Moving people – towards collective action in soil and water conservation

Experiences from the Bolivian mountain valleys

2006

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Dit onderzoek is uitgevoerd binnen de C.T. de Wit onderzoeksschool Production Ecology and Resource Conservation (PE&RC)

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Aad Kessler

Proefschrift
ter verkrijging van de graad van doctor
op gezag van de rector magnificus
van Wageningen Universiteit,
Prof. Dr. M. J. Kropff,
in het openbaar te verdedigen
op dinsdag 24 oktober 2006
des namiddags te 16:00 uur in de Aula

Kessler, C.A. (2006)

Moving people – towards collective action in soil and water conservation. Experiences from the Bolivian mountain valleys.
Doctoral Thesis Wageningen University – with ref. – with summary in English, Dutch and Spanish.

ISBN 90-8504-476-6

Key words: Bolivia, land degradation, soil and water conservation strategies, adoption, policy development

Dedicated to my father

Cover picture
Painting by Jorge Michel, a talented medicine student from Sucre (2002)

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Preface

With this thesis I finalize an important phase in my life: my work in Latin America. It started twelve years ago in Chile, it continued in the Andean mountain valleys of Cuzco (Peru) and Sucre (Bolivia), and has been concluded in the following chapters. This thesis is also the start of a new phase: my work in the Netherlands at the Wageningen University; however, without loosing contact with Latin America. The desire remains to contribute to a more sustainable world and work at the interface of soil conservation and policy development. It is my ambition to understand, unravel and influence the complex causal networks leading to the worldwide problem of a rapidly degrading living environment. This thesis is my first personal contribution to the search for concrete solutions.

When I started this research almost five years ago, I wasn't sure at all whether I would finish it. I had always considered myself a practitioner, rather than a scientific researcher or a writer. However, I also realized that without writing down the project's findings, the impact of our efforts would probably never go beyond the boundaries of our villages. In order to complete al those years of fieldwork satisfactorily, I had to write this thesis. Now that it is finished, I see that it has become what I wanted it to become: a rather down-to-earth scientific analysis and synthesis of our experiences, with a tingle of idealism and passion. As such, I hope it is accessible for its main target group: open-minded policy-makers who are willing to make the correct decisions.

The two phases of this PhD research (Sucre and Wageningen) couldn't have been more different. While the practical work in Bolivia was one of the best teamwork experiences one can imagine, writing down this thesis in Holland was a mainly individual endeavour. From the work of both phases I've learned that doing a PhD research requires – above all – an adequate enabling environment, in particular good colleagues and friends that stimulate one to keep going and finish the job. This is the moment to thank them all.

In Sucre, first of all I thank Dr. Hideo Ago, not only for having trusted me the responsibility to lead the JGRC project, but most of all for his progressive and imaginative ideas concerning soil conservation and rural development in Bolivia. Our discussions have definitely enriched my way of thinking and have helped me to keep the project on the right track. My Bolivian colleagues working in the JGRC project were of an exceptional good quality: ever-dedicated to the project and its goals, and always willing to work with our villagers, even under often difficult circumstances. I will never forget how some of you were almost stoned by angry farmers when trying to get around one of their roadblocks, only not to be lacking on a meeting in one of our villages. Especially with Hugo Uzeda, Edwin Arteaga and Elizabeth Barroso, the project staff based in Sucre, I have had innumerable fruitful discussions about the project's strategy and on how to focus our activities. I think that this open interchange of opinions and the flexibility to change direction were the strongest points of our project. Of course I must also involve our extension workers in the former statement: Fernando Flores, Victor Durán, Arnulfo Borges and late Constantino Loayza. You were able to establish excellent relations with the farmers in our villagers, which was crucial for the work we did. On your motorbikes you travelled thousands of kilometres; by foot you walked maybe even more than that. *Les quiero dar las gracias a todos ustedes, fue un honor y un privilegio ser considerado parte del equipo Boliviano de nuestro proyecto…*Of course I can't

forget to thank all the other colleagues and students whom I've worked with and who have – one way or the other – contributed to this research: Jorge and Miguel (from the Prefecture), Adhemar and Juan de Dios (our chauffeurs), Yuko and Norie (our translaters and secretary's), Guido and Bernard ("my" Dutch MSc students), Omar, Oscar and Ratón ("my" Bolivian students who conducted the Case-study used in Chapter 4), all the other students who have done their thesis with us, and the academic staff of the Faculty of Agronomy of the San Fransisco Xavier University in Sucre. Also thanks to my Japanese colleagues: Mitsuru Marumoto, Yukio Shinomi, Yasusada Oue, Koichi Takenaka, Haruyuki Dan, Takao Fujimoto, Tomio Hanano and Takao Nakagiri. Although the cooperation between you and this stubborn Dutch "*jóven*" was not always easy due to lingual and cultural differences, I'm sure we have all learned a lot from it. Thanks for starting and supporting this interesting project. Last but not least, very warm and special thanks to all the villagers of Tomoroco, Kaynakas, Sirichaca, Talahuanca and Patallajta: your contribution to this thesis is invaluable.

In Wageningen, first of all thanks to Jan de Graaff, my co-promoter, for your time, discussions, stories and punctual comments to all the draft versions of my chapters. I thank Leo Stroosnijder, my promoter, for helping me to focus this research rightly and for pushing me to finish the work. I also thank all the other (current and former) colleagues at the Erosion and Soil & Water Conservation Group: Geert, Dirk, Wim, Saskia, Piet, Jolanda, Tony, Luuk, Michel, Jakolien, Helena, Ferko, Monique, Olga, as well as all foreign students and friends at the third floor of the Nieuwlanden with whom I regularly drank a cup of coffee and had my lunch. Special thanks to Anton, who shares the same passion for Latin America and its people.... Finally, I sincerely thank the referees of the five chapters of this thesis that have been published and/or accepted for publication. Their constructive comments have tremendously improved my work.

It was certainly not the best choice to move in wintertime from sunny Bolivia to rainy-cold Holland. It was a tremendous change in every respect, and a tough period for our family. Nevertheless, we have made it, Wageningen is now our home. *Mi querida Stela, gracias por tu apoyo y amor, te prometo que algún día regresaremos a un país più caldo…*Thanks also to Jan Lucas, Tom y Nathalie, who never failed to distract me from my work when I came home... My gratitude goes to many people here in Wageningen: neighbours from the Eykmanstraat (the most enjoyable street in town), Latin-related friends who felt the same "disconnectivity", and of course "oma" for always taking care of us when we most needed it. Special thanks to Jan Joost, who read most of the chapters of this thesis and contributed to it with his inspiring comments. Like him, I dedicate my thesis to our father, who – without being physically present – so strongly marked the pathway of my life: I know you're always here with us.

