voor de boerenbeheerstrategie kan beschouwd worden als een reactie op processen die hebben geleid tot het zich toeëigenen (*appropriation*) en het beperken van toegang door boeren tot landbouwbiodiversiteit. De strategie kan dus worden beschouwd als een civiele reactie op een zich terugtrekkende publieke sector in landbouwkundig onderzoek en een toenemenende private aanwezigheid en dominantie in landbouwbiodiversiteitbeheer en gewasontwikkeling.

Met betrekking tot de institutionele kaders ligt de nadruk op het sociale contract van NPGRPs met de maatschappij, zeker gezien het feit dat NPGRPs per definitie publieke instellingen zijn. Organisaties die zich bezig houden met behoud, maar ook andere publieke en private organisaties kunnen alleen functioneren in de maatschappij via een sociaal contract met burgers. Oftewel deze organisaties dienen sociaal en politiek verantwoording af te leggen aan de publieke opinie (*civil society*). Het sociale contract verbindt het boek met het huidige GMO debat waarbij het sociale contract van genetisch onderzoek en dientengevolge de maatschappelijke aanvaardbaarheid van en ontwikkeling van een publieke opinie over biotechnologische producten belangrijke onderwerpen van discussie zijn.

De activiteiten, die het boek beschrijft en analyseert, kunnen op basis van het adaptief beheerperspectief in een historisch kader van institutionele vernieuwing in de landbouwbiodiversiteitarena geplaatst worden. Een voorlopige conclusie is dat deze activiteiten en de betrokken projecten vooral nieuwe mogelijkheden scheppen om te komen tot een adaptief beheer van landbouwbiodiversiteit en duurzame landbouwbeoefening. Het is echter te vroeg om vergaande conclusies te trekken of deze nieuwe projecten al dan niet bijdragen aan vernieuwing en reorganisatie van de institutionele kaders voor het beheer van landbouwbiodiversiteit en voor de gewasontwikkeling of dat deze slechts een tijdelijk alternatief zijn voor beperkte toepassing. Het boek beschrijft projecten en activiteiten welke geïnitieerd zijn kort na de Biodiversiteitconventie. Het blijkt te vroeg om de potentiële bijdrage te bepalen op institutionele hervormingen die nodig zijn om boerenbeheer van landbouwbiodiversiteit te ondersteunen. Er worden een aantal paden en voorbeelden beschreven en geanalyseerd waarlangs het kader zich zou kunnen ontwikkelen.

Glossary

An actor is a person who acts or performs, the people and groups that are responsible for carrying out human activities (adapted from Wilson & Morren, 1990).

Adaptive management is the release of human opportunities that require flexible, diverse and redundant regulation, monitoring that leads to corrective action, and experimental probing of the continuously changing reality of the external world (Holling, 1996).

Agro-biodiversity can be defined as biodiversity in agriculture. More specifically it includes all crops and livestock and their wild relatives, and all interacting species of pollinators, symbionts, pests, parasites, predators and competitors (Qualset *et al.*, 1995).

An arena is a context in which a debate about an improved future state of a human activity system take place (Wilson & Morren, 1990).

Biodiversity or **biological diversity** refers to the variety of life forms, the genetic diversity they contain, and the assemblages they form (Convention on Biological Diversity).

A boundary serves to indicate, physically or by convention, the limits of anything; a defining property of a system separating internal from environmental features; in human activity systems, boundary discussions include the description of the management functions for each subsystem and the system as a whole, the definitions of what is to be controlled or regulated external to and within the system, and the interrelationships (Wilson & Morren, 1990)

A component a part, an element of a system (Wilson & Morren, 1990).

Crop development is conceptualised as the complex of maintenance, utilisation and improvement of crop genetic diversity (Hardon & de Boef, 1993).

A domain places actors in society and economy; it is an arrangement of actors (civil, public and private) that reveals their principal objectives and strategies.

An ecological service are ecosystem functions that are currently perceived to support and protect human activities or affect human wellbeing (Barbier *et al*, 1994).

An emergent property is a major propositions of system thinking that the whole is different from the sum of its parts, with the difference being the emergent property (Wilson & Morren, 1990).

The ecological knowledge system perspective has been developed to emphasise social and institutional aspects ("socio-sphere") of ecologically sound agriculture; it is formed by five dimensions: ecologically sound practices, learning, facilitation, supportive institutions and networks, and conducive policies (adapted from Röling & Jiggins, 1998).

