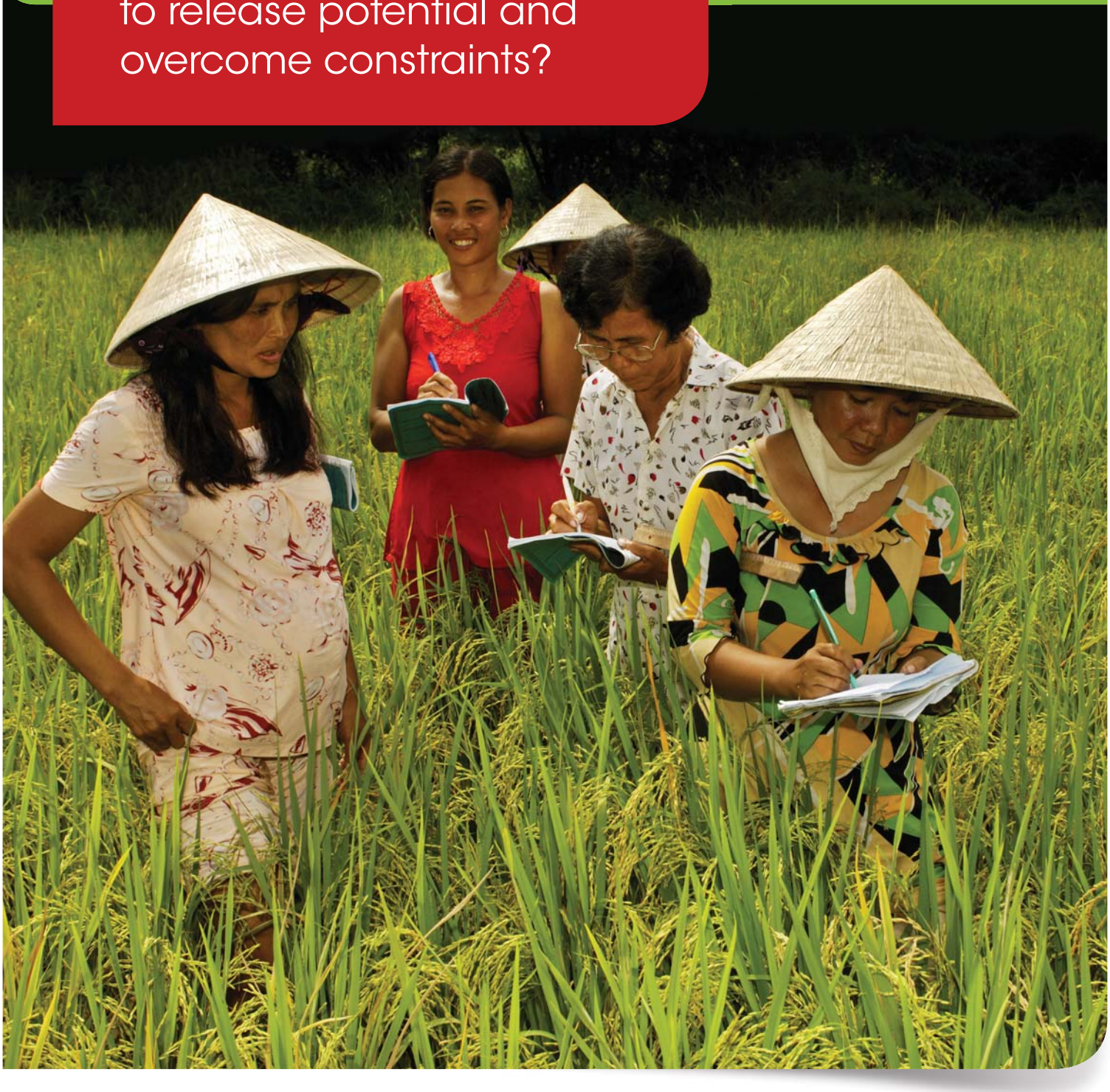
Agricultural biodiversity for resilient farming systems

What knowledge is needed to release potential and overcome constraints?

Synthesis Report



Hivos people unlimited

Oxfam Novib

Colophon

This report is an adaptation of the knowledge mapping study conducted by the Stockholm Resilience Centre for Hivos and Oxfam Novib's Agrobiodiversity@knowledged programme. For further information contact Sarah Doornbos at s.doornbos@hivos.nl.

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Summary

The Resilience and Development Programme (SwedBio) at the Stockholm Resilience Centre (SRC) was commissioned by Hivos and Oxfam Novib to identify knowledge constraints related to the role of agricultural biodiversity for smallholder farmers' livelihoods, to inform the development of a Knowledge Programme. This is an adaptation of the original report.[1]

The report identifies agrobiodiversity's potential for food security, smallholder livelihoods, and the environment in the face of global change. Using a theoretical framework based on resilience thinking, it analyses the potential role of knowledge and knowledge flows in change processes. Data collected through literature study and consultations with key actors is used to identify where constraints on knowledge or knowledge flows can form barriers and where strengthened knowledge can contribute to positive change through releasing the potential of agrobiodiversity for resilient farming systems. The study revealed a broad range of successful cases showing how agricultural biodiversity – through the actions and management of smallholder farmers and their organisations – has contributed to strengthened livelihoods as well as to more resilient ecosystems. Sample cases are presented in this report.

The report further identifies several knowledge-related constraints to releasing agrobiodiversity's potential to strengthen smallholder livelihoods and their environments. We have synthesised these into three main constraints:

1. Lack of understanding of factors driving change and transformation in agricultural systems.
2. Inadequate recovery, adaptation, transfer, and internalisation of knowledge relevant to smallholder livelihoods.
3. Lack of analysis of external barriers to transformation and ways to influence them.

Finally, the report suggests five niches and opportunities for a Knowledge Programme on agricultural biodiversity and smallholder livelihoods:

1. Analysing transformation processes to increase understanding of barriers to and opportunities for the adoption and scaling up of practices and means to achieve a complete transformation of agricultural systems or landscapes.
2. Facilitating analysis, experimentation, and innovation in social-ecological systems research.
3. Enhancing exchange between traditional, practitioners', and scientific knowledge systems.
4. Supporting local seed-supply systems and participatory plant breeding; combining knowledge and empowerment.
5. Challenging policy and power barriers through enhancing vertical knowledge flows.

1 The original report can be accessed at www.hivos.net/Hivos-Knowledge-Programme/Themes/Agrobiodiversity-knowledged/Publication

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1. Introduction

Food security for all is a key goal for global society at large. The World Food Summit in 1996 set as its main target halving the number of undernourished people by 2015. In addition, the first of the Millennium Development Goals is to eradicate extreme poverty and hunger. Despite such good intentions, the number of hungry people has risen rapidly over the past decade. It is the rural poor in Asia and Africa – who, ironically, play a vital role in food production – who are disproportionally affected. By 2050, the global population will surpass nine billion, putting further pressure on world food demands. At the same time, the world's agricultural systems will be increasingly challenged by water scarcity, climate change and volatility, increasing the risk of production shortfalls.

There is a risk that, in a context dominated by the fear of food shortage, the need for both socially and environmentally sustainable solutions will be underestimated in the name of increased production. As de Schutter writes: "One indicator of the reality of the risk is the almost complete silence in international discussions about the conclusions of the International Assessment of Agricultural Knowledge, Science and Technology for Development,[2,3] that concludes the way the world grows its food will have to change radically to better serve the poor and hungry if the world is to cope with a growing population and climate change while avoiding social breakdown and environmental collapse".

Several approaches have been developed that emphasise social sustainability in food security. Important elements include food sovereignty, the right to food, and food justice. These approaches focus on strengthening peoples' livelihoods in a broad sense, and view food production and consumption as intimately linked. These rights-based approaches to food security are based on the recognition that poverty, social exclusion, and a lack of participation in political decision-making processes are the main causes of food insecurity worldwide.[4] This raises the question: who are the key and new actors in the global food-security debate, and how can they best be included and supported?

Parallel to this runs the debate on how to grow food for an ever-increasing population without jeopardising the environment. The planetary boundaries analysis[5,6] suggests that the degrees of freedom for future expansion of cropland, freshwater use, and extraction of phosphorus for food production are limited, while extraction of nitrogen from the atmosphere (for fertilisers) and loss of biodiversity rates need to fall rapidly. Hegemonic global industrial agriculture can itself be a major driver of biodiversity loss and climate change.[7,8] The questions then are: how can agriculture strengthen biodiversity; what type of agriculture is more likely to reduce carbon emissions; and what type of agriculture is best placed to mitigate, cope with, and adapt to the effects of climate change?