Aad Kessler

Chapter 1

Introduction

"My land doesn't produce anymore, it's worthless, I prefer to leave and find work elsewhere, so my wife and children can eat the few potatoes that my land produces"

(villager from Sirichaca)

1. Introduction

1.1 Setting the scene

On my first trip to Sucre, in August 1997, I was shocked by the bareness of the land. It was the dry season, and looking through the window of the airplane, I saw yellow slopes, dried-up rivers, only some green spots with eucalyptus trees, and dispersed farmhouses under a burning sun. I wondered: "How can people live here?" Once in Sucre, walking on the clean plaza with its enormous ancient trees, these first impressions were directly repressed. I saw students strolling around and laughing with each other, happy children playing and eating lots of sweets, old men chatting on the benches in the park, well-dressed business-men talking on their mobile phones, and some lost backpackers looking for a cup of coffee.

Entering the narrow side streets, I began to see the harsh reality of poverty and inequality in Sucre: a young *campesino* mother with five half-naked children sitting on the sidewalk, an old legless man waiting beside an empty coin box, hordes of shoeshine boys, and busses blowing black exhaust right into my face. I went straight to the central market; always the best place to get a good first impression of a city's level of development. I was pleasantly surprised; neatly piled-up products, clean pathways, decently dressed salesladies, and, best of all, every imaginable tropical fruit for sale. Here, in this remote mountain town!

Exactly two years later, in 1999, I came back to live and work in Sucre – this well-ordered friendly capital of Bolivia situated in a desert-like environment. My first field trip was to Tomoroco, one of the project's research villages, a two-hour drive from Sucre. With the Japanese project manager and some Bolivian extension workers, we drove in our big four-wheel-drive over dusty roads through a landscape with enormous gullies between the hills, and with some scattered green bushes and trees. I saw cropland with enormous amounts of stones, huge flocks of sheep and goats looking for something to eat, small miserable adobe houses, and nowhere a living human soul around. Once again I wondered "How can people live here?" "What do they do?"

We entered the watershed of Tomoroco from the upstream side: a rolling valley with scattered farmhouses surrounded by steep hills, on one side covered with – sometimes quite dense – vegetation. Anxious to arrive on time for the village's assembly meeting, we hurried down the road to the village centre. Only few people were waiting there, and they welcomed us warmly. Two hours later the meeting started. For one hour the village's president read all the names of the 160 families and checked their presence. People walked in and out; children were running around; men were constantly chewing coca-leaves; and we were waiting on one of the few wooden benches for our turn. Discussing the agenda and the problem of children not attending school took another long hour. Finally we were given the opportunity to present our project. Although we emphasized that this validation study aimed at improving soils, and that we would not make major investments in Tomoroco, people kept asking "What are you going to bring us?" I sensed widespread incomprehension, and left with the feeling that we had done it completely wrong.

During later visits I got to know these extremely poor people much better. While walking on their fields or chewing coca under a tree, we talked about their lives and their future prospects. I was moved by their desperation and their overwhelming uncertainty concerning the future. There I was, with my (relatively) well-planned future and plenty of built-in securities; and there they were, in their day-to-day battle for survival, lacking any imaginable security in their lives, and having to cope with enormous agro-climatic constraints. I could not imagine myself living here. Even so, these people were often warm and hospitable. They invited me into their homes, and offered me the best food they had. Despite all the negative experiences with previous projects, our project was a new ray of hope for these people; maybe finally something was going to change. I felt we could not fail.

It did not take long before we realized that we had indeed gotten off to a bad start in Tomoroco. In spite of our insistence that this be a "participatory" and "integrated" project, we had made the same mistake as all the other projects: we had started with fixed objectives and without knowing local peoples' aspirations. Our project changed direction quickly. We wanted to provide these people with better future prospects, by making their village a better place to live in, based on sound natural resources management. Soil and water conservation became only one of the components of our strategy, although still the main one. During more than four years we tried to do things right; together with the local people, in a joint effort. It was a learning process for all of us. The main lessons and insights this process provided are presented in this thesis.

1.2 The JGRC project

The Japan Green Resources Corporation (JGRC; currently identified with the name J-Green) conducted a baseline study on soil erosion in several Latin American countries from 1995 to 2000. This rather technology-oriented study concluded that due to technical and methodological problems, conservation projects had not achieved significant results. It recommended that projects focus more on soil fertility and integrated rural development activities, combined with a motivating participatory planning process.

Based on these conclusions, the JGRC started a 5-year project in 1999 in the north-Chuquisaca region of the inter-Andean valleys of Bolivia (Figure 1.1). It was titled "Validation Study of Sustainable Rural Development, based on Soil and Water Conservation". This project, known by all local people as "*el Proyecto JALDA*", will be referred to as "the JGRC project" throughout this thesis. The JGRC project was executed with the collaboration and participation of the Prefecture of Chuquisaca, by means of a ministerial agreement signed in 1999 between the governments of Japan and Bolivia. It took place in five study villages (Figure 1.1): three experimental villages where the research was conducted (Tomoroco, Kaynakas and Sirichaca), and two validation villages where the intervention strategy was validated (Talahuanca and Patallajta).

The objectives of the JGRC project were to:

1. Identify soil and water conservation practices that small farmers can implement by themselves on their agricultural fields;
2. Develop an intervention strategy for sustainable rural development based on soil and water conservation;

3. Validate in a participatory way the applicability of these practices and of the intervention strategy.

The JGRC project worked with a permanent team of six Bolivian agronomists, and received regular visits from Japanese experts in diverse topics related to soil and water conservation. Three of the Bolivian agronomists worked at the headquarters in Sucre: one rural development expert, one soil conservation expert, and one gender expert. The other three agronomists were based as extension workers in each of the experimental villages. Another Bolivian extension worker supervised the validation of the intervention strategy in the two validation villages.

In collaboration with the "University of San Francisco Xavier de Chuquisaca", the JGRC project also conducted validation experiments on two other research sites. The first one was a site with erosion plots and soil fertility plots situated on the university's campus in Yotala, a village 20 km outside Sucre. The second one was an experimental farm with conservation practices situated 40 km from Yamparaez, on the paved road leading from Sucre to Tarabuco. On both sites local BSc students collaborated in conducting the research. Lecturers from the university provided regular supervision.