Experiential learning is a methodical perspective used to learn about and elaborate concepts and theories on the basis of experiences with their application (adapted from Checkland, 1985)

***Ex situ* conservation** means the conservation of components of biological diversity outside their natural habitat (Convention on Biological Diversity).

Facilitation is the act of providing help and guidance; according to the tenets of experiential learning, adaptive management and knowledge system management, facilitative intervention guides people and their organisations through a processes of learning to create joint knowledge that can be used to improve problematic situations (adapted from Wilson & Morren, 1990)

A flow is a patterns of interaction characterised by exchanges of materials (germplasm), energy, knowledge and information (adapted from Wilson & Morren, 1990).

Grounded theory is the a theory that developed on the basis of a recursive and process-oriented procedure (Steins, 1999).

Hard system inquiry is a research methodology based on system thinking making use of quantitative modelling of present situations using optimisation or maximisation assumptions; "hard" means that the problems, goals, or end states addressed by research are readily defined by the analyst, hard system researchers take systems as real (Wilson & Morren, 1990).

A human activity system is conceptualised as a purposive system that expresses purposeful human activity; it is conceptual in the sense that is not a description of actual, current, real-world activities, but is an intellectual formulation used in a debate about possible changes that might be introduced into a real world problematic situation leading to improved future human system (Wilson & Morren, 1990).

***In situ* conservation** means the conservation of ecosystems and natural habitats and the maintenance and recovery of viable populations of species in their natural surroundings and, in the case of domesticated and cultivated species, in the surroundings where they have developed their distinctive properties (Convention on Biological Diversity).

Institutional crop development comprises the chain of actors responsible for conservation, plant breeding, seed multiplication and marketing. The chain is organised and regulated by variety and seed regulatory frameworks. Germplasm and information flow in a linear manner through the chain and innovation is achieved making use of scientific knowledge (Section 2.6).

Institutions are humanly devised constraints that structure human interaction. They are made up of formal constraints (rules, laws, constitutions), informal constraints (norms of behaviour, conventions and self-imposed codes of conduct), and their enforcement characteristics (North, 1993). Institutions are also defined as sets of rules actually used by a set of individuals to organise repetitive activities that produce outcomes affecting those individuals and potentially affecting others (Ostrom, 1992).

An interaction is the relationship between components of a system; mutual or reciprocal action, communication, or controlling influence (Wilson & Morren, 1990).

A landrace (or local variety) is variable populations of cultivated plants (Frankel, 1971; Frankel & Brown, 1984). A broader definition refers to landraces as populations or races that have become adapted to farmers' conditions through natural and artificial selection (Thurston *et al.*, 1999).

Learning is the process whereby individuals, organisations or institutions acquire and internalise experiences, language, social and institutional behaviour, responses, understanding, meaning, knowledge, actions, plans, and so on (Wilson & Morren, 1990).

Local crop development is used to cover the continuous and dynamic cycle in which farmers manage crop diversity within specific agro-ecological and socio-economic environments; varieties and their seeds are maintained, adopted, adapted, displaced and exchanged (Section 2.6).

Modern varieties are those varieties that have been selected or bred for certain traits (such as high yield, short stature, or good response to fertilisers) using scientific methods (Thurston *et al.*, 1999).

"On-farm management" of agro-biodiversity is the term used for the conservation strategy that targets at farmers' continued utilisation and management of agro-biodiversity (Chapter 2.5).

Organisations are social groups, people who work together, networks of contracts, nested in an institutional environment; they are key action components of social systems (North, 1990).

A paradigm may be viewed as a set of basic beliefs (...) that deals with ultimates or first principles. It represents a worldview that defines, for its holder, the nature of the world, the individual's place in it, and the range of possible relationships to that world and its parts, as, for example cosmologies and theologies do" (Guba & Lincoln, 1994).

Plant genetic resources are defined as all plant material with an actual or potential value" (IBPGR, 1991).

A platform is a group of social actors involved in a process of social learning, building new institutions and facilitating joint innovation, resource management and resource use negotiation (adapted from Röling & Jiggins, 1998).

A praxeology is a theory that informs practice.