2 IAASTD. 2007. International Assessment of Agricultural Knowledge, Science and Technology for Development.

3 UN Human Rights Council. 2008. Building resilience: a human rights framework for world food and nutrition security: report of the Special Rapporteur on the Right to Food, Olivier De Schutter.

4 European Commission. 2010. Communication from the commission to the council and the European parliament. An EU policy framework to assist developing countries in addressing food security challenges

5 J. Rockström et al. 2009 a. A safe operating space for humanity. Nature.

6 J. Rockström et al. 2009 b. Planetary Boundaries: Exploring the Safe Operating Space for Humanity. Ecology and Society.

7 IPCC Fourth Assessment Report: Climate change 2007. Chapter 8. Agriculture.

8 GRAIN. 2011. Food and climate change: The forgotten link.

1.1 Agricultural biodiversity

Agricultural biodiversity plays a central role in responding to these challenges and the questions they raise. Agricultural biodiversity, or agrobiodiversity, is among the earth's most important resources. It is a broad term that includes all components of biological diversity of relevance to food and agriculture, and all components of biological diversity that constitute agricultural ecosystems: the variety and variability of animals, plants, and micro-organisms, at the genetic, species, and ecosystem levels, which are necessary to sustain key functions of the agro-ecosystem, its structure and processes.[9]

Crop and livestock diversity has been developed by humankind over at least the last 10,000 years. Out of around 30 000 known edible plant species,[10] about 7000 are currently used in agriculture. Traditional agricultural practices and management greatly expanded diversity within species, resulting in thousands of different livestock breeds and crop varieties with specific characteristics to suit local environments or socio-economic requirements. Genetic diversity (both within and between species) forms the basis for agriculture, simply because it is the factor that enables adaptation to changing environmental conditions. In addition to diversity in crops and livestock species, breeds, and varieties, agrobiodiversity also includes biodiversity that supports production systems, particularly soil biota, pollinators, and predators. Farm-, landscape- and ecosystem-level components of agrobiodiversity include ecosystem services provided by and to the farming system, such as nutrient and water cycling, erosion prevention and carbon sequestration.

Genetic erosion and vulnerability

Current trends in agriculture have lead to two major concerns with regards to crop and livestock genetic diversity, increasing levels of genetic erosion and genetic vulnerability:

- Genetic erosion, or the loss of genetic variability, may be the result of extinction of crop and livestock species, cultivars or breeds, or of crop and livestock propagation from a narrow breeding base. The major driving forces behind genetic erosion are variety replacements and selective breeding for desirable traits to improve productivity. There is also a strong concern globally about genetic erosion of crop wild relatives caused by habitat loss, fragmentation, pollution, and other human-induced pressures on wild populations.
- Genetic erosion within crop cultivars or livestock breeds through selective breeding can also lead to genetic vulnerability. Although the developed genetic uniformity may offer substantial advantages in quality and quantity of the crop variety or livestock breed, it may also cause greater susceptibility to pests or pathogens making such varieties or breeds more vulnerable to epidemics.

Without proper management and maintenance of a broad diversity of species, cultivars, and breeds within crops and livestock in the agricultural systems, key functions of the agricultural ecosystem may be lost.

9 Convention on Biological Diversity. COP decision V5, annex.

10 FAO1998. The State of the World's Animal Genetic Resources for Food and Agriculture. FAO. Rome.

In the face of changing global conditions, including climate change, changing market dynamics, reduced availability of inputs, and pressure on agricultural lands, agricultural biodiversity has rightly received attention as an indispensible resource in developing coping strategies for farmers. The resilience of local food systems to change and stresses can be enhanced through a strategy of diversification, including maintenance of inter- and intra-species diversity, increased use of agro-ecosystem-associated biodiversity, and mixed farming systems such as agroforestry. Adaptation activities include the maintenance and reintroduction of traditional varieties, the adoption of new species and varieties to meet newly developed production niches, ways of ensuring that materials remain available (e.g., community banks) and adapted (e.g., participatory plant breeding).

Indigenous varieties of seeds should be protected, nurtured, and cultivated for their varied properties.

Effects of climate change

The areas with climates that are now suitable to a particular set of crops, forages, livestock, trees, microbes, and aquaculture are expected to shift in ways that are more favourable to a minority of countries, and less favourable to the majority.[11] Agricultural production in tropical areas is likely to be most at risk. At the local level, farmers will need to take on the challenge to adapt their cropping patterns and livestock strategies, and in this context a diversified mix of crops, varieties, and breeds will be crucial as a base for enhancing resilience. Three principal climatic risks related to agriculture can be defined:[12] novel climates; changes in averages and increases in variability; and increased maximum temperatures above and beyond those experienced today. Thirty percent of the farming systems will be located in areas with a completely novel climate, i.e. with a combination of climatic factors never before experienced on earth,[13] emphasising the importance of increased efforts to make use of and developing the diversity of both old and new varieties of crops and livestock breeds.

In this context, it is important to acknowledge the role of smallholder farmers as the managers and custodians of the world's agrobiodiversity heritage of as well as their dependence on this biodiversity for their livelihoods. Smallholder farmers are strongly influential in shaping their landscape and are at the same time affected by changes at all levels. Farmers, and particularly women, of all regions of the world play a crucial role in maintaining agrobiodiversity and related local and traditional knowledge. They have and continue to make major contributions to the conservation and development of plant genetic resources that constitute the basis of food and agriculture production throughout the world. Resilient communities are therefore an integral part of healthy social-ecological food production systems. Of particular importance to small-scale farmer livelihoods is a reduced risk of food and income insecurity where diversification at the genetic, species, farm, and landscape level results in decreased yield fluctuations under changing climatic or market conditions. Strengthening farmer livelihoods includes efforts to define and strengthen the rights of small-scale food producers. An important aspect for smallholder farmers is the right to agricultural biodiversity, and to save, reuse, and sell seed and other plant material. This right also encompasses rights to their traditional knowledge and to take part in decision-making, and rights related to the use and sharing of benefits from their seeds and their knowledge.

11 FAO. 2009a. Commission on Genetic Resources for Food and Agriculture. The Impact on Countries' Interdependence on Genetic Resources for Food and Agriculture.

12 http://www.slideshare.net/ciatdapa/climate-change-and-plant-genetic-resources-for-food-and-agriculture-fao-july-2011?from=ss_embed.

13 J.W. Williams et al. 2007. Projected distributions of novel and disappearing climates by 2100 AD. PNAS.

1.2 Developing a Knowledge Programme

Despite the importance of agrobiodiversity for food security, smallholder livelihoods, and the environment, the planet's agricultural biodiversity – including agricultural landscapes, species, varieties, breeds, wild crops and livestock relatives, pollinators, microorganisms, and genes – is disappearing at an alarming rate, and with it the knowledge embedded in its management and use. With the erosion of these resources, humankind loses the potential to adapt to new socio-economic and environmental conditions, such as population growth and climate change. Despite the urgency of the situation, we have not been able to slow down the rate of loss, nor spread and use the traditional and indigenous knowledge on agricultural biodiversity that smallholders worldwide possess.

High levels of inter- and intra-species diversity can decrease vulnerability and enhance resilience to climate change.

Generating new knowledge on agricultural practices and biodiversity management of particular relevance to smallholder farmers – also including livestock keepers, pastoralists, fisherfolk, and others – is important. However, exchanging and internalising knowledge over generations and between systems, as well as adapting existing knowledge to altered conditions, will be equally important. This will become increasingly urgent as farmers around the world face new and additional challenges in adapting to changing global conditions, including climate change, changing market dynamics, reduced availability of inputs, and pressure on agricultural lands.

"There is an urgent need to explore the ways in which the contribution of agricultural biodiversity can be optimised in support of agro-ecosystem functionality and the livelihoods of small-scale farmers. This involves the linked exploration by farmers, communities and scientists of diversity in ways that take account of resilience."

