7 BUILDING UP AND SHARING KNOWLEDGE FOR BETTER DECISION-MAKING ON SOIL AND WATER CONSERVATION IN A CHANGING MOUNTAIN ENVIRONMENT – The WOCAT Experience

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Abstract

For successful implementation of any soil and water conservation (SWC) or sustainable land management practice, it is essential to have a proper understanding of the natural and human environment in which these practices are applied. This understanding should be based on comprehensive information concerning the application of the technologies and not solely on the technological details. The World Overview of Conservation Approaches and Technologies (WOCAT) is documenting and evaluating SWC practices worldwide, following a standardised methodology that facilitates exchange and comparison of experiences. Notwithstanding this standardisation, WOCAT allows flexible use of its outputs, adapted to different users and different environments. WOCAT offers a valuable tool for evaluating the strengths and weaknesses of SWC practices and their potential for application in other areas. Besides collecting a wealth of information, gaps in available information are also exposed, showing the need for more research in those fields. Several key issues for development-oriented research have been identified and are being addressed in collaboration with a research programme for mitigating syndromes of global change.

Introduction

Fragile mountain environments with their steeper slopes and erodible soils require well-adapted land use systems that maintain the role of mountains as water towers, minimise the risk of degradation, and optimise production (Oldeman et al. 1991, UNEP 1997, WBGU 1997, Liniger et al. 1998, Hurni and Meyer 2002, The Bishkek Mountain Platform 2002; Viviroli et al. 2003). Mountain areas have a high risk of land degradation with negative impacts on natural resources (water, soil, and vegetation), which in turn affect rural livelihoods. Mountains have been identified as areas with fast changes, either in the human environment through high out-migration or changes in the market and economy, or in the natural conditions due, for example, to climate change. (Denniston 1995; Messerli and Ives 1997; Ojany 1998). Because of socioeconomic impacts of

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degradation such as out-migration and because the biophysical environment is so precarious, sustainable land management (SLM) strategies need to be addressed.

In the search for land management solutions and improvements, consideration needs to be given to the fact that the conditions are not static; therefore this search is a continuous process that needs continuous adaptations to the changing environment. Hence it is crucial to show how different land management technologies function and what impact they have on the natural resources, on production, and on the socioeconomic situation. Reasons need to be addressed as to why a certain technology at a given time and in a certain environment works or fails, or what advantages and disadvantages it has.

Success or failure of soil and water conservation (SWC)3 measures or land management practices in a wider context does not only depend on technical appropriateness and applicability. Measures that have proven their technical effectiveness in field experiments may be a success in one place but can be a failure in another despite similar biophysical conditions. Factors such as cost/benefits (both for the implementation phase and for maintenance), incentives, participation issues, land users' skills and priorities, training and extension, market and infrastructure, and various other aspects influence the uptake of a specific technology.

For every intervention the assessment of the current situation and the trends is a prerequisite for success. In addition, the assumptions made in identifying different scenarios and how they lead to various improvements should be stated.

The Need to Document and Use the Available Knowledge

Experience shows that a wealth of knowledge exists (with land users, extension workers, experts, and researchers) but that it is not available in an easily accessible format. Knowledge is scattered and unrecorded. Comparison of different types of experience is difficult. This SWC knowledge therefore remains a local resource, often known only by individuals and unavailable to others working in the same areas and seeking to accomplish similar tasks. This is one of the reasons why soil and water degradation persists, despite many years of considerable investments in SWC throughout the world.

During the International Soil Conservation Organisation (ISCO) conference in Sydney in 1992, a global network of SWC specialists was initiated, called the 'World Overview of Conservation Approaches and Technologies' (WOCAT). The CDE, Institute of Geography, University of Bern provides the secretariat and a management group4, consisting of members from international and national institutions, and coordinates the network and

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3 In the context of WOCAT, SWC is seen as part of SLM and is defined as: activities at the local level which maintain or enhance the productive capacity of the land in areas affected by, or prone to, degradation. SWC includes prevention or reduction of soil erosion, compaction, and salinity; conservation or drainage of soil water; maintenance or improvement of soil fertility.