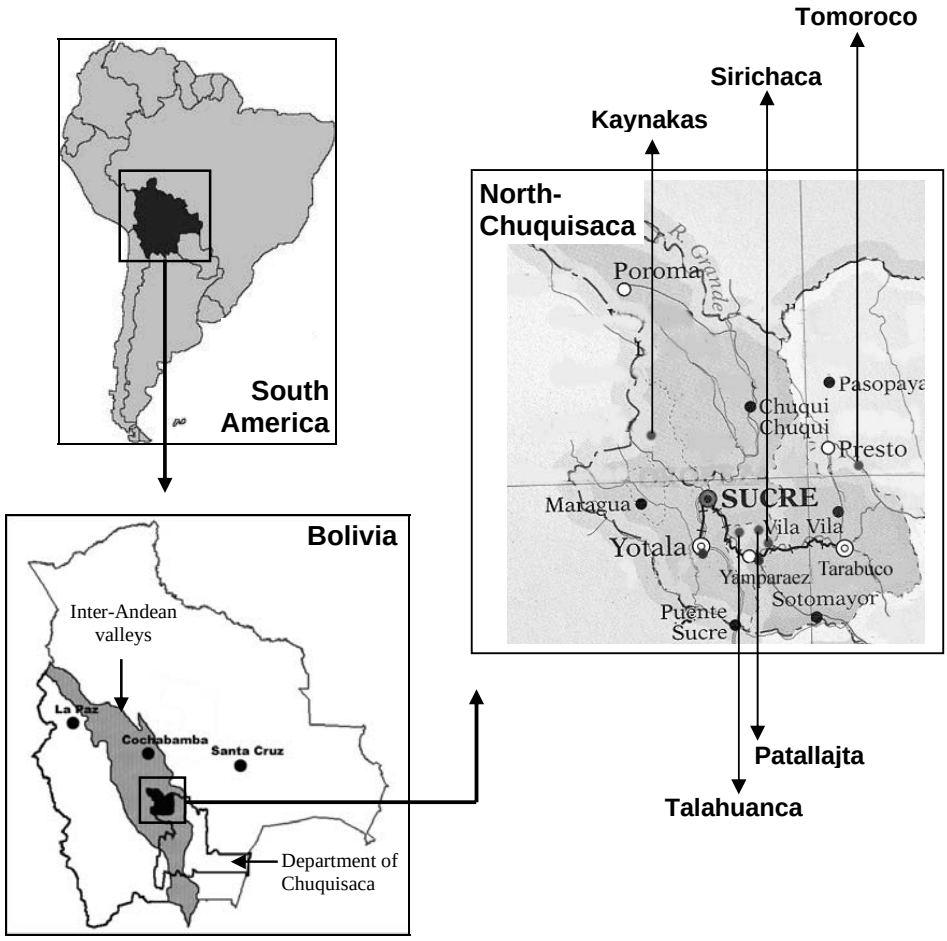


Figure 1.1
South America, Bolivia, north-Chuquisaca and the location of the study villages

From the start, the JGRC project tried to involve the municipalities to which the study villages belong in some of the activities. This was an extremely difficult task, given that the project had not much to offer (from a financial perspective). In Tomoroco, situated in the municipality of Presto, municipal workers limited their participation mainly to official events. Lack of interest on the part of the mayor was the main constraint. Kaynakas, situated far away from the municipality's capital Poroma, received some attention only in the final stage of the project, once results were more visible in the village. The municipality of Poroma contributed to the construction of several small irrigation and drinking water schemes in Kaynakas. The best collaboration was with the municipality of Yamparaez, where Sirichaca and the two validation villages Talahuanca and Patallajta are situated. Thanks to a dynamic and interested mayor, this municipality gave support to the activities of the JGRC project and contributed financially to the execution of several activities.

1.3 The study villages

Among the five study villages, the experimental villages (Tomoroco, Kaynakas and Sirichaca) are the most important. The JGRC project was active in these villages for about four years; in the validation villages (Talahuanca and Patallajta) this was less than two years.

The experimental villages were carefully selected, in order to obtain a representative sample of villages for the north-Chuquisaca region. Table 1.1 shows the most important geographical, climatic, cultural and socio-economic differences between the experimental villages.

Table 1.1
Differences between the three villages in the north-Chuquisaca region, Bolivia

	Kaynakas	Tomoroco	Sirichaca
Number of families	180	160	50
Topography	V-shaped	U-shaped	Flat
Altitude	2,500 – 3,100 m a.s.l.	2,600 – 3,000 m a.s.l.	3000 m a.s.l.
Yearly rainfall	750 mm	350 mm	500 mm
Water availability	Good	Regular	Bad
Organization	Very well organized	Many limitations	Very poorly organized
Market access	Bad	Regular	Good
Agriculture	Subsistence	Subsistence	Cash-crop / subsistence
Migration rate	Low	Moderate	High
Ethnic group	Jalqas	Yamparas	Mixed

Tomoroco (Photo 1) is the driest village, but several natural wells and relatively good access make it adequate for vegetable and fruit production under irrigation. It is situated in a U-shaped valley with extensively eroded soils. Higher-up in the mountain valleys some remaining natural relicts of forest are still found. Kaynakas (Photo 2) is much wetter and greener; many small wells are found on the steep slopes. Difficult access to this village limits the commercialization of agricultural products, and is the main reason that institutional support never arrived here. Due to these limitations, and despite being very well organized,

Kaynakas is the poorest of the three experimental villages. Sirichaca (Photo 3) is the richest, thanks to its location on the paved road to Sucre, and its flat land that used to produce very good-quality potatoes. Every possible development agency has shown up in this village, although without being able to reverse the continuing decline in soil productivity. Agriculture is not (or hardly) profitable anymore, and many villagers nowadays migrate for several months to the lowlands. Consequently, Sirichaca is poorly organized.

The validation villages are situated at the same altitude as Sirichaca (3000 m above sea level) and receive similar amounts of rainfall (500 mm/year). Talahuanca is a small village (40 families) that is well-organized and has generally steep slopes (Photo 4). Patallajta is much bigger (120 families) with dispersed houses and it is – thus – less organized. Steep as well as gentle sloping fields are found in this village. In both villages irrigation potential is very limited; agriculture is completely rainfed. Migration rates are lower than in nearby Sirichaca.

The majority of the families in all these villages still manage a mixed farming system, with mainly subsistence agriculture and a flock of goats and sheep. Average cultivable area in this region is about 4 ha per family. However, families in the lower socioeconomic stratum have less than half of this at their disposal (Aramayo, 1998). Moreover, these families generally have the less-productive soils, which have lost most of their former production capacity (for more details see Chapter 3). Potatoes are still the main crop and the only one that receives small amounts of manure. Other important crops are maize, wheat and barley. Animal traction is mostly used for land preparation. Because only few families have a pair of oxen, these are lent to other families in exchange for labour. Sirichaca is the only one of these villages in which some of the richer farmers prepare their land with a tractor. About 75% of the families in this region do not maintain fallow periods in their crop rotation (Aramayo, 1998). As a result of this and other limitations such as low-quality seeds and low sowing densities, agricultural production levels are often extremely low in this region.