Agricultural biodiversity has great potential to contribute further to positive change and strengthening smallholder farmers' livelihoods. To identify existing knowledge constraints to releasing this potential, Hivos and Oxfam Novib invited the Resilience and Development Programme (SwedBio) at the Stockholm Resilience Centre (SRC) to carry out a mapping study to inform the development of a Knowledge Programme. The study was carried out using a resilience-theory approach, focussing on where possible constraints on knowledge and knowledge flows can be identified, and where strengthened knowledge can help make smallholder farmers, their organisations and their surrounding environments more resilient. A strategic aim was to identify areas in which key civil-society actors can act as bridges between different knowledge paradigms and levels of intervention. This report is an adaptation of the original report of the knowledge-mapping exercise conducted by the SRC.[14]

14 For the original report, see http://hivos.net/Hivos-Knowledge-Programme/Themes/Agrobiodiversity-knowledged/Publications

The first section of this report briefly explains the resilience framework used in this study. The knowledge constraints identified are then discussed, based on a mapping study which included a literature study[15] and consultations with relevant stakeholders[16], specifically representatives from NGOs, CSOs, international organisations, and academic institutions. Information was gathered through a questionnaire and interviews, as well as from seminars and other information-sharing events organised by CSOs and UN agencies. The report concludes with a number of suggested focal areas for a knowledge programme on agricultural biodiversity and smallholder livelihoods. Examples and quotes from people interviewed are featured throughout the report. Based on the original report, the results from an actors' meeting held in Kenya in October 2011, and additional consultations, Hivos and Oxfam Novib have developed the outline of the proposed Knowledge Programme.[17]

15 For a full list of references used in this study, see Annex i: Bibliography.

16 For a full list of organizations consulted for this study, see Annex ii: List of relevant organisations

17 For more information on the Knowledge Programme set up by Hivos and Oxfam Novib, "Agrobiodiversity@Knowledged"; see http://hivos.net/Hivos-Knowledge-Programme/Themes/Agrobiodiversity-knowledged

2. Resilience framework

This mapping of knowledge constraints with regards to agricultural biodiversity has been conducted using a "resilience" framework. Starting from the premise that people, agriculture, and the environment are interconnected and interdependent in social-ecological systems, this framework focuses on enhancing long-term capacities to deal with change, and to continue to develop.

Resilience research focuses to a large extent on the dynamics and feedbacks between people and nature in the social-ecological systems that they make up. It aims to find out how people and systems can continuously adapt to keep their basic structure or livelihoods in place. This is illustrated in the figure below.[18] By aiming for one optimal solution to a problem, one ends up like the ball on the convex shape on the left: it is always in danger of rolling away, and therefore a lot of effort needs to be made to keep it firmly in place. On the other hand, when a system is able to deal with changes and is resilient, the ball can move from side to side without any danger of falling off, and it will tend to return to the centre on its own.

Resilience can be interpreted as the long-term capacity of a social-ecological system to deal with change and continue to develop.

It is important to note that resilience in itself is not necessarily desirable. A social-ecological system in an undesirable state may be highly resilient to change in the sense that it resists all efforts to move out of that state. In such cases, system transformation would be more desirable than adaptation to resist change. System transformation occurs when internal or external factors lead to major changes in the system and adaptation isn't possible or not sufficient to deal with the change. Resilience theory can help us understand the source and role of change in systems, particularly adaptive systems, and change that leads to transformation.

Identifying constraints to agrobiodiversity is necessary to assess how we can arrive at a system where farmers are more resilient to change.

By analysing cause and effect in a system (agricultural or otherwise), we can better understand why systems are or are not resilient. By identifying barriers in feedback mechanisms (using "feedback mapping" or "causal loop analysis", an exercise in which stakeholders name and categorise obstacles to improving the agricultural

18 Figure showing "control" versus "adaptive" models adapted from: Ten Napel, F. Biancji and M. Bestman. 2006. Utilising intrinsic robustness in agricultural production systems. In: Inventions for a sustainable development of agriculture. Working paper no 1, TransForum AgroetGroen, Zoetermeer, The Netherlands. By Fred Geven.

system), we can better understand local systems and plan relevant action to enhance agrobiodiversity and improve its use. Identified barriers can range from technical or knowledge barriers to barriers that lie far beyond the local system, such as the policy or market environment. Power relations also form a crucial constraint in releasing potential for positive change for smallholder farmers and the agricultural landscapes they manage.[19]

Resilience at the community level

Some civil society organisations and networks have been inspired to develop resilience thinking further. One example is the African Biodiversity Network, which has adapted its own definition of resilience at the community level. The ABN defines resilience as "the ability of a community to withstand negative internal and external pressures and threats. Resilience enables adaptation and strength, coherence and intergenerational learning. Communities can be resilient when they are empowered and clear about their future and can act together to protect their rights". The route to resilience is developed through:

- intergenerational learning to revive indigenous ecological knowledge;
- the creation and use of eco-maps and calendars to facilitate land and biodiversity governance and control, first within communities, and then with local government; and
- dialogues within the community to analyse and strengthen relevant traditional ecological knowledge and practices, and build community ecological governance capacity.

All of these methods promote dialogue, analysis, and negotiation to identify and implement solutions that increase local control and protection of ecosystems and community rights and responsibilities.

Source: African Biodiversity Network

This mapping study identifies knowledge constraints to strengthening agricultural biodiversity and releasing its potential for smallholder livelihoods. Within a resilience framework, this is necessary to assess how we can arrive at a system where farmers and their agricultural systems are more resilient to external change. Farmers are influential in the process of shaping and reshaping landscapes and genetic resources, but they are also affected by changes at all levels, from climate to policy. They constantly develop strategies to address changes to their surroundings, leading to further adaptation of their systems. Resilience theory can help explain system changes, and identify where intensified knowledge would be helpful. It is important that researchers and practitioners collaborate in this. Details on resilience theory and the approaches used – such as adaptive cycles, regime shifts, and feedback loops – are described in the original mapping report by the SRC.[20]

19 G. Peterson. 2000. Political ecology and ecological resilience: An integration of human and ecological dynamics. Ecological Economics.

20 The original report can be found at http://hivos.net/Hivos-Knowledge-Programme/Themes/Agrobiodiversity-knowledged/Publications. More on resilience theory can be found in C. Folke et al. 2004. Regime Shifts, Resilience, and Biodiversity in Ecosystem Management, Annual Review of Ecology, Evolution and Systematics; and B. Walker and D. Salt. 2006. Resilience Thinking: Sustaining Ecosystems and People in a Changing World.

3. Knowledge constraints

Mapping based on a literature study and extensive consultations with key actors identified three broad constraints on knowledge and knowledge flows that form barriers to releasing the potential of agricultural biodiversity to strengthen the resilience of farmers and their agricultural systems.

1. Lack of understanding of factors contributing to change in agricultural systems
2. Inadequate recovery, adaptation, transfer and internalisation of relevant knowledge
3. Lack of analysis of external barriers to change and ways to influence them

3.1 Analysing change processes

There are many internal and external factors that can lead to adaptation, scaling up or transformation in agricultural systems towards an optimal use and enhancement of agrobiodiversity, at gene, species, and landscape level. To understand how these changes take place, more knowledge of the factors that drive this change is needed.

- How do agricultural systems interact with the broader landscape?
- What factors contribute to scaling up successful approaches?
- How do agricultural system transformations take place?

3.1.1 Analysing landscapes

To understand how farmers and farming systems respond to change, it is important to view the farm in the context of the broader landscape. Social-ecological systems – of which agricultural systems are a great example – are interconnected and interdependent through dynamics and feedbacks at the landscape level. "Landscape literacy" is referred to by respondents and in literature[21] to describe what can be viewed as the capacity to identify and understand feedback loops (including social factors) at the landscape level. Respondents say knowledge of how agricultural landscapes and landscape-wide processes function needs more attention. There is a need for more information about different crop and livestock combinations, and of interaction between agricultural sectors and other ecological functions. A landscape approach views small biodiverse farms as part of a larger system, acknowledging the green corridors and refuges they form between protected areas. More information is needed about what types of landscape are generally managed by smallholders in different ecosystems and food systems. Knowledge on smallholders' landscape management, showing the value of those smallholder agricultural systems that contribute to sustainable development, would underpin actions in support of sustainable intensification and conservation of agricultural biodiversity, adaptive capacity, and resilience, one respondent argues.

21 H. Palang and G. Fry (Eds.) 2003. Landscape interfaces: Cultural Heritage in Changing Landscapes.

Landscape-wide processes and planning

"One notable barrier is that individuals and groups working in different sectors have very different understandings of landscape-wide processes, e.g. how agriculture uses broader natural resources beyond the farm, the role that farms play in hydrological cycles or in wild species territorial land use. We are working to develop visual teaching tools to facilitate shared understanding of the landscape, which is foundational for multi-stakeholder negotiation and planning."