4 Currently the management group is represented by CDE (Switzerland), ISRIC (The Netherlands), the Food and Agriculture Organization of the United Nations (FAO, Italy), the Regional Land Management Unit (RELMA, Kenya), the Institut du Sahel (INSAH, Burkina Faso), the Bureau of Soil and Water Management (BSWM, Philippines), and the Soil and Water Conservation Monitoring Center (SWCMC, P.R. China)

its activities. Since 1992 over 30 international workshops have been held to discuss the development and improvement of the methodology and the operation of the network. Whereas in the first five years the emphasis was on methodology development and expanding the international network, the second five years concentrated on training, data collection, and production of outputs (Figure 7.1). This is a steady process, but WOCAT is gradually gaining momentum and getting increasing attention at local, national, and international levels. Progress in methodology and outputs has been fully reported in Giger et al. 1999, Liniger and Schwilch 2002, Liniger et al. 2002a, b, and Van Lynden et al. 2002.

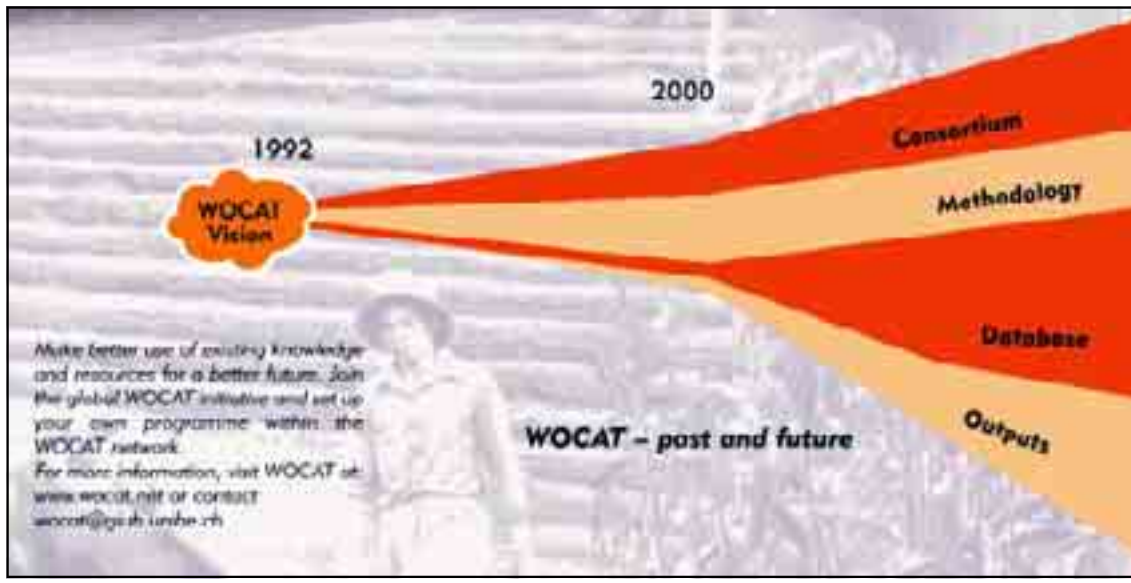

Figure 7.1: **WOCAT past and future**

Scaling up SWC Knowledge

WOCAT documents and evaluates experiences in SWC and SLM from all over the world. This requires a common platform and therefore a standardised methodology (a framework) had to be developed to handle the information (Figure 7.2). So far this framework has been translated into nine languages. WOCAT takes care that local and regionally important peculiarities are not being lost. Based on the feedback from over 25 national and international WOCAT workshops, improvements have been made as illustrated in the evaluation of the participants concerning the usefulness of the WOCAT framework.

Information is collected by local and regional experts in consultation with land users, through the use of a set of three questionnaires. In case studies, information on technical and non-technical aspects is collected through two comprehensive questionnaires on SWC technologies and SWC approaches. These case studies may be applied from small areas (field level) to larger regions, although the rather specific questions in the questionnaires encourage necessary detail. The information is stored in a database that facilitates data entry, editing, and querying. The questionnaire on SWC technologies ('QT') covers details of a technology as applied in a specific case (WOCAT 2003a), and the second questionnaire describes the approach ('QA'), for example the ways and means and conditions to implement successfully a technology on