Resilience is the buffer capacity or the ability of an eco-system to absorb before a systems changes its structure by changing the variables and processes that control behaviour (Holling *et al.*, 1995)

A soft system is formed by social actors to the extent that they become collectively engaged to form a system through jointly agreed and negotiated goals and activities. A soft system facilitates processes of social construction and learning (adapted from Checkland & Scholes, 1990).

A system is a set of components that behave in a way that an observe has chosen to view as co-ordinated to accomplish one or more purposes (Wilson & Morren, 1990).

System thinking conceptualises the complexity and dynamism of the world in terms holism, means of measurements and control, emergent properties, structures and communication (Wilson & Morren, 1990).

Acronyms

ABC	Agro-Biodiversity Centre (Bhutan)
AKIS	Agricultural Knowledge and Information System
AS-PTA	Acessória e Serviços a Projetos em Agricultura Alternativa (Brasil; CBDC)
A-Team	Agro-biodiversity Team (informal research and development group with CGN/CPRO)
BI	Biodiversity Institute (Ethiopia; predecessor IBCR)
BMZ	Federal Ministry for Development Co-operation (Germany)
CBD	Convention on Biological Diversity
CBDC	Community Biodiversity Development and Conservation Programme
CBO	Community-based Organisation
CBUD	Centre for Biodiversity Utilisation and Development (Ghana)
CET	Centro de Educacíon y Tecnología (Chile; CBDC)
CG	Consultative Group (CGIAR)
CGIAR	Consultative Group on International Agricultural Research
CGN	Centre for Genetic Resources, The Netherlands
CIED	Centro de Investigación e Capacitación para el Desarrollo Perú; CBDC)
CIKSAP	Centre for Indigenous Knowledge Systems and (by-) Products (Kenya; CBDC)
CIMMYT	International Centre for Maize and Wheat Improvement (Mexico)
CIP	International Potato Centre (Peru)
CLADES	Latin American Consortium for Agro-Ecology and Development (International; CBDC)
CPRO	Centre for Plant Breeding and Reproduction Research (The Netherlands)
CTDC	Community Technology Development Centre (Zimbabwe; CBDC)
CTU	Can Tho University (Vietnam; CBDC)
DFID	Department For International Development (UK)
DGIS	Directorate General for International Co-operation (Netherlands)
DGIS-ABP	DGIS Agro-Biodiversity Programme (informal name for the assignment to support the development and formulation of regional agro-biodiversity programmes by CGN for DGIS)
DLO	Agricultural Research Department (The Netherlands)
EC/PGR	European Co-operative Programme on Plant Genetic Resources
EMBRAPA	Brazilian Enterprise for Agricultural Research
ENDA	Environment and Development Association (Zimbabwe; CBDC)
EU	European Union
FAO	Food and Agriculture Organisation of the United Nations (Rome)
FSD	Forestry Services Division (MoA; Bhutan)
FSO	Federal Seed Office (Germany)
FSR	Farming Systems Research
GEF	Global Environment Facility
GMO	Genetically Modified Organisms
GO	Governmental Organisation
GPA	FAO Global Plan of Action for the conservation and sustainable utilisation of Plant Genetic Resources
GRAIN	Genetic Resources Action International (Spain; CBDC)
GTZ	German Enterprise for Technical Co-operation
HMNN	Hat Muang Nan Network (Thailand; CBDC)
IBCR	Institute for Biodiversity Conservation and Research (Ethiopia; CBDC & IPGRI *in situ*)
IBPGR	International Board for Plant Genetic Resources (predecessor for IPGRI)
ICDP	Integrated Conservation and Development Programme
IDRC	International Development Research Institute (Canada)
IMCA	Instituto Mayor Campesino (Colombia; CBDC)
INERA	Institut National de Etudes et de Recherches Agronomiques (Burkina Faso; CBDC & IPGRI *in situ*)
INGO	International Non-Governmental Organisation
INIBAP	International Network for the Improvement of Banana & Plantain (associated to IPGRI)
IPGRI	International Plant Genetic Resources Institute, Rome
IPR	Intellectual Property Right
IRRI	International Rice Research Institute (Philippines)
ITP	International Technical Programme (CBDC)