Quote actors survey, EcoAgriculture partners

3.1.2 Analysing scale-up

Great initiatives can be found all over the world, but often they do not change things at a larger scale.[22] Why is that? Why don't they make a bigger difference? How can we make sure that they have greater impact? A better understanding is needed of the factors that enable the successful scaling up of positive change. Several factors contributing to the expansion of sustainable approaches have been identified. So-called champions,[23,24] key individuals rather than institutions, are found to be crucial to initiating successful change. In addition, the importance of endorsing a multi-stakeholder approach from the start – including in the planning stages of an intervention – has been stressed as essential for successful scale up. However, respondents further indicate that under the right circumstances, successful cases can "automatically" scale up. To add to the complexity, cases that initially scale-up successfully can be hampered by conflicting policies at a later stage. This shows that more knowledge of the exact processes that contribute to sustainable scaling up is needed. The often-cited case of the Institute for Sustainable Development in Ethiopia (see below) illustrates collaboration with government as a basis for successful expansion.

The Tigray Project

"The Tigray Project in Ethiopia, a farmer-led project co-run by the Bureau of Agriculture and Rural Development, has successfully demonstrated that ecological agricultural practices can benefit poor farmers and communities, particularly female-headed families. Among the benefits are increased yields, improved hydrology, improved soil fertility, rehabilitation of degraded lands, and increased incomes. Success has led to expansion of the project in Tigray and elsewhere, and the government has adopted the project's approach as its main strategy for combating land degradation. Farmers experienced real change in productivity using their own varieties without relying on expensive external inputs."

Quote actors survey, Institute for Sustainable Development

22 L. D. Danny Harvey. 2000. Upscaling in Global Change Research. Climatic Change.

23 H. Reid et al. 2010. Community Champions: Adapting to Climate Changes. IIED.

24 S. L. Yaffee et al. 1997. Factors that promote and constrain bridging: A summary and analysis of the literature.

3.1.3 Analysing system transformation

There is currently no clear framework for studying transformations in agricultural systems or landscapes.[25] Why does change lead to transformation in some regions or systems, but not in others? System-feedback mapping exercises can help identify barriers to and opportunities for system transformation towards a more positive state of the system, where agricultural biodiversity is used and enhanced. One example of current research that asks how these transformations occur at a systems level focuses on re-greening in the Sahel.[26] Initial results show that farmers appear to have actively managed their land in ways that contribute to re-greening and enhanced productivity.

Interaction between researchers and local communities plays a crucial role in understanding how landscape and system transformations take place. Scientists can contribute with, among other things, models for analysing collected data, aggregations, and technological support. Communities naturally have deeper knowledge and understanding of local conditions, including experience of historical events that have contributed to shaping the current system.

3.2 Enhancing knowledge flows

Knowledge is not static, and needs to be generated, recovered, adapted, shared, and internalised by society over and over again. The previous section identified several areas where knowledge needs to be strengthened or developed to start understanding processes of change. This section identifies constraints on understanding and enhancing knowledge flows as a key factor for successful adoption and scaling up of interventions related to agricultural biodiversity management.

- Traditional, local, and indigenous knowledge needs to be recovered and valued
- Interpreting, adapting, and applying knowledge according to local contexts helps farmers adapt to external change
- Internalisation of knowledge through knowledge sharing and innovative learning needs to be encouraged

3.2.1 Recovering and valuing local knowledge

Although many people in positions of power remain under the impression that indigenous crops or local knowledge are "backward", there is increasing recognition that different knowledge systems and local observations described in local language help understand how social-ecological systems function.[27] Rural women play a key role in small-scale agriculture and often possess specialised local and traditional knowledge. A common concern among civil society representatives and scientists is the loss of traditional, local, and indigenous knowledge of agricultural

"The most important barrier is the mindsets of people. A lot of people still hold to the colonial teaching that growing and eating indigenous crops is backward. We have been working on a process of decolonizing the minds of the people through the dialogues so that they accept themselves and their local biodiversity"

25 F. Westley et al. 2011. Tipping Toward Sustainability: Emerging Pathways of Transformation. Ambio.

26 http://stockholmresilience.org/research/researchthemes/freshwaterfoodandecosystemservices.

27 M. Tengö. 2011. How to deal with exchange between knowledge systems – a way forward. Background paper for meeting in Jokkmokk, 22 June 2011.

biodiversity. Several organisations have developed tools to regenerate and recover traditional knowledge, and to strengthen contacts between generations in order to reverse the trend of intergenerational knowledge loss. Examples include encouraging traditional knowledge in formal education systems, and transferring knowledge through the development and use of ecological calendars, eco-mapping, and seed fairs.

However, knowledge-related issues can be political and very sensitive. It is therefore important to recognise the right to free, prior, and informed consent[28] in all efforts dealing with exchange and documentation of the knowledge and practices of indigenous and local communities. Respondents note that cases of exploitation of indigenous and traditional knowledge have led to situations in which knowledge holders are reluctant to share.

Climate Seeds and Knowledge process

"In different countries in Africa, ABN has initiated the Climate, Seeds and Knowledge (CSK) project, engaging local people in dialogues about food production at local and national levels. Farmers start to revalue their indigenous crops and their own knowledge about them. This project brings together men and women who have different but complementary knowledge, to address household food security using their indigenous biodiversity."

Quote actors survey, African Biodiversity Network

3.2.2 Adapting knowledge to local contexts

Farmers need information that is adapted to local conditions and can be easily understood. There is a role for extension systems, but survey results highlight that they should recognise and respect the knowledge already held by farmers and livestock keepers. Farmers have often developed strategies to cope with long-term stresses such as pests, but lack strategies to cope with the unpredictable effects of climate change at the local level. Concerns are also raised that local communities often lack the knowledge, information, and sharing of experiences to effectively counter harmful impacts to local diverse agricultural systems created by large-scale interventions and processes, e.g., the industrialisation of agriculture, GMOs, and land grabbing. Education should entail disseminating the right kind of knowledge, promoting sustainable agricultural practices rather than large-scale, high-input practices. Curricula do not always integrate knowledge relevant to children and youth from agricultural communities, and do not consider cultural contexts carefully enough. It is further stressed that gender-sensitive interventions and empowerment of women is crucial in an agricultural context.

There are examples of interventions, such as participatory plant breeding, that have equipped farmers for adaptation to changed local conditions. Farmers in Vietnam, for example, have been able to develop rice varieties with an increased tolerance to saline conditions, responding to increased salt intrusion in rice paddies from sea level rise.[29] Education about locally relevant sustainable agricultural practices that use and enhance agricultural biodiversity is considered absolutely crucial for development. Farmers and livestock keepers need to have sufficient knowledge to make their own informed choices in their local contexts.

28 UNGAS. 2007. United Nations Declaration on the Right for Indigenous Peoples.

29 Interview with SEARICE representative. August 2011.

3.2.3 Knowledge sharing and innovative learning

The opportunity and will to experiment, innovate, and learn within and between different knowledge systems and cultures is crucial to enable farmers to cope and adapt in times of global change.[30] Various respondents have noted the need for innovative learning approaches, such as *participatory action research,*[31,32,33] in which multidisciplinary teams of researchers and local knowledge holders jointly analyse livelihoods, agro-ecosystems and landscapes, market relations, organisations, and impacts. Cycles of learning, reflection, and action *by, with,* and for farmers are designed to produce knowledge and positive change for social-ecological resilience, empowering local communities to use their knowledge of agricultural biodiversity to adapt to their (changing) environments.

Respondents suggest that it would be useful to experiment with technological and institutional innovations to strengthen local voices and actors. This includes exploring the potential of citizen-controlled media, such as participatory video and community radio, as well as methods for citizen deliberation and inclusion in policy making. Respondents highlight that fora for knowledge sharing, where knowledge can be expressed and turned into action, are crucial.

Knowledge sharing in participatory processes

"Joko Learning Centre in Thailand encourage farmers (and their families) to share their tacit knowledge – the unspoken knowledge that everyone has within, which becomes a source for learning only when shared with others, for example when transformed to written, documented knowledge. Farmers teach and learn from each other through Farmer Field Schools (FFS) on participatory plant breeding, participatory variety selection and organic farming."

Interview, Joko Learning Centre representative

3.3 External barriers to system transformation: policy and power structures

Respondents emphasise that barriers to achieving positive change are often external, and notably include power structures and policy constraints. Analysing external barriers to strengthening agricultural biodiversity for small-scale farmers can help identify pathways towards more resilient farming systems.[34] Knowledge is an indispensable tool for influencing existing policy and power relations, in particular for those that have few other resources at hand.