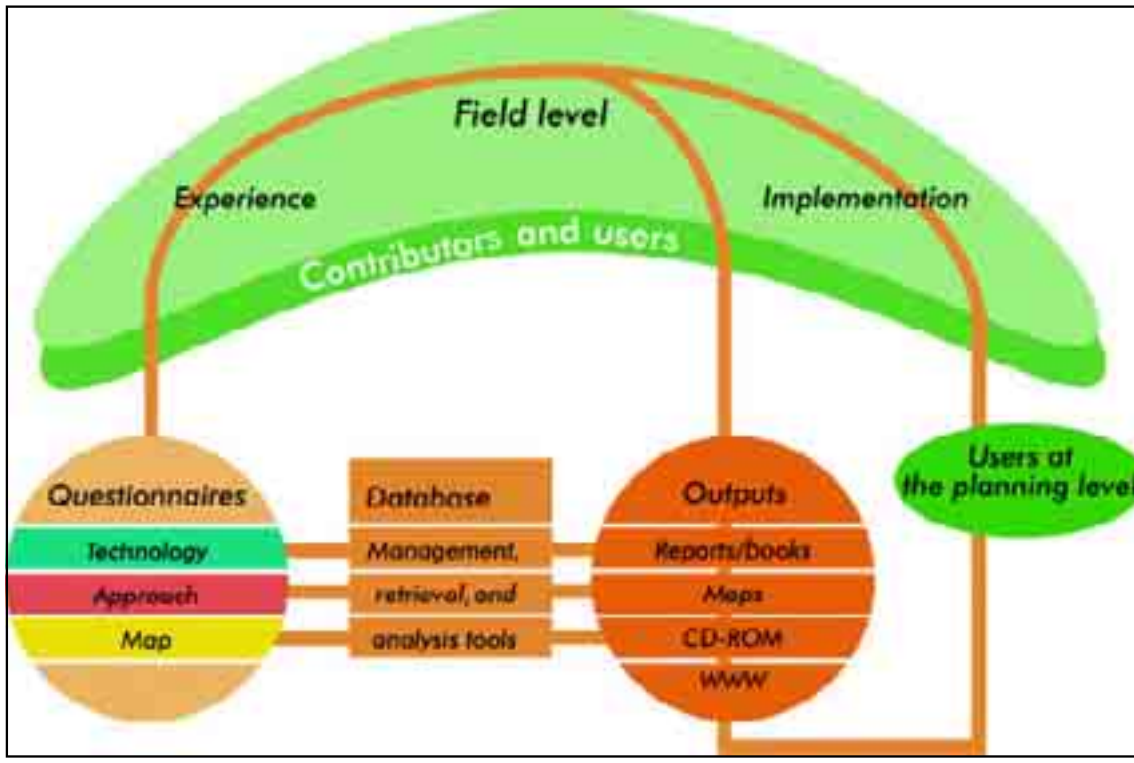

Figure 7.2: **The WOCAT process and tools**

the ground (WOCAT 2003b). These two questionnaires are strongly interrelated. The case studies may constitute project-implemented changes, traditional practices, or farmers' innovations (see Mutunga and Critchley 2002).

The third questionnaire concerns the spatial distribution of SWC/SLM for the purpose of mapping ('QM') in order to show where degradation is occurring and where SWC is being applied and with what impact (WOCAT 2003c).

WOCAT has been tested and applied in a wide range of environments (Figure 7.3). Because soil degradation in sloping areas is a much bigger problem and threat than in lowlands, lots of SWC activities actually take place in mountains and highlands. The declaration of the UN International Year of Mountains 2002 and International Year of Freshwater 2003 (Box 7.1) provided a good platform for WOCAT to emphasise the importance of land management in mountain regions and to stress that water and land cannot be separated and need to be seen as an entity (Liniger and Schwilch 2002).

Experience so far has shown that appropriate land use and management are key to local and global issues such as combating desertification, mitigating water conflicts, providing food security, alleviating poverty, and even maintaining or improving biodiversity.

The compilation, evaluation, and dissemination of SWC knowledge should be considered as an ongoing activity at local, national, regional and global levels (Figure 7.4). WOCAT is not a centrally run data collection exercise and should not be seen as a separate activity or project that runs parallel to existing efforts in SWC.