Livestock is also of a very low quality. The animals completely depend for their food on local pastures, which are increasingly scarcely available on the degraded rangeland. Most animals are underfed and weak, and have all kind of diseases and parasites. As a result, mortality rates are high and reproduction rates are low. Because of not being informed, farmers generally vaccinate their animals only once they become ill. Nevertheless, livestock is still very important for most families: its manure is used for potato cropping; having animals is considered as a kind of savings; it is an activity that does not require (in its current form) any investment; and children can easily do keeping watch over the animals.

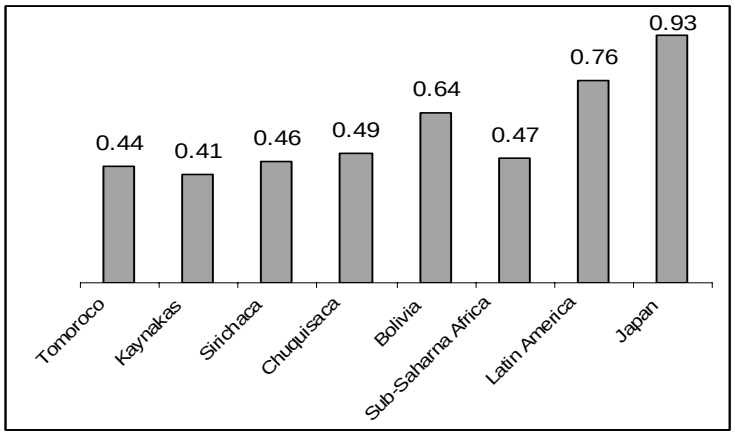
A case study by the JGRC project investigated how a family (including only all family members older than 12 years) distributes its time between the productive activities “agriculture”, “livestock” and “off-farm employment”. The study revealed that 50 to 70% of a family’s available time is dedicated to livestock-related activities. It also found that income from livestock activities is almost negligible (Table 1.2). Hence, families dedicate most of their time to a non-profitable activity. Most income comes from off-farm labour activities, mainly executed during migration periods in the lowlands of Bolivia. However, remarkably only 5% (in Kaynakas) to 20% (in Sirichaca) of a family’s time is dedicated to this activity. Even external sources (e.g. money sent by family members living permanently abroad) contribute often more to a family’s income than agriculture and livestock together.

In general, the most striking statistic is that most families have to live on less than half a US dollar per day. Zoomers (1998) conducted a more comprehensive study of farmers' strategies in the same region. In villages where subsistence farming is the main activity, the study found an average yearly household income of approximately US$ 500. Given that in the experimental villages the average yearly household income is about US$ 200 (Table 2.1), it must be concluded that the study villages definitely belong to the poorest in the inter-Andean valleys of Bolivia.

Table 1.2
Average yearly household income in the experimental villages (in US$)

	Tomoroco	Kaynakas	Sirichaca
Agriculture	22	33	55
Livestock	3	2	10
Off-farm labour	125	52	237
External sources	36	46	29
Total	186	133	321

Source: Case Study of the JGRC project with 6 families per village



Sources: UNDP (1997), UNDP (2001) and JGRC field data from 2002

Figure 1.2
Human Development Index for the experimental villages compared to other regions and countries

Similar striking results concerning poverty in the area come from another study conducted by the JGRC project. In this study all villagers in the three experimental villages were taken into account. It revealed that the Human Development Index (HDI) in each of the villages is lower than the average for the Department of Chuquisaca, and also even lower than the average for sub-Saharan Africa (Figure 1.2). Although comparing villages with regions or countries is not ideal, and surely many villages in sub-Saharan Africa will show even lower HDIs than the experimental villages, it illustrates the extremely low level of development in the inter-Andean valleys of Bolivia. This is not only caused by low income, but also by a very low life-expectancy in the villages (51 years). Similarly, the Human Poverty Index (HPI) for the experimental villages is also among the highest in the world (on average 45%), with lack of

access to drinking water and health facilities being the principal constraints. However, the fact that 40% of the adults are illiterate also strongly contributes to a high HPI.

This short overview of the study villages sketches a quite dramatic picture of current living conditions in the region. The objective of this section was to illustrate the context in which the JGRC project conducted its activities. Throughout this thesis more details will be revealed, specifically regarding natural resources and land degradation. It is, however, important for the reader to keep the above-described context in mind, and to be conscious of the enormous constraints that these people are facing.

1.4 Key definitions and concepts

In this thesis, I use several definitions and concepts repeatedly. Especially when reading the Synthesis (Chapter 9) it is recommendable to be acquainted with the following key definitions and concepts.

Land degradation: The permanent decline in the rate at which land yields products useful to local livelihoods (Scoones and Toulmin, 1999). In low-input agricultural systems most important forms of land degradation are soil and vegetation degradation (Mazzucato and Niemeijer, 2000).

Land management: The technology, activities and strategies employed by land users to manage their land. Land management is sustainable when the available technology, activities and strategies are employed and integrated in such a way as to optimize the current and future land use (for food production) while maintaining the quality of the natural resources base.

Soil and water conservation: Soil and water conservation (SWC) is the opposite of land degradation, and aims at preventing, reducing or recovering losses of soil, water and plant nutrients. SWC is the foundation of sustainable land management, given that availability and quality of soil and water are crucial for food production and a healthy environment.

SWC practices: All land management practices that aim at runoff control and/or better soil management. Runoff control practices are generally physical practices, i.e. (semi) permanent structures in or around the field. Soil management practices are mostly agronomical (non-permanent) practices to improve soil quality and nutrient availability to the crop.

Adoption (of SWC practices): A decision-making process in which small-scale initial experiments with SWC practices are followed by gradually increasing investments (to execute or maintain SWC practices). A SWC practice is considered adopted only when its execution is sustained and fully integrated in the household's farming system.

SWC investments: All labour (efforts) and (financial) inputs that a farmer uses to execute SWC practices (annual practices as well as practices aiming at long-term impact).

Progressiveness: A farmer's orientation to change and to modernize; progressiveness strongly relates to the adoption of conservation practices (Hansen et al., 1987). Farmers with a progress-driven attitude are generally more willing to learn, to make progress and to invest in SWC practices.

The logical strategy for SWC: A strategy at farm household and village level, in which a logical set and sequence of activities based on farmers' needs and capabilities must lead to the (eventually widespread) adoption of SWC practices.

The human dimension of the logical strategy: The logical strategy's emphasis on generating a progress-driven attitude among the villagers. This is achieved by means of a process of conscientization, motivation and the genuine participation of people in collective actions.