- More systematised knowledge is needed on policy and power relations that constrain smallholder resilience
- Sharing knowledge on smallholder experiences vertically can help address external barriers

30 R. Costanza. 2010. The Search for Real, Integrative Solutions. Solutions Journal.

31 P. Kristjanson et al. 2009. Linking international agricultural research knowledge with action for sustainable development.

32 M. Bruges and W. Smith. 2008. Participatory approaches for sustainable agriculture: A contradiction in terms?

33 F. Baum et al. 2006. Participatory Action Research. Journal of Epidemiology and Health.

34 E. Enfors. 2009. Traps and Transformations. Exploring the Potential of Water System Innovations in Dryland Sub-Saharan Africa.

3.3.1 Policy and power barriers

"Agriculture and biodiversity conservation are in conflict with each other in many of the current food production systems the world over. We have to find ways to overcome these conflicts in agriculture policies and institutions. Historical evidence and current studies show that biodiversity conservation strategies must be integrated with agricultural practices that are also socially just and ecologically sustainable."

African Centre for Biosafety

More knowledge is needed of institutions and policies that affect and often restrict smallholders' access to seeds, land, water, and (wild) biodiversity. Land grabs, privatisation, centralisation of water sources, the concentration of seed companies, the expansion of GM crops, and unequal competitiveness of global, national, and local markets affect smallholders' ability to maintain resilient agricultural systems. Agricultural biodiversity is often not part of mainstream policy, and at times directly conflicting policies exist, originating in different government departments. Additionally, respondents note that land administration, biodiversity protection, and climate-change policies are badly integrated in national policies. Literature study and consultations revealed that farmers' knowledge and experiences related to agricultural biodiversity have not (yet) been sufficiently translated into policies and strategies relevant to development organisations working in the South.[35]

Policies of particular relevance to agricultural biodiversity are marketing/trade policies, Payments for Ecosystem Services (PES) and Intellectual Property Rights (IPR). Market and trade policies influence and often limit a farmer's options in relation to selling their own seeds or certain crops at the market. As for PES, more basic research is needed to explore the implications of this kind of economic incentives: some oppose the commodification of nature, while others claim that PES can support farmers and raise awareness of the less known goods and services provided by agricultural landscapes.[36] IPR policies have a strong effect on agricultural biodiversity, e.g., diversifying seed systems and plant breeding, and is highlighted as a policy area in need of urgent revision in order to safeguard agricultural biodiversity and farmers' rights.

Climate adaptation in national planning

"It is still unclear what specific climate adaptation practices could be used by farmers and encouraged by governments. There needs to be further exploration of incorporating ecological agriculture practices in national adaptation plans. There also needs to be consideration of slow onset impacts of climate change on smallholder farmers and the benefits that ecological agriculture practices bring."

Quote actors survey, Third World Network

35 A. Sharma. 2009. Planning to Deliver: Making the Rio Conventions More Effective on the Ground. Climate Change, Biodiversity, Desertification. GTZ.

36 Swedish Biodiversity Centre. 2008. Contributing to Resilience. Results and experiences from the SwedBio Collaborative Programme 2003–2008.

3.3.2 Vertical knowledge exchange

Respondents highlight the importance of vertical knowledge exchange between the local and regional/global level to change perceptions and influence policy, stressing that evidence-based cases can effect policy change. Smallholders' experiences of positive transformations in their social-ecological systems need to be better documented, understood, and shared vertically. A current problem is the lack of local communities' influence on the design of strategies related to agriculture, rural development, conservation, and investments. Mechanisms are needed to address this constraint, and to strengthen local and farmer organisations' opportunities to engage in multi-stakeholder landscape-scale planning processes. Connecting individuals and organisations across levels and fields of expertise plays an important role in achieving multi-level positive transformation.

Participatory Plant Breeding

"Through participatory plant breeding, SEARICE and the CBDC-BUCAP network in Southeast Asia have been able to promote farmers' knowledge and innovations and to raise farmers concern in national and global policy processes. At the local level, field evidence provided proof to researchers and local government that farmers have the capacity to breed plants. Moreover, SEARICE provides farmers with simplified information on policies that affect them and report on farmers' feedback on these laws at policy level. From SEARICE's experience, the key to success for bridging knowledge gaps is a multi-stakeholder approach."

Interview, SEARICE representative

4. Focal areas for a Knowledge Programme

The mapping study demonstrated that the main constraints to realising and releasing the potential of agrobiodiversity for food security, smallholder livelihoods, and the environment are not technical knowledge gaps, but rather constraints on the effective use of knowledge in the change process. Based on the outcomes of the mapping study, the SRC identified five focal areas that could be incorporated in a Knowledge Programme on agricultural biodiversity[37] in order to address the three main knowledge constraints identified in Chapter 3:

1. Lack of understanding of factors contributing to change in agricultural systems
2. Inadequate recovery, adaptation, transfer and internalisation of relevant knowledge
3. Lack of analysis of external barriers to change and ways to influence them

FOCAL AREA 1:
Analysing transformation – assessing system resilience

As described under **knowledge constraint 1**, an analysis of positive change in agricultural systems is needed. Such an analysis would help to understand the factors that contribute to or limit the adoption of practices and their scale-up to a complete transformation of agricultural systems or landscapes.

Describing a social-ecological system's feedback loops in order to identify barriers to and opportunities for change can be useful. The Resilience Alliance publication *Assessing Resilience in Social Ecological Systems: Workbook for Practitioners* can act as a starting point for integrating resilience thinking in knowledge networks.

Example from the Stockholm Resilience Centre

Scientists from various academic institutions, including universities in Burkina Faso and Niger, as well as the SRC, work together in an interdisciplinary project to analyse transformation at the systems level. This project draws comparisons between sites in the Sahel that have responded to climatic variability in contrasting ways to understand why change happens in some regions while not in others. To the surprise of many scientists and policy-makers, large areas of the Sahel have become increasingly green over the past 20 years. While the causes behind the re-greening are debated, it seems that the trend is not just a result of returning rainfall, but instead that farmers have actively managed their land in ways that have enhanced its productivity. The Sahelian re-greening thus presents a unique opportunity to identify lessons for how to adapt and cope in challenging environments characterized by high climatic variability.

37 For more information about the Knowledge Programme set up by Hivos and Oxfam Novib, "Agrobiodiversity@Knowledged", see http://hivos.net/Hivos-Knowledge-Programme/Themes/Agrobiodiversity-knowledged

FOCAL AREA 2:
Facilitating analysis, experimentation, and innovation in social-ecological systems research

Knowledge constraint 1 shows that stakeholders need to understand barriers and feedback loops at the landscape level, while **knowledge constraint 3** shows that policy can be influenced if experiences are shared vertically.

Respondents have identified a group of organisations working in this field as potential collaborators in and contributors to the building of new knowledge on landscape approaches. Experiences gained through this collaboration could be very useful for policy advocacy activities, as they can provide evidence for the success of landscape approaches for agricultural biodiversity and sustainable livelihoods.

Example from EcoAgriculture Partners

With KENVO, a community based organisation in the Kijabe/Kikuyu Forest Escarpment landscape in Kenya, EcoAgriculture Partners have worked to pilot test concepts and methods for integrated landscape analysis and management. The collaboration has helped KENVO develop a variety of agroforestry production practices to conserve agrobiodiversity; link small-scale commercial agricultural developments with forest conservation strategies; and identify how wild species use agricultural lands. It also helped them adapt and use tools for assessment, planning and management, and monitoring and evaluation for landscape scale action.

FOCAL AREA 3:
Exchange between knowledge systems – traditional, practitioners', and scientific knowledge

As can be deduced from the section on **knowledge constraint 2**, efforts to promote and conserve local and traditional knowledge and to enhance exchange between different knowledge systems are needed.

Promoting empowerment through learning, and contributing to systematic documentation of much-needed evidence, is necessary to share traditional, practitioners' and scientific knowledge effectively. Efforts can be made to enhance the exchange of traditional and local knowledge on agricultural biodiversity with other knowledge paradigms. It is relevant to explore synergies between knowledge systems to move towards more sustainable practices, while respecting the interests of all knowledge holders.[38] The concept of social learning, according to which people engage with one another and share diverse perspectives and experiences to develop a common framework of understanding and a basis for joint action, may prove particularly useful in strengthening smallholder livelihoods and their farming systems. Bridging organisations that connect stakeholders from different sectors and regions could play an important role to overcome this kind of constraint on achieving positive transformations.[39]

38 M. Tengö. 2011. How to deal with exchange between knowledge systems – a way forward. Background paper for meeting in Jokkmokk, 22 June 2011.