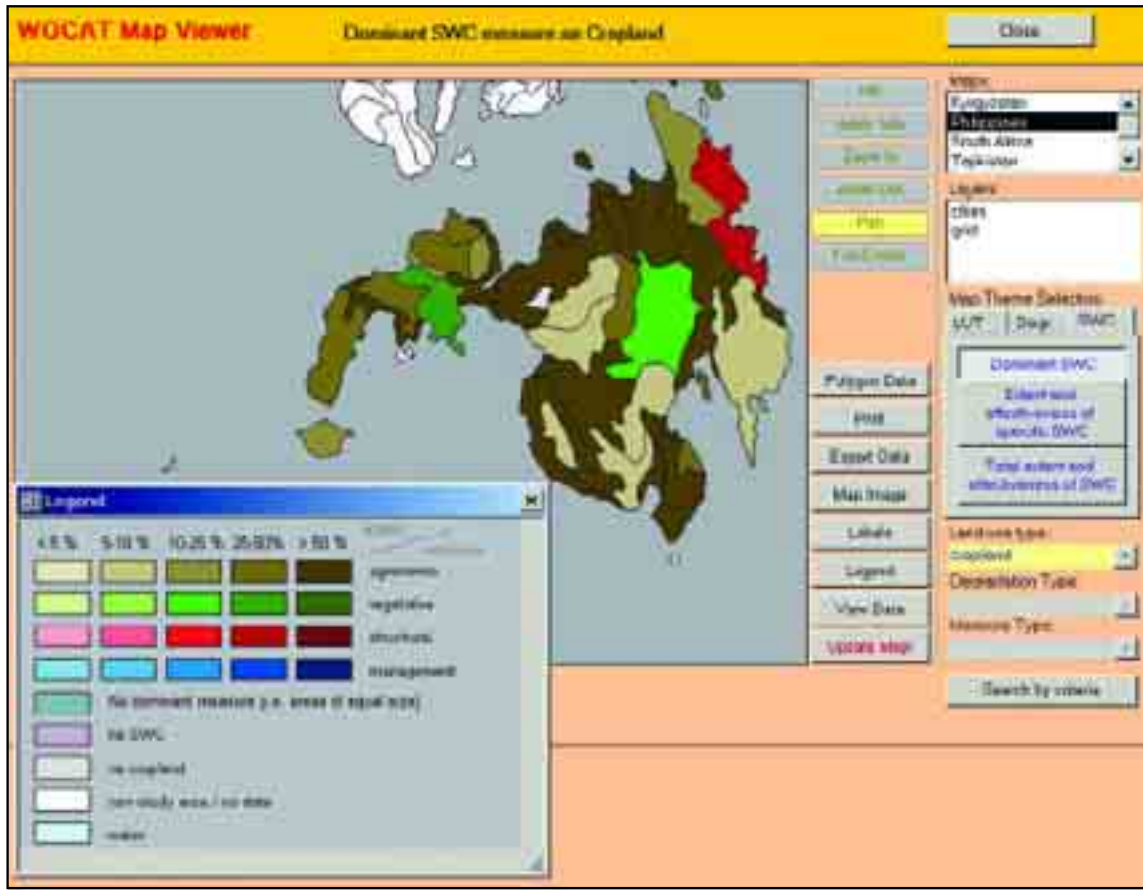

Figure 7.3: **Example of a WOCAT map for Mindanao Island, the Philippines**

Hanspeter Liniger

Figure 7.4: **Compiling knowledge from different resources: the land users, SWC specialist and researchers**. Source: Research Workshop on Renewable Natural Resource Management in Landruk, Nepal, March 2003

Box 7.1: **WOCAT and the International Year of Mountains 2002 and the International Year of Freshwater 2003**

The basic purpose of the International Year of Mountains 2002, as declared by the UN General Assembly, was "to promote the conservation and sustainable development of mountain regions, thereby ensuring the well-being of mountain and lowland communities." In order to achieve this purpose, natural resources in mountain regions need to be used in a sustainable way that avoids overuse and degradation. Mountains are particularly susceptible to soil erosion caused by surface runoff due to high rainfall, steep slopes with erodible soils, growing pressure to use marginal lands for agriculture in some areas, abandonment of agropastoral land in other areas, and the construction of infrastructure for economic activities.

More than 50% of the global soil degradation is caused by water erosion, due to improper water management with excess water causing damage. On the other hand there is a globally growing freshwater crisis with growing conflicts over decreasing quality and the diminishing availability of water. Both water quality and quantity depend heavily on land use and management. So far WOCAT's focus has been firstly on the soil and its degradation or improvement. In future additional emphasis will be given to the impact of land management on water. The year 2003 has been declared by the UN General Assembly as the International Year of Freshwater**.** WOCAT provides tools that show achievements made towards improving freshwater availability and quality.

Because mountains also provide water for the surrounding lowlands, land degradation in mountains has serious impacts on the global supply of freshwater and may contribute to water-related conflicts. The documentation and exchange of knowledge on sustainable use of the fragile mountain systems through WOCAT should be seen as a contribution to the overall purpose of the International Years of both Mountains and Freshwater.