A solid foundation for sustainable development: The first phase of the logical strategy, which aims at generating a progress-driven attitude at village level. It is expressed in e.g. good village organization, responsible participation of villagers, and effective collaboration.

Scaling-up of SWC: The (horizontal) spreading of SWC practices to wider geographical areas, combined with the (vertical) involvement of meso and macro-level institutions to create an enabling environment and ensure continuing adoption.

1.5 Problem definition, research question and objectives

Land degradation is clearly visible in the inter-Andean valleys of Bolivia: erosion gullies appear almost everywhere, vegetation is being replaced by overgrazed pastureland, and natural wells are drying up due to lower infiltration rates. People respond to these changing conditions by diversifying their activities (Zoomers, 1998). Although most farmers prefer their daily life on their farms (Vargas, 1998), a growing number of them have been migrating to the cities for short periods or even permanently. Migration is often a necessity; adequate soils for agriculture and livestock have become scarce (Barrón and Goudsmit, 1998). Increasingly, agriculture tends to become an additional activity.

Investments in soil improvement are rarely made. Morgan (1995) argues that farmers are not unwilling to invest in soil and water conservation (SWC), for example, but will do so only if the investment costs can be recovered. Hence, the best way to overcome land degradation is to ensure that practices are financially attractive for the actors concerned. This is the key dilemma in all SWC projects: conservation practices rarely generate such profits, at least not in the short run. Often, by using incentives, SWC projects have stimulated farmers to conduct SWC practices (Kessler et al., 1995), but this only disguised the unwillingness of farmers to invest in their land. Such misguided strategies, combined with the frequently observed disharmonious execution of institutional efforts in the rural area (Kessler, 1998; Kessler 1999), have led to the preservation of the vicious circle in which poverty and land degradation reinforce each other.

In this context, the challenge from a SWC point of view lies in finding a way to motivate land users to adopt SWC practices. According to FAO (1995), a conservation

strategy will not be successful unless it is closely linked with strategies for increasing agricultural productivity and profitability. That is true, but there is more. If agriculture tends to become an additional activity, can increased productivity alone motivate farmers to adopt SWC practices? Are there other factors that should be taken into account? What reasons might land users have to decide *not* to invest in their land? To properly address these questions, a profound understanding is needed of the reasons for adoption, partial adoption or non-adoption (Erenstein, 1999). A variety of economic and socio-cultural factors should be considered in such an analysis (Fujisaka, 1993). Only once the fundamental reasons for farmers' decision-making are understood can more adequate intervention strategies be formulated.

This research project was inspired by my profound concern that land degradation (especially soil erosion) is visibly increasing in the inter-Andean valleys of Bolivia, and that no action is being undertaken to stop it. Have people simply thrown in the towel? Have they resigned themselves to the current situation? Must we just follow the easiest route and simply "give up" this land because the alternative pathways are too complicated? Or is it possible to conserve soil and water in a sustainable way? If so, how, and what strategy should be followed? Most importantly, how can we achieve widespread impact, instead of (again) throwing drops in the ocean with small-scale local experiences that cannot be scaled-up?

These were my concerns, and these were the challenges I faced with this research. They are all reflected in the research question of this work:

"How can farmers in the inter-Andean valleys of Bolivia be motivated to adopt soil and water conservation practices on a wide scale?"

To be able to answer this question, I worked with the following five specific objectives during this research project:

1. Assess the seriousness of land degradation in the inter-Andean valleys of Bolivia.
2. Validate available SWC practices in the region.
3. Determine key factors that influence farm households' decisions to invest in SWC.
4. Validate a strategy that motivates farmers to adopt SWC practices.
5. Analyse the prospects and requirements for the scaling-up of SWC activities.

1.6 Thesis outline

The chapters in this thesis follow the sequence of the above-described objectives. In Chapter 2 the seriousness of land degradation in the inter-Andean valleys of Bolivia is assessed (*Objective 1*). Due to the absence of data in the region, a methodology is presented in which farmers themselves are directly involved in assessing loss of soil, productivity, and vegetation cover over the past decades. The results of this assessment are used to justify the call for urgent action to tackle land degradation.

Chapter 3 looks at what farmers actually undertake to control runoff and to improve soil fertility. It presents the results of the validation of all available SWC practices in the region

(*Objective 2*), both traditional and newly introduced practices. Six of these practices were actively promoted by the JGRC project by means of SWC contests.

Chapter 4 analyses why some farmers have adopted one or more of these six SWC practices more easily than others have. In this chapter, decisive key factors that influence farm households' decisions to invest in SWC are determined (*Objective 3*). Based on this information, four concrete recommendations are given for a SWC strategy that aims at motivating farmers to adopt SWC practices.

This strategy is presented in Chapter 5. An overview is given of the human dimension of this "logical strategy for SWC", as well as the fundamentals for working with farmers in SWC. The experiences of the JGRC project with the implementation of the logical strategy in its study villages are presented and discussed.

In Chapters 6 and 7 the results of the validation of the logical strategy are given (*Objective 4*). Chapter 6 focuses on the importance of laying a solid foundation for sustainable development before executing concrete development activities. It presents how the study villages have changed, and analyses whether these changes are sustainable. Chapter 7 focuses on SWC practices. It presents how SWC contests were conducted, and discusses the results of these contests. Based on the results of an ex-post evaluation conducted in 2005, the sustainability and continued adoption of these SWC practices are also discussed.

Chapter 8 is a descriptive and analytical chapter, in which the prospects and requirements for the scaling-up of SWC activities are discussed. It focuses mainly on the institutional enabling context for scaling-up, and the existing constraints at micro-, meso-, and macro levels. It tells what should be done and who must act.

Finally, the synthesis in Chapter 9 integrates all previous chapters in a conclusive discussion, and gives two concrete steps for moving people towards collective action in soil and water conservation.