39 M. Huitric (Ed.). 2009. Biodiversity, Ecosystem Services and Resilience – Governance for a Future with Global Changes. Background report for the scientific workshop "Biodiversity, ecosystem services and governance – targets beyond 2010" in Tjärnö, Sweden, 4–6 September 2009.

Example from the Millennium Institute/Biovision (Kenya)

The Organic Farmer (TOF) is a magazine for Kenyan small-scale farmers with scarce access to information on sustainable agriculture. The magazine is distributed monthly in Kenya, free of charge, and online it reaches readers worldwide. It provides concrete guidance and practical tips on how farmers can increase their harvests using simple, environmentally friendly methods. This information is also disseminated via radio and brochures, and so-called iTOF Centres ("Information and organic input for farmers") improve access to training services.

FOCAL AREA 4:
Local seed-supply systems and participatory plant breeding

Building on **knowledge constraint 2** we can observe that it is necessary to strengthen local knowledge by setting up participatory plant breeding and strengthening local seed-supply systems. From **knowledge constraint 3** we can learn that successful experiences can be used as evidence to influence policy.

Many interventions use participatory learning to empower communities. Participatory plant breeding and selection approaches combine this with on-farm conservation, development, and use of plant genetic resources. This promotes the role of traditional and improved farmer varieties for risk reduction and adaptation. Such tools often have the added value of building relations between different knowledge systems. Some respondent organisations have used participatory plant and livestock selection and breeding methods. These include concrete observations and actions regarding climate change adaptation, and gathering evidence for policy and legal systems for seed certification, intellectual property rights, and plant variety protection. Promoting these methods in a Knowledge Programme would therefore improve farmers' capacity to contribute to enhanced agricultural biodiversity.

Example from Centre for Indian Knowledge Systems (Chennai, India)

Seeds are mostly produced and distributed by the official government seed supply system or by private seed industries in which the indigenous seed varieties receive very poor attention. Our efforts to help farmers cultivate and market indigenous seeds for exchange not only aims to ensure a good income for farmers, but also supplies good quality seeds as inputs for sustainable organic farming. Formal trade is possible only for the very few indigenous seed varieties that are "notified" by the agriculture systems. Others cannot be labelled and sold as certified seeds but only as "truthfully labelled seeds". This limits their commercial potential and eligibility for any support or subsidy for seed production.

FOCAL AREA 5:
Policy and power

Knowledge constraint 3 pointed out that smallholders face significant policy barriers to using and improving agricultural biodiversity, and that farmers' knowledge and experiences related to agricultural biodiversity have not (yet) been translated sufficiently into policy. It also shown that policy barriers could be tackled by strengthening vertical knowledge-sharing. Even though the Knowledge Programme may not target policy change directly, it can play an important role in evidence-building to catalyse change and influence policy interaction indirectly, and enhance the links between practice, policy, and science. There is an opportunity for a Knowledge Programme to contribute to systematic documentation of experiences and to link organisations to develop more relevant policies.

Example from Centro Ecológico (Brazil)

Initially, certification for organically produced goods at a local level was not deemed necessary considering the close relationship between producers and consumers. However, gradually the feeling developed that a certification system was necessary to contest the claim that goods were of lower quality. Local consumers and producers in Brazil established the Participatory Guarantee System (PGS), which is based on local quality guarantees instead of the international certification system model with expensive external controls. A particular aim is to stimulate self-determination and to build up a sense of pride in local producers. In dialogue with the Ministry of Agriculture, PGS has today spread throughout Brazil. Similar systems have been developed in e.g. Chile, Bolivia and Costa Rica.

5. Way forward

The information and ideas presented in the original report and summarized in this synthesis report were intended as a starting point for discussion, with the specific aim to provide a background for the further development of a Knowledge Programme *on Strengthening agricultural biodiversity for smallholder livelihoods*. The testimony of actors in this field has been included to this end. SRC recommended that Hivos and OxfamNovib use the knowledge constraints identified to develop a Knowledge Programme on this topic, in consultation and collaboration with relevant actors. This report can be relevant as a background document and provoke further thoughts and inspiration for individuals and organisations working in this field, in and beyond the Knowledge Programme.

Since the completion of the original report in October 2011, the Agrobiodiversity@knowledged Knowledge Programme has carried out activities and started initiatives in line with the five focal areas indentified in the report. A key cross-cutting initiative has been the development and strengthening of a global agricultural biodiversity knowledge and experience community. The foundations for this community were laid during two meetings that brought together farmers, scientists and civil society leaders from all over the world.

During the first agricultural biodiversity meeting in Kenya in October 2011, the state of knowledge and knowledge gaps with regards to agricultural biodiversity were discussed, as identified through the SRC knowledge mapping study. During this meeting, common ground and support for the development of an agricultural biodiversity community (abc) was established. The image of a glasshouse emerged, with its walls, floor and ceiling representing the barriers to the mainstreaming of agricultural biodiversity in research, policy and practice.

In July 2012, 45 members of the abc came together in Thailand to further develop thinking and formulate a shared vision, mission and strategy for the community. It was agreed that through targeted action, generation and sharing of knowledge and experience the community will aim to break glasshouses all over the world that limit the scaling up, institutional embedding and horizontal extension of biodiverse resilient agricultural production systems. Five strategic themes were identified for joint action: a) Seeds and technology; b) Policy and governance; c) Markets and trade; d) Information networks; and e) Resilient communities.

Action plans and communication platforms were developed to achieve the community's goals. It is envisaged that over time, the abc becomes a force to be reckoned with, where the whole organizes the parts through the shared vision and mission. The abc is now a motivated and connected global community of more than 70 organisations[40] that together work with millions of farmers on agrobiodiversity projects worldwide.

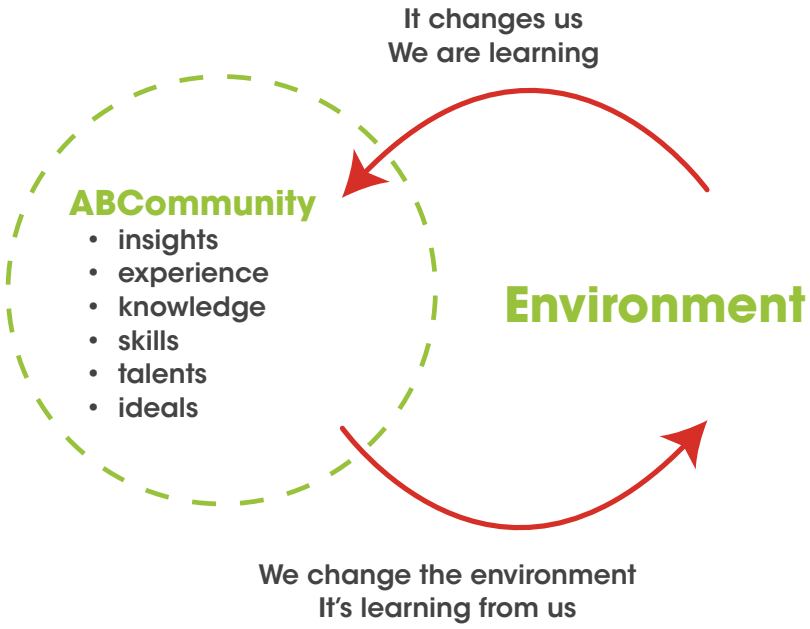
40 In addition to organisations listed in Annex ii, these include: ACORD, ALIN, Better Life, Biovision, CEOSS, CIRAD, Cornell University, PBA, CSA, CTDT, Doabe Foundation, DHAN Foundation, EAFRINET, ECODEV, Embassy of the Earth, FACHIG, Fambidzanai, FishNet Africa, Groene Aap, Hag Muang Nan, IIRD, INADES, Kesan, Ministry of Agriculture and Forests Cambodia, Metta, Naandi Foundation, National Museum Kenya, SCOPE, TOAM, USC, Vedco, ZOPPA

Since the meeting in Thailand important steps have been made towards the common goal, including:

- Coordinated presence and input of abc members at key international fora to influence the global debate and policy agenda on agrobiodiversity (Rio +20, Convention on Biological Diversity (CBD) Conference of the Parties, Global Consortium on Agricultural Research for Development (GCARD), Commission on Genetic Resources for Food and Agriculture (CGRFA).
- Formation of the Zimbabwe Agricultural Biodiversity Consortium (ZABC), to enable collaboration and implementation of insights from the abc at the local level.
- Bilateral and multilateral horizontal knowledge sharing and collaboration through the abcinternal communication platforms on Dgroups and Ning as well as through meetings and joint activities of abc members.
- External communication and profiling of abcand the Knowledge Programmethrough quarterly publications in Farming Matters[41], the AgriCultures Network website[42], the abcWordpress[43], the Hivos website[44], and at international events.