IU/PGR	International Undertaking of Plant Genetic Resources (FAO)
IvP	Institute for Plant Breeding (Netherlands; now Plant Breeding Laboratory of Wageningen University)
LBI	Louis Bolk Institute (Netherlands)
LI-BIRD	Local Initiatives for Biodiversity and Rural Development (Nepal; IPGRI *in situ* project)
LMDG	Local Multi-Disciplinary Group (IPGRI *in situ* project)
LNV	Ministry of Agriculture, Nature Management and Fisheries (Netherlands)
MoA	Ministry of Agriculture
MoU	Memorandum of Understanding (IPGRI *in situ* project)
MTA	Material Transfer Agreement
MV	Modern Variety
NARS	National Agricultural Research System
NCC	National Co-ordination Committee (IPGRI *in situ* project)
NCS	Nature Conservation Section (MoA; Bhutan)
NEC	National Environment Committee (Bhutan)
NGO	Non Governmental Organisation
NMDG	National Multi-Disciplinary Group (IPGRI *in situ* project)
NORAGRIC	Norwegian Centre for International Agricultural Development (Norway, CBDC)
NPGRP	National Plant Genetic Resources Programme
NRTI	Natural Resources Training Institute (Bhutan)
NTFP	Non Timber Forest Product
OPV	Open Pollinated Variety
PACOS	Partners for Community Organisation of Sabah (Malaysia; CBDC)
PCC	Programme Co-ordination Committee (CBDC)
PGR	Plant Genetic Resources
PGRC	Plant Genetic Resources Centre (Ghana)
PGRC/E	Plant Genetic Resources Centre (Ethiopia; predecessor of IBCR)
PPB	Participatory Plant Breeding
PVS	Participatory Varietal Selection
RAAKS	Rapid Appraisal of Agricultural Knowledge Systems
RAFI	Rural Advancement Foundation International (Canada; CBDC)
REID	Research, Extension and Irrigation Division (MoA; Bhutan)
RGoB	Royal Government of Bhutan
RNR	Renewable Natural Resource (Bhutan)
RNRRC	Regional Natural Resource Research Centre (Bhutan)
RSS	Rice Research Station (Sierra Leone; CBDC)
SADC	Southern Africa Development Community
SDA	Sustainable Development Agreement between Netherlands, Benin, Bhutan & Costa Rica)
SDC	Swiss Development Co-operation
SEARICE	Southeast Asian Regional Institute for Communication & Education (Philippines; CBDC)
SIDA	Swedish International Development Authority
TAD	Chair Group on Technology and Agrarian Development (Wageningen University)
TRIPS	Agreement on Trade Related Intellectual Property Systems
UNCED	United Nations Conference on the Environment and Development
UPOV	International Union for the Protection of Varieties
WTO	World Trade Organisation

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APPENDICES

Appendix I: A-Team's projects and activities

Between 1990-1998, the A-Team initiated, participated and was involved in a number of programmes and activities, which bear a direct relationship to conservation, management, and utilisation of agro-biodiversity. I will give an overview in chronological order:

i. The organisation with Wageningen Agricultural University (Department of Rural Sociology), GRAIN and ENDA-Zimbabwe of the international workshop *"Local knowledge and agricultural research"* in Zimbabwe, 1992. During the workshop a diversity of actors discussed the value of local knowledge in research and plant genetic resources management. This workshop resulted in the book "Cultivating knowledge; genetic diversity, farmer experimentation and crop research" (de Boef *et al.*, 1993).

ii. The *Community Biodiversity Development and Conservation* (CBDC) Programme is a global collaborative research and development programme of a group of NGOs, NARS, universities and genebanks. Its major objective is to study community innovation systems in management of biodiversity and develop methodologies to strengthen and support these systems. CBDC includes 15 partner organisations on five continents. The A-Team was responsible for the formulation of the programme's first phase and participated as a partner in its implementation (1994-1999) (CLADES *et al.*, 1994). CBDC is discussed in Chapter 13.

iii. In collaboration with IPGRI and the Overseas Development Institute (ODI), CGN has published the *"Annotated bibliography on local crop development"* (Van der Heide *et al.*, 1996). The project assisted in making documentation and information collected by the A-Team on crop development and on-farm management of agro-biodiversity available to partners and practitioners in the South.