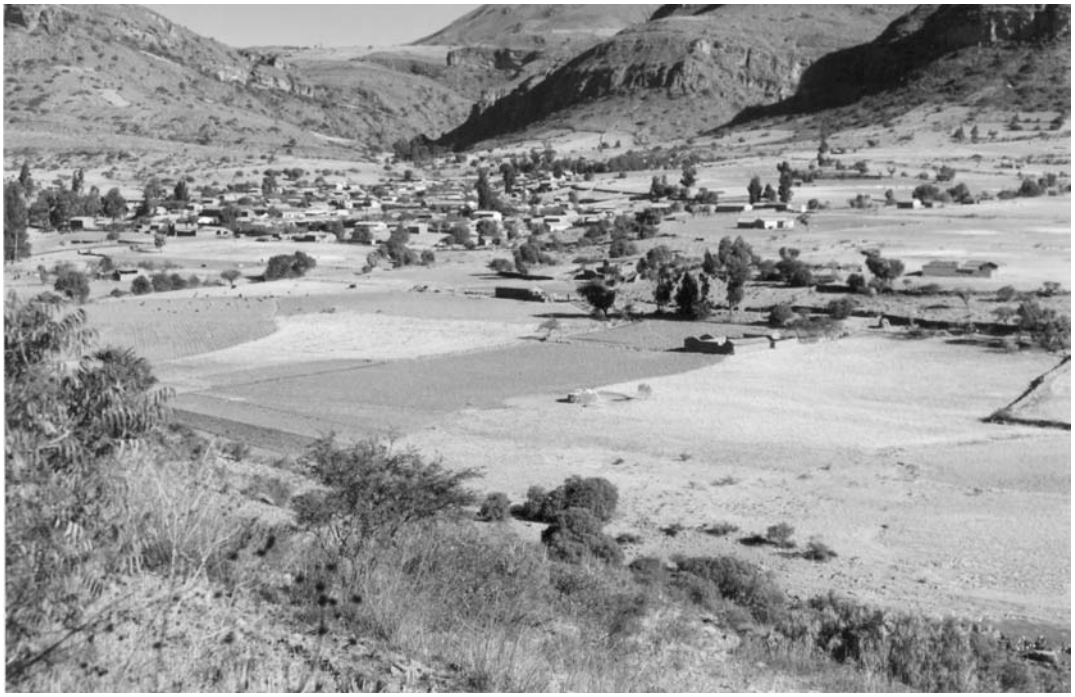


Photo 1: Tomoroco

Photo 2: Kaynakas

Photo 3: Farmers in Sirichaca with the A-Frame

Photo 4: Talahuanca; a farm with diversion ditches and stone lines

Chapter 2

Land degradation assessment by farmers in Bolivian mountain valleys

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Land Degradation & Development 17, 235-248 (2006)
DOI: 10.1002/ldr.699

"It's true that our soils are sick,
we think we can cure them by giving Mother Earth our
***"chicha"* (local corn beer), but that doesn't return to the**
soil what it has lost……, its fertility"

(Villager from Tomoroco)

2. Land degradation assessment by farmers in Bolivian mountain valleys

Abstract

A methodology is presented for assessing the seriousness and impact of land degradation from a historical and a farmer perspective, in regions where data are not available. Farmers are directly involved in the assessment of soil, productivity and vegetation cover loss over the past decades, both on cropland and on rangeland. The results for the Bolivian mountain valleys in north-Chuquisaca show that the intensive use of small cropland fields has increased soil degradation and consequently led to less water and nutrient availability. Due to the subsequent productivity loss many cropland fields have been abandoned. Rangeland is also severely degraded as a result of the excessive removal of vegetation and subsequent soil loss. Farmers are very concerned, but consider the impact of changed rainfall and less available cropland beyond their control. Consequently, no serious initiatives are taken to solve the land degradation problem. This research adduces evidence of increased land degradation in the Bolivian mountain valleys over the past decades, and stresses the need for urgent (integrated) action with regard to soil and water conservation.

Key words: Land degradation assessment; Farmers' participation; Soil loss; Productivity loss; Vegetation loss; Rainfall changes; Soil and water conservation; Bolivia.

2.1 Introduction

Land degradation is the permanent decline in the rate at which land yields products useful to local livelihoods (Scoones and Toulmin, 1999). In low-input agricultural systems most important forms of land degradation are soil and vegetation degradation (Mazzucato and Niemeijer, 2000). Soil degradation, i.e. the loss of soil productivity, often occurs due to land use changes. Where cropland replaces natural vegetation and land management is inappropriate, this leads to reduced infiltration rates, higher runoff and erosion, and thus continued soil degradation. In uncultivated areas, vegetation degradation (i.e. the decrease or removal of vegetation cover) often precedes soil degradation.

In the Bolivian valleys deforestation and heavy erosion occurred over the generations: "…both the forest and the land have reached a state of utter degradation unparalleled even in Bolivia, which is the result of a problem that was acute two hundred years ago" (UN, 1951). During the 1980s and 1990s there were alarming reports about extreme soil erosion (Zimmerer, 1993). Nowadays, the views of barren landscapes and the general impression of poverty still shock most visitors travelling though the region. Hence, land degradation seems to be a grave problem and one would expect a lot of action to tackle it.

However, the reality is different. Project activities and budgets – rather than being spent on countering on land degradation – are mainly focused the construction of schools, roads, playgrounds and irrigation schemes. Activities with impact at a longer term, like those related to soil and water conservation (SWC), are seldom mentioned. Farmers also mainly request

short-term and tangible activities when projects come to their villages, and execute conservation works principally when incentives are given in exchange. Hence, although erosion studies report severe erosion rates and land degradation apparently endangers the future sustainability of local livelihoods, institutions and farmers act with indifference.

Considering this general passivity, the question arises: "Is land degradation really a serious problem?" Even more important, we must know how farmers perceive land degradation, since evidence for land degradation not being as widespread as it was presumed to be can explain farmers' hesitance in adopting SWC practices (e.g. Fairhead and Leach, 1996; Howarth and O'Keefe, 1999). However, this evidence is not available for the Bolivian mountain valleys.

This chapter makes a step towards filling this gap. For the correct assessment of land degradation more farm and village level measurements need to be made (Mazzucato and Niemeijer, 2001). Moreover, farmers' knowledge has proved to be very useful in land degradation assessment (Murage et al., 2000; Vigiak et al., 2005). Therefore, with the objective to explore the seriousness of land degradation in the Bolivian valleys, we used a methodology in which farmers are directly involved in assessing soil, productivity and vegetation cover loss over the past decades. This methodology for land degradation assessment by farmers in the Bolivian mountain valleys is presented and the results will be used to explain why farmers and institutions do not act to tackle land degradation.

2.2 The villages and research areas

The villages

The research was conducted in the villages of Kaynakas, Tomoroco and Sirichaca in the north-Chuquisaca region of the inter-Andean valleys in Bolivia (Figure 1.1). Chuquisaca is one of the least developed departments in Bolivia, with the second lowest Human Development Index (HDI) in Bolivia, equalling only 0.49 (UNDP, 1997). The villages are considered representative for the north-Chuquisaca region. They lie at altitudes between 2,500 and 3,100-m a.s.l. Kaynakas can be characterized as "the green village", with more rainfall and higher water availability, but with a very poor population due to difficult market access. Tomoroco is much drier, but irrigation and a relatively good access make cultivation of fruits and vegetables possible. Sirichaca is "the flat village", where, despite the lack of water, cash crops are produced in good rainy seasons and sold at the nearby Sucre market.