A next abc meeting is planned for July 2013 where the focus will be on uncovering tacit knowledge, unpacking and analyzing good practice for scaling up and operationalization of joint activities.

The abcommunity is the heart of the Knowledge Programme as this is where insight and evidence are generated, shared and tested. Through their cumulative knowledge and experience, the abc and its members provide a platform for ground-truthing, implementation and dissemination of insights and enable joint strategizing. At the same time, the Knowledge Programme aims to contribute to the development and testing of theories and analytical frameworks through synthesis of evidence and insights from a local to a global scale, commissioning research on approaches and analytical frameworks that provide new perspectives on agricultural biodiversity and its role in resilient socio-ecological food systems, and through improving horizontal and vertical knowledge flows.



41 http://www.agriculturesnetwork.org/farmingmatters
42 http://www.agriculturesnetwork.org/farmingmatters/agrobiodiversity
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Several Knowledge Programme activities in various stages of development will contribute to this aim:

- A barometer is being developed to take stock of local and informal-sector initiatives that support and enhance agrobiodiversity and visualize what this looks like on a global scale. This could become a first step in a multi-year effort to gradually build a comprehensive overview of local and informal-sector drivers of positive change. It is envisaged that this could provide important input to the landmark CGRFA's State of the World's Biodiversity for Food and Agriculture report, planned for completion in 2016.
- In partnership with one or several research institutes new perspectives on agricultural biodiversity for resilient food systems will be explored using resilience thinking, theory of change and transformation and the landscape approach as possible entry points for an analytical framework.
- Insights into the factors driving positive change and transformation at scale towards biodiverse agricultural systems will be generated through analysis and synthesis of good practice examples.
- Insights and evidence will be published, promoted and disseminated to influence policy, research and practice.
- Joint and well prepared presence at various international meetings ensure a strong and joint vision is heard at these fora: unity for diveristy

The Knowledge Programme follows an adaptive management cycle and will continue to adapt and evolve as new developments, insights and opportunities emerge throughout the live of the programme. It is our ambition that by building on worldwide knowledge and experience and adding concepts and ideas, the Knowledge Programmecontributes to agricultural biodiversity and the people that use and enhance it, getting the recognition and the role they deserve in the global food and agriculture agenda.

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101	Pimbert, M. et al.	2005	Farmers' Views on the Future of Food and Small Scale Producers. Summary of an Electronic Conference, 14 April to 1 July, 2005	report	IIED
102	Pretty, J.	1995	Regenerating agriculture	book	
103	Pretty, J.	2002	Agri-culture: reconnecting people, land, and nature	book	Earthscan
104	Pretty, J. et al. (Eds.)	2011	Sustainable Intensification. Increasing Productivity in African Food and Agricultural Systems	book	Earthscan
97	Palang, H. and G. Fry (Eds.)	2003	Landscape interfaces: Cultural Heritage in Changing Landscapes	book	Kluwer Academic Publishers
98	PELUM Association, Participatory Land Use Management		GroundUp Magazine	magazine	
99	Philip, D.	1995	People's Farming Workbook	book	Environmental and Development Agency Trust
100	Pimbert, M.	2009	Towards Food Soverignty: reclaiming autonomous food systems		IIED
101	Pimbert, M. et al.	2005	Farmers' Views on the Future of Food and Small Scale Producers. Summary of an Electronic Conference, 14 April to 1 July, 2005	report	IIED
102	Pretty, J.	1995	Regenerating agriculture	book	
103	Pretty, J.	2002	Agri-culture: reconnecting people, land, and nature	book	Earthscan
104	Pretty, J. et al. (Eds.)	2011	Sustainable Intensification. Increasing Productivity in African Food and Agricultural Systems	book	Earthscan
105	Pretty, J., and R. Hine	2001	Reducing food poverty with sustainable agriculture: A summary of new evidence. Final report from the "SAFE-World: The potential of sustainable agriculture to feed the world" Research Project	report	Centre for Environment and Society, University of Essex
106	Pretty, J.N.	2008	Agricultural sustainability: concepts, principles, and evidence.	article	Phil.Trans. R. Soc. B
107	Pretty, J.N. et al.	2003	Reducing food poverty by increasing agricultural sustainability in developing countries	article	Agriculture, Ecosystems & Environment
108	Pretty, J.N. et al.	2006	Resource-conserving agriculture increases yields in developing countries	article	Environmental Science and Technology
109	Raudsepp-Hearne, C. et al.	2010	Ecosystem service bundles for analyzing tradeoffs in diverse landscapes	article	PNAS
110	Resilience Alliance	2010	Assessing Resilience in Social-Ecological Systems: Workbook for Practitioners	book	
111	Rifas, L.	1982	Food First	comic	
112	Rocha, C.	2007	Food insecurity as market failure: A contribution from economics		J. of Hunger and Env. Nutrition
113	Rockström, J. and M. Schultz	2011	Contributing to Resilience. Chapter in Djoghlaf, A. and F. Dodds. 2011. Biodiversity and Ecosystem Insecurity: A Planet in Peril	book chapter	Routledge

	Author	Year	Title	Type	Journal/publisher
114	Rockström, J. et al.	2009	Planetary Boundaries: Exploring the Safe Operating Space for Humanity	article	Ecology and Society
115	Rockström, J. et al.	2009	A safe operating space for humanity	article	Nature
116	Ruitenbeek, J. and C. Cartier	2001	The Invisible Wand: Adaptive Co-management as an Emergent Strategy in Complex Bio-economic Systems	article	CIFOR
117	Rukuni M. et al.	2006	Zimbabwe's Agricultural Revolution. University of Zimbabwe, Harare.		
118	Sanchez, N.V. Et al.		Mariposas, Escarabajos CopróFagos Y VegetaciÓN AcompañAnte En Cultivos De Cacao Banano OrgáNico Y PláTano Convencional, Región De Talamanca, Costa Rica	article	
119	Scherr, S.J. and J.A. McNeely	2007	Biodiversity conservation and agricultural sustainability: towards a new paradigm of 'ecoagriculture' landscapes	article	Phil.Trans. R. Soc. B
120	Scherr, S.J. and J.A. McNeely	2007	Farming with Nature: The Science and Practice of Ecoagriculture	book	
121	Scherr, S.J. and S. Sajal	2009	Mitigating Climate Change Through Food and Land Use		World Watch Report
122	Schutter, O. De	2011	Agroecology and the Right to Food. Report presented at the 16th Session of the United Nations Human Rights Council, by the Special Rapporteur on the right to food, Olivier De Schutter	report	UN Human Rights Council
123	SEARICE	2006	Pathways to Participatory Farmer Plant Breeding. Stories and Reflections of the Community Biodiversity Development and Conservation Progamme		CBDC
124	Seeberg-Elverfeldt C.	2010	Carbon Finance Possibilities for Agriculture, Forestry and other Land Use Projects in a Smallholder Context		FAO, Rome
125	Sharma, A.	2009	Planning to Deliver: Making the Rio	report	GTZ
126	SLUF	2006	Indigenous Agroforestry Practices and their Implications on Sustainable Land Use and Natural Resources Management the Case of Wonago Woreda : Research Report No 1	report	
127	SLUF	2008	Best Practices in Natural Resources Management the Case of Four Sub-Grantee NGOs: Research Report No 3	report	
128	SLUF	2009	The Swedish NGO/CSO cooperation programme in the area of environmental protection: Best Practices in Community Empowerment Approach for Natural Resources Management the case of Waton Sub-Watershed IWSM project : Research Report No 4	report	
129	SLUF		Best Practices in Vetiver System Application for Soil & Water Conservation, Recycling Coffee Pulp, Agro-forestry and Area Closure : From Implementation of the Sida/SLUF Environmental Protection Programme (2005-2010)	report	
130	SLUF		A Review and Analysis of Land Administration & Use Legislation and Applications of The Federal Democratic Republic Ethiopia and The Four Regional States Of Amhara, Ormia, SNNP and Tigrai (Under Publication)	report	
131	Styger, E. et al.	2011	The system of rice intensification as a sustainable agricultural innovation: introducing, adapting and scaling up a system of rice intensification practices in the Timbuktu region of Mali	article	Int. J. Of Ag. Sustainability
132	Swedish Biodiversity Centre	2008	Contributing to Resilience. Results and experiences from the SwedBio Collaborative Programme 2003 – 2008	report	
133	Tansey, G. and G. Rajotte	2008	The Future Control of Food. A Guide to International Negotiations and Rules on Intellectual Property, Biodiversity and Food Security		Earthscan
134	Technical Centre for Agricultural and Rural Cooperation (CTA)		Spores Magazine	magazine	