iv. The research and training programme *entitled Farmers Utilisation of Biodiversity in agro-ecosystems of Ethiopia (FUB)* is a joint initiative of CGN taken in 1997 with Awassa College of Agriculture and Mekelle University College. This research programme addresses increased utilisation by farmers of biodiversity in agriculture covering crops, animals, forestry and agro-ecosystems diversity pursuing a participatory and interdisciplinary approach. The FUB proposal (Abay *et al.*, 1997) was developed in a collaborative effort co-ordinated by the A-Team in the context of the DGIS-Agro-Biodiversity Programme (ABP). The proposal is being reviewed by Ethiopian authorities for approval and submission to DGIS.

v. The *Agro-Biodiversity* Centre (ABC) in Bhutan is a project to install a national centre for agro-biodiversity management; the project will pursue an integrated and adaptive approach using various conservation strategies. The project has been developed in the context of the Sustainable Development Agreement between Bhutan and The Netherlands. The A-Team contributed to the formulation of a proposal in 1996 (Pradham *et al.*, 1997). A preparatory phase was implemented in 1998 and 1999, it is expected to start in the course of 2000. The proposed project is discussed in Chapter 10.

vi. The *Centre for Biodiversity Utilisation and Development (CBUD)* in Ghana is a programme to install a national co-ordinating centre for the development of biodiversity products. It covers various components of both natural and agricultural biodiversity; the centre strongly focuses on chain development and facilitation and process management of projects to be implemented by groups of social actors. The A-Team has supported the formulation of the project proposal (de Boef & Asibey, 1997). DGIS has approved the proposal. The CBUD project started in 1999. The CBUD project proposal is discussed in Chapter 11.

vii. The Proposal entitled *SADC* in situ *and on-farm management of plant genetic resources* was a joint initiative by the A-Team and the SADC Plant Genetic Resources Centre (SPGRC), Zambia. The proposed programme through pilot studies within NPGRPs in seven SADC-countries aimed to develop *in situ* and on-farm conservation strategies (de Boef & Mnenyembe, 1998). The initiative was taken in 1996 within the context of DGIS-ABP. Even though DGIS expressed an interest in the proposal, SPGRC and CGN have not been able to conclude the preparation and come a joint final proposal and for submission to DGIS.

viii. Another initiative in the context of the DGIS-ABP concerned the *SADC Seeds for Diversity Programme.* This programme aimed to link local seed supply to the issue of access to and use of genetic diversity in projects in six countries in Southern Africa. Identified partners were NGOs and National Seed Organisations. In 1998 members of the A-Team together with regional consultants identified potential partners and planned a formulation workshop (Serra King *et al.*, 1998). A proposal for a formulation workshop was submitted to a range of interested donor organisations. The formulation phase has not been concluded.

ix. Commission by the GTZ Programme on small-scale seed production in the SADC region, and with additional support through DGIS-ABP, the A-Team produced the book entitled *"Farmers' seed production: new approaches and practices".* This book addresses local seed supply and relates to participatory plant breeding, conservation of agro-biodiversity and policy issues. It makes approaches and practices accessible to people working with seed supply in development organisations and NGOs at grassroots level (Almekinders & Louwaars, 1999). Additional financial support was provided by DGIS-ABP.

x. Together with the International Plant Genetic Resources Institute, the A-Team in 1997 organised the workshop with the title *"Towards a synthesis between crop conservation and development".* Social actors in local management of plant genetic resources from all continents participated. The workshop pursued a process approach organising the debate on developing a synthesis between crop conservation and development paradigms. Its output was used for the compilation of a book *"Encouraging diversity. The conservation and development of plant genetic resources"* with inputs from a wide range of stakeholders in the arena (Almekinders & de Boef, 2000). Eight donor organisations (including DGIS-ABP) supported the project.

xi. The *South Asia Participatory Plant Breeding Programme (SA-PPB)* was an initiative LI-BIRD (an NGO in Nepal) and the A-Team. This programme focuses on the development and up-scaling of participatory plant breeding of a number of crops with NGOs in five countries in the Himalayan region as major actors (Sthapit *et al.*, 1997). The SA-PPB proposal was originally developed in the context of DGIS-ABP. A preparatory phase started by LI-BIRD in 1999 funded by GTZ and IDRC.

xii. A project addressing the *Utilisation of diversity of root and tuber crops* in the Philippines, Vietnam and Lao has been explored in the context of DGIS-ABP. This project may be considered to complement the CIP-UPWARD programme, addressing a genetic diversity component. In a co-ordinated effort with UPWARD, the A-Team has identified NARS and NGOs as potential partners in the research programme. No proposal has been finalised yet.

xiii. The *Central America Participatory Plant Breeding Programme* is an initiative of the A-Team. This programme focuses on the development and up-scaling of participatory plant breeding of maize and beans, and involves CG-Centres, NARS, universities and NGOs in six countries in the region. With an NGO in the region, the A-Team organised a seminar (Cárdenas & Almekinders, 1998) and formulation workshop in 1998. The preparatory phase was implemented in the context of DGIS-ABP. A proposal (Aguirre *et al.*, 1998) was submitted to DGIS, IDRC and Development Fund (Norway); the project started in 1999.