The research areas

Small research areas of 84 to 163 hectares were selected in each village. These representative research areas, with a variability of cropland and rangeland (or silvo-pastoral land) and the presence of a number of at least ten families (Table 2.1), were visited between September 2002 and February 2003. Low organic matter (< 2%) and N contents (< 0.2%) of the predominantly sandy-loam soils pose serious restrictions for their agricultural use.

Table 2.1
Land use and number of families in the three research areas

	Kaynakas*	Tomoroco*	Sirichaca*
Total area (ha)	84	163	125
Cropland (ha)	15	31	51
Rangeland (ha)	69	122	74
Number of families	10	18	18

** In the rest of this chapter, when mentioning the names of Kaynakas, Tomoroco and Sirichaca, the research areas in these villages are referred to.*

2.3 Research methodology

Assessing land degradation from a different perspective

Most existing methodologies for land degradation assessment focus on status or risk assessment, with land degradation expressed in terms of actual or expected loss of soil, water, vegetation, etc. per year (Oldeman, 2002). These assessments are generally based on data obtained from site-specific studies, which reflect only the situation (or susceptibility) of a certain plot at a given moment (Stocking, 1987). In Bolivia, such data are not available or not reliable enough for extrapolation purposes.

To overcome this problem of data paucity and at the same time evaluate the seriousness of land degradation in a relatively short time, we used an innovative methodology that assesses land degradation from a historical- and a farmer's perspective. It is based on the judgments and observations of farmers (the farmer's perspective) regarding changes in their fields between 1963 and 2003 (the historical perspective). These changes, expressed in soil, productivity and vegetation cover losses, are assessed by means of visible, and for farmers, comprehensible indicators. Where possible, these losses are quantified in order to enable mutual comparison of all fields. For each field, soil losses and productivity or vegetation cover losses are classified and assigned to one of the five respective classes (ranging from none to extreme losses). Since these classes do not represent absolute levels of losses, the adequate classification of losses is crucial in this methodology.

Following the work of an extensive land degradation study in South Africa (Hoffman and Todd, 2000), a distinction is made between cropland and rangeland. Cropland includes permanent cropland (fields used in 1963 and in 2003), abandoned cropland (fields used in 1963 but not in 2003) and new cropland (fields used in 2003 but not in 1963). Rangeland are all the other fields, i.e. those that were never used as cropland and where cattle can generally graze freely, including small woodlands and wasteland. The main input data for assessing cropland and rangeland degradation are soil losses over the past decades. Additionally, for cropland, productivity loss over the past decades is taken into account and for rangeland the vegetation cover loss (Figure 2.1). Enlarged 1962 aerial photographs were used to help the elder farmers recall the past state of their fields. Hence, when in this chapter "the past decades" is mentioned, it ideally refers to the situation 40 years ago, but for some farmers – especially the younger ones – it means about 10 to 20 years ago. In the case of new cropland, exceptionally even more recent years are referred to when talking about "the past".

This methodology provides an instrument not only for assessing land degradation changes over the past decades, but also for estimating its seriousness, for explaining its causes and for discovering trends in regions with data paucity. Although any statement about land degradation should be treated with caution (Mazzucato and Niemeijer, 2000), the combined message of 48 farmers' opinions and measurements on more than 300 fields resulting from this methodology, is powerful enough to assess the seriousness of land degradation objectively.

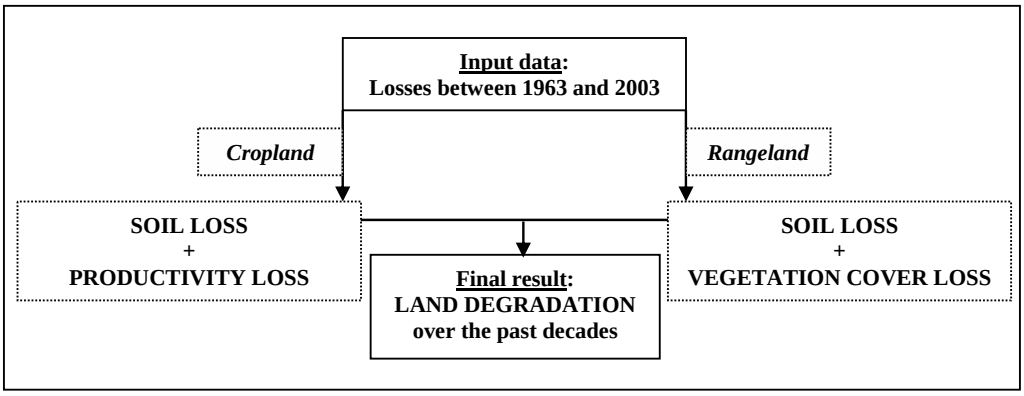


Figure 2.1
Input data for land degradation assessment by farmers in Bolivian mountain valleys

How the methodology was applied

For soil loss, five *main* and eight *additional* soil loss indicators were selected from those described by Stocking and Murnaghan (2001) (Table 2.2). The main soil loss indicators are for farmers the most clearly visible and comprehensible. On all fields the presence of these indicators was checked and changes over the past decades were discussed and described. Also additional – and for farmers less easily comprehensible – indicators were evaluated. Based on all the information, for each field soil loss over the past decades was classified.

For productivity loss, which for farmers is the most tangible sign of land degradation, indicators were used such as seed-yield relations now and in the past, the size of yielded potatoes and maize, and – whenever possible – quantitative crop (production) data given by farmers. Based on all the information and farmers' comments, productivity loss of each field was assessed.

For vegetation cover loss, which whenever possible was assessed with the women (who are responsible for taking cattle to the grazing fields), current vegetation cover was assessed first. After that, the past vegetation cover situation and the changes were discussed, using the 1962 aerial photographs, and the vegetation cover loss was classified. Examples of class 5 losses ("extreme") for soil, productivity and vegetation cover loss are given in 2.3.