Through the WOCAT network, national and regional initiatives have been developed and the activities are being integrated into ongoing government (mostly the Ministries of Agriculture, Water, or Natural Resources), non-government, and other development projects (for example, in the Philippines, Ethiopia, Tanzania, South Africa, and P.R. China) as part of their efforts to use their existing knowledge for improved decision-making and comparison with other experiences within their own countries, in the region, or even on other continents. Additionally, WOCAT tools and results have been increasingly used in training and education for universities and in extension programmes.

At the international level WOCAT has been mentioned amongst others as a useful tool for the Land Degradation Assessment in Dryland Areas (LADA) project (FAO 2002) and within the framework of the UN Convention to Combat Desertification (UNCCD).

WOCAT experience so far in over 35 countries shows that no other systematic and standard tools for documentation and evaluation exist, despite the expressed need. However, even if these tools are now made available, considerable efforts and dedication would be needed to put them into practice.

Knowledge Gaps and the Need for Research

Data quality is a major concern of WOCAT. Completion of the questionnaires is demanding and complicated and cannot just be approached as a quick and simple desk study, because it requires dialogue with colleagues and land users.

The questionnaires themselves already force the contributor to consider many relevant issues related to SWC/SLM. As this knowledge is scattered in different reports and in the minds of various SWC specialists and researchers, the compilation of the information constitutes a first form of self-evaluation. Sometimes information on important aspects related to SWC turns out to be unknown. Although this creates data gaps or inconsistencies in the database, it shows at the same time that the SWC experts are lacking information crucial for the success or failure of a technology or approach. The lack of information hence constitutes valuable information in itself, but the data contributors should clearly indicate whether data are not available or not known, rather than leaving a question blank, as this may also mean that it has just been overlooked.

An analysis of how well questionnaires were filled in and especially which questions were inconsistently, incompletely, or not answered (Table 7.1) shows that the contributing specialists had particularly problems in identifying the area coverage of the technologies and approaches and often had difficulties in providing information about the economics. In almost half of the selected case studies in Table 7.1, figures on the costs and/or returns were not or only partially known and it was just assumed that the measures taken were beneficial. The absence of this information, however, poses a serious limitation to the successful implementation and maintenance of such measures.

Experience during training workshops also showed that there is much guesswork and uncertainty on the impacts of SWC – ecological, social, or economic. Although questions about the impact of land use and SWC measures are often answered in the questionnaires, the analysis shows that there are contradictions or vague and unconsolidated statements. This reveals important gaps in essential information required for application of SWC.

Although WOCAT was not designed originally as a research programme, the experience gathered so far has shown that WOCAT is also a research tool. Through the compilation and exchange of knowledge, gaps and contradictions are being exposed, which need to be addressed by research. Based on the analysis of the data received so far and the experiences during the training workshop, the following contributions of research towards better understanding of degradation and improved implementation of good land management practices have been identified:

- compilation and analysis of existing SWC knowledge – traditional/indigenous and new SWC technologies and approaches;
- assessment and monitoring of the state of degradation and good land use using the WOCAT mapping tool combined with remote sensing, surveys, and so on;
- assessment of impacts of land use (ecological, social, economic);

Table 7.1: **Questions that were not or were incompletely answered out of 42 selected datasets**	
Question	**%**
Questionnaire on SWC technology	
Define the area in which the SWC technology has been applied: total area	36
Indicate in the map below the area where the SWC technology is applied	38
Provide a sketch ('artist's impression') and a photograph/slide showing an overview of the technology	33
Provide a technical drawing	33
Establishment and recurrent costs	45
How many land users have implemented the technology with incentive support/ wholly voluntarily	71
List the major strengths/advantages of the technology and how they can be sustained / enhanced, in the land users' view	24
List the major weaknesses/disadvantages of the technology and how they can be overcome, in the land users' view	43
Questionnaire on SWC approach	
Define the area where the SWC approach has been (or is still being) implemented	33
Provide a photograph / slide showing an impression of the approach	74
Provide, if possible, an organogram that points out important actors within the approach	82
Indicate the total budget for the SWC component of the approach (over entire period)	54
List the major strengths/advantages of the approach and how they could be overcome, in the land users' view	24
List the major weaknesses/disadvantages of the approach and how they could be overcome, in the land users' view	42
Source: WOCAT database	

- identification of impact indicators and threshold values;
- assistance in the search for solutions based on land users' experiences and adapted to specific natural and human environments.

In order to address several of the above identified key questions and assist in further analysis of the existing knowledge as well as in filling in the gaps concerning sustainable use of land resources, WOCAT actively searches for the collaboration or synergies with research programmes. As examples, two recently initiated research activities are described briefly.