Appendix II: IPGRI *in situ* project partners (2000)

Project - Country/ institution	acronym	type of organisation
Mexico		
Centro de Investigación y de Estudios Avanzados del Incipiente Projección Nacional- Unidad Merida	CINVESTAV-IPN	university and research organisation
Colegio de Postgraduados, Institute de Recursos Genéticos y Productividad	CP-IREGEP	university and conservation organisation
Instituto Tecnologico de Merida	ITM	regional research organisation
Instituto Nacional de Antropología e Historia	INAH	research organisation
Instituto Tecnologico Agropecuario No. 2 of Conkal Yucatan	ITA	regional research organisation
Universidad Autónoma Chapingo	UACh	regional university
Peru		
Consorcio para el Desarrollo Sostenible de Ucayali	CODESU	regional development organisation
Gobierno Regional de Ucayali		regional government
Universidad National de Ucayali	UNU	regional university
Universidad National Agraria La Molina	UNALM	agricultural university
Instituto Nacional de Investigación Agraria	INIA	national agricultural research institute
Instituto de Investigaciones de la Amazonía Peruana	IIAP	regional research organisation
Organizacíon de Mujeres Indígenas de la Amazonía Peruana	OMIAP	women NGO
Confederacíon de Comunidades Indígenas y Campesinas de la Amazoniía Peruana	COICAP	indigenous and rural people NGO
Nepal		
Nepal Agricultural Research Council	NARC	national agricultural research institute
- Division of Agricultural Botany	DAB	national research centre
- Lumle Agricultural Research Centre	LARC	regional agricultural research organisation
- Malepatan Agricultural Research Centre	MARC	regional agricultural research organisation
- Pawanipur Agricultural Research Centre	PARC	regional agricultural research organisation
International Centre for Integrated Mountain Development	ICIMOD	Intern. Research and Training Institute
Ministry of Agriculture	MOA	
- Department of Agriculture	DA	extension (national and local)
Local Initiatives in Biodiversity, Research and Development	LI-BIRD	NGO

Project - Country/ institution	acronym	type of organisation
Vietnam		
Vietnam Agricultural Science Institute	VASI	national agricultural research organisation
National Plant Genetic Resources Department	NPGRD	national agric. research organisation
Food Crops Research Centre	FCRC	national agric. research organisation
University of Can Tho		university
Action Aid Vietnam		International NGO
Hungary		
Agrobotanical Institute of Tapioszele	AIT	national agricultural research organisation
University of Western Hungary	UWH	regional university
Morocco		
Comité national des Ressources PhytoGénétiques	CNRPG	national PGR committee
Institut National Agronomique et Vétérinaire - Hassan II	IAV	national agricultural res. org.
Institut National de Recherche Agronomique	INRA	national agricultural res. institute
Ecole National d'Agriculture	ENA	agricultural college
Direction Provinciale d'Agriculture de Taounate	DPA	regional agricultural office
Direction Provinciale d'Agriculture d'Azilal	DPA	regional agricultural office
Office Régional de la Mise en Valeur agricole de Tafilalet	ORMVAT	regional agric. development office
Association Aïn El Ati	AAEA	NGO - farmers association
Association Beldia	AB	NGO - farmers association
Burkina Faso		
Centre National de la Recherche Scientifique et Technologique	CNRST	national agric. research org.
Institute d'Études et de Recherces Agricoles	INERA	national agric. research institute
Centre National de Semences Forestières	CNSF	national agric. research institute
Institute de Recherche en Sciences Sociales et Humaines	IRSSH	national agric. research institute
Université de Ougadougou	UO	university
- Faculté des Sciences et de Techniques	FAST	
- Institut du Développement Rural	IDR	
Féderation de Unions de Groupements Naam	FUGN	NGO
Ethiopia		
Institute of Biodiversity Conservation and Research	IBCR	national conservation organisation
University of Addis Ababa	UAA	university
- Department of Biology		