	Author	Year	Title	Type	Journal/publisher
135	Tengö, M.	2011	How to deal with exchange between knowledge systems – a way forward. Background paper for meeting in Jokkmokk, June 22, 2011.	background paper	SRC
136	The Crucible II Group	2000	Seeding Solutions. Volume 1. Policy options for genetic resources: People, Plants, and Patents revisited		IDRC, IPGRI, Dag Hammarsköld Foundation
137	The Development Fund, Norway	2010	A Viable Food Future	report	The Development Fund, Norway
138	The Development Fund, Norway	2011	Banking for the future: Savings, security and seeds. A short study of community seed banks in Bangladesh, Costa Rica, Ethiopia, Honduras, India, Nepal, Thailand, Zambia and Zimbabwe	report	The Development Fund, Norway
139	Thiaw, I. et al.	2011	Food and Ecological Security: Identifying synergy and trade-offs	policy report	UNEP
140	UN Human Rights Council	2008	Building resilience : a human rights framework for world food and nutrition security : report of the Special Rapporteur on the Right to Food, Olivier De Schutter	report	UN Human Rights Council
141	UNCTAD	2011	Sustainable agriculture and food security in LDCs	press release	
142	UNCTAD	2011	Assuring Food Security in Developing Countries under the Challenges of Climate Change: Key Trade and Development Issues of a Fundamental		UNCTAD
143	UNCTAD	2008	Organic agriculture and food security in Africa		UNEP-UNCTAD
144	UNEP	2009	The Natural Fix? The role of ecosystems in climate mitigation		UNEP-WCMC
145	UNEP	2009	The Environmental Food Crisis. The environment's role in adverting future food crises		UNEP/GRID-Arendal
146	UNEP	2011	Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication		UNEP
147	UNEP	2011	Ecosystems for water and food security		UNEP
148	Vermeulen, S. and L. Cotula	2010	Making the most of agricultural investment: A survey of business modells that provide opportunities for smallholders		FAO and IIED
149	Vorley, B. and F. Proctor	2007	Regoverning Markets – Small-scale producers in modern agrifood market, Policy brief 1 Inclusive Agrifood markets		
150	Walker, B and D. Salt	2006	Resilience Thinking. Sustaining Ecosystems and People in a Changing World	book	Island Press
151	Walker, B. et al.	2004	Resilience, adaptability and transformability in social–ecological systems	article	Ecology and Society
152	Walker, B. et al.	2002	Resilience management in social-ecological systems: a working hypothesis for a participatory approach	article	Conservation Ecology
153	Wiggins, S.	2009	Can the smallholder model deliver poverty reduction and food security for a rapidly growing population in Africa? Expert Meeting on How to feed the World in 2050		FAO
154	Williams, J.W. et al.	2007	Projected distributions of novel and disappearing climates by 2100 AD	aricle	PNAS
155	Windfuhr, M. and J. Jonsén	2005	Towards democracy in localized food systems		ITDG Publishing, UK.
156	World Bank	2007	World Development Report 2008. Agriculture for Development.		Washington, DC
157	World Bank	2009a	World Development Report 2010. Development and Climate Change		Washington, DC
158	World Bank	2009b	Gender in Agriculture. Sourcebook. Co-production IFAD, FAO		Washington, DC
158	World Bank	2009b	Gender in Agriculture. Sourcebook. Co-production IFAD, FAO		Washington, DC

Relevant organisations

Annex 2

Organisation	Homepage	Region
African Centre for Biosafety	www.biosafetyafrica.org.za	South Africa
African Biodiversity Network	www.africanbiodiversity.org	Regional Network, Africa
Agroecology	www.agroecology.org	Global
Biocultural Heritage	www.biocultural.iied.org	Global
Bioversity International	www.bioversityinternational.org	Global
Biodiversidad en America Latina y el Caribe	www.biodiversidadla.org	Latin America and Caribbeans
Centre for Genetic Resources, Netherlands	www.cgn.wur.nl	Global
Consultative Group on International Agricultural Research	www.cgiar.org	Global
Convention on Biological Diversity	www.cbd.int	Global
Centre for Indian Knowledge Systems	www.ciks.org	Global
Commission for Genetic Resources for Food and Agriculture	www.fao.org	Global
Committee on World Food Security	www.fao.org	Global
Corporación Educativa para el Desarrollo Costarricense, CEDECO	www.cambio2.org	Costa Rica
Ecoagriculture Partners	www.ecoagriculture.org	Global
Earth Net Foundation	www.greennet.or.th	Thailand
ETC Group	www.etcgroup.org	Global
Farmers Rights Resource Pages for Decisionmakers and Practioners	www.farmersrights.org	Global
Forest Peoples Programme	www.forestpeoples.org	Global
Globally Important Agricultural Heritage Systems	www.fao.org	Global
Global Crop Diversity trust	www.croptrust.org	Global
GRAIN	www.grain.org	Global
Foundation for Genetic resource, Energy, Ecology and Nutrition	www.greenconserve.com	India
Hivos	www.hivos.org	
Institute for Sustainable Development, Ethiopia	www.isd.org.et	Ethiopia
ILEIA – Centre for learning on sustainable agriculture	www.agriculturesnetwork.org	Global
International Institute for Environment and Development, IIED	www.iied.org	Global
International Federation of Organic Agriculture Movements	www.ifoam.org	Global
International Planning Committee for Food Souvereignty	www.foodsovereignty.org	
International Treaty on Plant Genetic Resources for Food and Agriculture, IT PGRFA	www.planttreaty.org	Global
International Union for the Conservation of Nature (IUCN)	www.iucn.org	Global
Landscape Measures Resource Center	www.landscapemeasure.info	Global
Landscapes for People, Food and Nature (LPFN)	www.landscapes.ecoagriculture.org	Global
Leauge for Pastoral People	www.pastoralpeoples.org	Global
Masipag	www.masipag.org	Philippines
Melca	www.melca-ethiopia.org	Ethiopia
Millenium Ecosystem Assessment	www.millenniumassessment.org	Global
Montanosa Research Development Center	www.mrdcsagada.blogspot.com	Philippines
Natural Justice	www.naturaljustice.org	South Africa
National Biodiversity Centre, Bhutan	www.nbc.gov.bt	Bhutan
Oxfam Novib	www.oxfamnovib.nl	Netherlands/ Global
Participatory Ecological Land Use Management Association	www.pelum.net	Regional Network, Africa
Platform for Agrobiodiversity Reserach	www.agrobiodiversityplatform.org	Global
Practical Action	www.practicalaction.org	Global
Southeast Asia Regional Initiative for Community Empowerment, SEARICE	www.searice.org.ph	Phillipine/global

Organisation	Homepage	Region
Regime Shifts Database	www.regimeshifts.org	Global
Revitalizing Rainfed Agriculture Network	www.rainfedfarming.org	India
Resilience Alliance	www.resalliance.org	Global
RUZIVO Trust	www.ruzivo.co.zw	Zimbabwe
Satoyama Initiative	www.satoyama-initiative.org	Global
Sustainable Land Use Forum (SLUF)	www.sluf.org.et	Zimbabwe
SHIRKAT GAH	www.shirkatgah.org	Pakistan
Stockholm Resilience Centre	www.stockholmresilience.org	Global
Tebtebba Foundation	www.tebtebba.org	Global
Third World Network, TWN	www.twnside.org.sg	Global
Traditional Knowledge Information Portal	www.cbd.int	Global
United Nations Environment Programme (UNEP)	www.unep.org	Global
Via Campesina	www.viacampesina.org	Global
World Agroforestry Centre	www.worldagroforestrycentre.org	Global
World Resource Institute	www.wri.org	Global
World Wide Fund for Nature	www.wwf.org	Global

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