The first research activity is related to WOCAT's involvement in a proposed European Union project 'Soil and Surface Water Protection using Conservation Tillage (SOWAP)'. This project aims to assess the viability of a more 'conservation-oriented' agriculture in north and central Europe, where reduced tillage practices replace the numerous cultivations carried out under more 'conventional' arable farming systems. The use of appropriate herbicides is tested and their potential for off-site contamination assessed, to ensure that suggested approaches are environmentally sound.

SOWAP involves various institutions (universities, non-government organisations, a commercial company, and government agencies), and will be implemented in the UK, Belgium, and Hungary. Field sites (farm scale) will be identified for each country, and the proposed conservation tillage system will be applied at each site. Local variations and farmer/land owner preference are crucial in the project and will be taken into account, so although inter-country comparisons may not be possible, the reasons for local variations in the adopted practices will be documented.

One criterion for the success of such a project is the potential for independent assessment of the environmental and economic benefits of the suggested approaches and a suitable manner for transmitting this information. This is in essence the role of WOCAT.

The second collaboration of WOCAT in research is a programme entitled 'Research Partnerships for Mitigating Syndromes of Global Change' (NCCR North-South 2000; Hurni et al. in press). In central Asia, the Horn of Africa, and eastern Africa, the main research issues are related to land resources, mainly water, soil, and vegetation. Two frequently occurring syndromes of global change are addressed, which are land degradation, particularly in rural areas and restricted access to and availability of freshwater. The research and the building up of research capacity focuses on the assessment and impacts of human-induced land degradation and conservation (good land use practices) and on the support of development activities in finding SLM options.

Through compilation of existing knowledge using the WOCAT tools combined with research addressing the knowledge gaps, training, and capacity building, a better understanding on SWC and SLM is envisaged in the search for improved solutions to land degradation (Figure 7.5).

Search for Solutions: Better Use of Knowledge and Better Decision-Making

Different stakeholders need to appreciate and recognise what options are available. The different users of the SWC knowledge database need to be able to compile the information that they are looking for in a number of ways, so that they can adapt it to their needs. Therefore WOCAT has created different ways to access information either digitally (CD-ROM, Internet) or as hard copy: in summary format (for example in overview books), through a multiple criteria query system, as selected chapters from the database, or using assessment criteria that help to evaluate the strengths and weaknesses (potential and limitations) of a given technology and approach. The latter could be either an evaluation of the users' own experience or an assessment of the applicability of a technology and approach from elsewhere.

Hanspeter Liniger

Figure 7.5: **Training on the assessment of soil degradation and conservation in Kyrgyzstan (using the WOCAT mapping tool) with students from central Asia**

Conclusions

During the last 10 years the WOCAT programme has developed a framework for the documentation, evaluation, and dissemination of knowledge in SWC, consisting of tools and methods such as questionnaires and a database, as well as a network of SWC specialists from all over the world. The main aim has been to share the knowledge of SWC specialists and land users and assist them in the search for options to mitigate land degradation and improve land management. Through national and regional initiatives, these methods and tools have been used and improved during over 40 workshops and meetings and subsequent data collection activities in over 35 countries all over the world.

The experiences so far show that WOCAT assists SWC specialists, in collaboration with land users, in compiling valuable but scattered information and in evaluating and disseminating the knowledge. This is essential to make better decisions and provide better advice to land users on how to improve SWC activities. The experience has revealed that SWC, as part of SLM, is a complex issue that involves a variety of different stakeholders and thus needs to be approached in a comprehensive way. Documentation, monitoring, and dissemination of SWC technologies and approaches therefore needs time and commitment, but it is perceived as useful in improving the effectiveness of SWC and thus should have a high priority on the agenda for development. However, the compilation of available knowledge has revealed a number of knowledge gaps and contradictions, which need to be presented and addressed by research. A key issue

identified so far is the need to clarify the impacts of land degradation or good land management practices on the natural resources and on human welfare.

Land use has been identified as playing a key role in the degradation or conservation of natural resources. In many societies of the less-developed world and in mountain regions in particular, over 80% of the population depend on agriculture. Great efforts are needed to identify well-adapted land use systems that do not degrade the natural resources and that provide a basis for the livelihood of people. Due to the continuous changes in the human environment (for example, high migration, changes in market situations) and natural conditions (climate change, degradation processes), solutions and improvements in land management that can be adapted to these changing environments have to be found. This is a process that needs continuous commitment of development institutions and research. Thus durable solutions need to be flexible and adaptable.

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