Appendix III. CBDC-Programme: overview of partners, 1994-1998

Name	acronym	country	type
Assessoría e Serviços a Projetos em Tecnología Alternativa	AS-PTA	Brazil	NGO network
Biodiversity Institute	*BI*	Ethiopia	NPGRP
Can Tho University		Vietnam	university
CPRO-DLO Centre for Genetic Resources, The Netherlands	*CGN*	Netherlands	NPGRP
Centre of Indigenous Knowledge Systems and (by-) Products	CIKSAP	Kenya	NGO
Centro de Investigación y Capacitación para el Desarrollo	CIED	Peru	Network NGO
Centro de Educacion y Tecnología	*CET*	Chile	NGO
Community Technology Development Trust	*CTDT*	Zimbabwe	NGO
Genetic Resources Action International	*GRAIN*	Spain	INGO
Institut National de Etudes et de Recherches Agronomiques	INERA	Burkina Faso	NARS
Instituto Mayor Campesino	IMCA	Colombia	NGO
Hat Muang Nan Network	HMNN	Thailand	NGO
Norwegian Centre for International Agricultural Development	*NORAGRIC*	Norway	university
Partners for Community Organisation of Sabah	PACOS	Malaysia	NGO
Rice Research Station	RRS	Sierra Leone	NARS
Rural Advancement Fund International	*RAFI*	Canada	INGO
South East Asia Regional Institute for Community Education	*SEARICE*	Philippines	INGO-network

Founding partners are indicated in *Italics*.

Curriculum vitae

Walter Simon de Boef was born in Delft (the Netherlands) in 1964. He completed his secondary education at the Hugo Grotius Scholengemeenschap in Delft in 1983. From 1983 till 1989, he studied Plant Breeding at Wageningen Agricultural University. For his practical training, he spent one year at a Brazilian plant breeding company. He completed a thesis for the University's Plant Breeding Department on mechanisms for partial resistance in wheat to leaf rust and another on partial resistance in rice to leaf and neck blast. For his rice research, he spent one year at the International Rice Research Institute in the Philippines. He conducted taxonomic and agronomic research of two potential oil crops at the Centre for Genetic Resources, the Netherlands (CGN), which resulted in a thesis for the Plant Taxonomy Department. He complemented the technical orientation of his study with an extensive programme of the Department of Sociology for Rural Development. During his stay in the Philippines, he conducted fieldwork for a thesis for this department on changing agriculture practices in the Ifugao Province.

From 1990 until 1992, Walter de Boef returned to CGN/CPRO to fulfil his national social service. His assignment was to support Dr Jaap Hardon in his international development activities, and to implement the arable crop conservation programme. Subsequently, he was employed by the Department of Sociology for Rural Development of Wageningen Agricultural University. He was responsible for the organisation of an international seminar on Local Knowledge and Agricultural Research, Zimbabwe. The seminar resulted in publication of the book "Cultivating Knowledge".

In 1993 and 1994, he was employed by CGN/CPRO. His main assignment was to act as a global coordinator for the development of the CBDC Programme. During this period, he worked in and visited a large number of countries in Africa, South America and Southeast Asia. Following the conclusion of CBDC preparatory phase, he joined the professional development programme of the International Centre for development-oriented Research in Agriculture (ICRA). Subsequently, he became responsible for a component of the CBDC programme at CGN/CPRO. Together with Dr Jaap Hardon, Dr Conny Almekinders and other CPRO-colleagues, he assisted national organisations in various African and South Asian countries in the formulation and development of regional and national agro-biodiversity projects. In 1997, he took the initiative and organised an international seminar on the link between conservation and development of plant genetic resources (the Baarlo workshop). This gathering resulted in the publication of "Encouraging diversity".

In 1997, he joined the Chair Group of Communication and Innovation Studies of Wageningen University as a part-time PhD-student to write his thesis under the supervision of Dr Niels Röling. Early 1999, he took up a new post at the Royal Tropical Institute (KIT) in Amsterdam. He currently works as a consultant in institutional and policy development in the fields of agricultural development and environmental management. In his work at KIT, he also maintains a focus on participatory and interactive approaches to biodiversity management.

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