Table 2.2
Soil loss indicators for assessing land degradation in Bolivian mountain valleys

Indicators	Indicator for	Measure
Main indicators		
The presence of gullies	Past soil losses	Gully growth
The presence of badlands	Past soil losses	Badland growth
Rock exposure and soil depth	Past soil losses	Soil depth difference
Build-up of soil against barriers	Past soil losses	Soil height difference
Root exposure from trees	Past soil losses	Soil depth difference
Additional indicators		
An armour layer	Past soil losses	Depth of armour layer
Chemical signs on rocks	Past soil losses	Height to the ground
Waterfall effect below trees	Ongoing soil losses	Soil height difference
Tree mound	Ongoing soil losses	Soil height difference
Sediment in waterways	Ongoing soil losses	Amount of sediment
Enrichment downslope	Ongoing soil losses	Growth differences
Texture and colour differences	Ongoing soil losses	Direct observations
Laminar erosion	Ongoing soil losses	Presence of rills

Table 2.3
Examples of soil, productivity and vegetation cover losses in class 5 (extreme losses)

Classes	Examples
5 Extreme soil loss	Clearly visible gully growth and soil depth differences (rock and root exposure)
5 Extreme productivity loss	Abandoned cropland fields that formerly showed good productivity levels
5 Extreme vegetation cover loss	Bare rangeland that formerly showed a relatively dense natural vegetation cover

Cropland degradation over the past decades was mapped and calculated in ARCVIEW for each field, by means of combining the scores of soil loss and productivity loss, with a respective weight factor of two and one. Similarly, rangeland degradation was calculated with a respective weight factor of two and one for the scores of soil loss and vegetation cover loss. In both cases soil loss was given a higher weight factor because soil loss classification is based on more and better measurable indicators. Final land degradation categories ranged from *no land degradation* to *extreme land degradation.*

All data were collected with the help of three Bolivian researchers who spoke the native language (Quechua). The high level of confidence between farmers and these researchers – who at the time of execution had already lived one year in each village – was a crucial aspect for correctly interpreting farmers' comments and for obtaining reliable results. E.g. in the case of productivity loss, where some farmers tend to exaggerate, this familiarity with each farmer helped to rule out big mistakes. Farmer visits were generally short (maximum two hours) but repeated several times, especially when many different fields had to be visited. Total amount of time invested by the researchers was about one month per research area. Hence, similar to other survey methods that consist of assessing the presence and intensity of erosion features (Morgan, 1985), the present methodology is rather time demanding.

However, in regions where land degradation data are not available, it is still a relatively quick and easy alternative.

Additional analyses

The discussions with farmers regarding the causes of land degradation over the past decades were an important methodological tool that helped to reconstruct past events in the village. During these informal talks, emphasis was given to human factors that generally induce land degradation, such as land use changes (in relation to population growth), soil management practices, natural resources use (especially fuelwood use) and the effect of livestock. Additionally, an analysis of historical rainfall data was conducted in order to investigate farmers' comments regarding rainfall regime changes over the past decades. The results of these discussions and the rainfall analysis are also presented.

2.4 Results

Soil loss (on cropland and rangeland)

The *main* indicators for soil loss proved to be easily comprehensible to all farmers, who generally could recall very well their size or scope of at least about two decades ago. The *additional* indicators, either for past losses or ongoing losses, were used for soil loss assessment when the main indicators were absent or not clear enough.

In Table 2.4 the results of soil loss assessment are presented for cropland and rangeland. It shows that on cropland, high to extreme soil loss has occurred on 12-25% of the fields, but that most of the cropland (30-57%) only presents light or no soil losses. Especially in Sirichaca a considerable amount (42%) of cropland can still be found where no soil has been lost. This is in line with a study by Aramayo (1998) who observed rills and gullies on 50% of cropland in the mountain valleys. However, on rangeland the vast majority of the fields (55-88%) have suffered high to extreme soil loss over the past decades, especially in the form of gully erosion. No to light soil losses have rarely occurred on these fields. Only in Kaynakas 23% of rangeland is not or only lightly affected.

Table 2.4
Soil loss over the past decades on cropland/rangeland (%) in the three research areas

Soil loss		Cropland			Rangeland		
		K	T	S	K	T	S
1	No	24	10	42	3	0	0
2	Light	23	20	15	20	1	7
3	Moderate	31	58	18	22	22	5
4	High	14	10	7	48	49	37
5	Extreme	8	2	18	7	28	51

K=Kaynakas; T=Tomoroco; S=Sirichaca

Productivity loss (on cropland)

Table 2.5 shows the results of productivity loss assessment on cropland. No to light productivity loss has occurred on 22-40% of the cropland fields. High to extreme productivity loss (38-48%) is mainly observed on already abandoned cropland that nowadays are eroded rangeland fields. Despite considerable productivity losses on cropland, farmers with access to chemical fertilizers and high yielding varieties (like some in Sirichaca) are generally able to maintain former production levels. This is reflected in average departmental yield data for potatoes and wheat, which show a light increase over the past two decades (INE, 2004). However, Aramayo (1998) shows that yield levels of the poorest farmers are 50% below these departmental levels. Hence, for most small subsistence farmers – the vast majority of farmers in the research areas – the only option is the permanent use of cropland until too low productivity levels force the abandoning of these lands.

Table 2.5
Productivity loss on cropland over the past decades (%) in the three research areas

Productivity loss		Kaynakas	Tomoroco	Sirichaca
1	No	14	0	0
2	Light	16	22	40
3	Moderate	30	30	22
4	High	28	27	12
5	Extreme	12	21	26

Vegetation cover loss (on rangeland)

In Table 2.6 the results of vegetation cover loss assessment on rangeland are presented. High to extreme vegetation cover loss is quite similar (27-38%) in the three research areas. Conversely, while in Kaynakas (“the green village”) still one third of rangeland presents no vegetation cover loss at all over the past decades, in Tomoroco and Sirichaca all rangeland fields have been at least slightly affected by a loss of vegetation cover.

Table 2.6
Vegetation cover loss on rangeland over the past decades (%) in the three research areas

Vegetation cover loss		Kaynakas	Tomoroco	Sirichaca
1	No	33	0	0
2	Light	15	15	35
3	Moderate	18	58	27
4	High	27	18	17
5	Extreme	7	9	21

Land degradation

The results of the assessment of land degradation in the research areas, as a combination of the previous presented losses, are given in Table 2.7. It shows that more than 50% of the research areas in Tomoroco and Sirichaca are affected by high to extreme land degradation over the past decades. In Tomoroco the situation is the worst, because no fields can be found that are not affected by land degradation. In Sirichaca, on still a considerable amount (19%) of the fields, land degradation has not occurred over the past decades.

Table 2.8 shows that rangeland is most affected. In Sirichaca 88% of the rangeland fields show high to extreme land degradation. In Tomoroco 99% of rangeland is at least moderately degraded over the past decades. The exception is Kaynakas, where still 26% of rangeland is only slightly degraded. Cropland is generally less affected by high to extreme land degradation (21-28%). In Kaynakas and Sirichaca even a considerable percentage (37-54%) of cropland is not or only slightly degraded over the past decades.

Table 2.7
Land degradation over the past decades (%) in the three research areas

Land degradation		Kaynakas	Tomoroco	Sirichaca
1	No	7	0	19
2	Light	22	5	17
3	Moderate	37	31	13
4	High	27	55	32
5	Extreme	7	9	18

Table 2.8
Land degradation over the past decades on cropland/rangeland (%) in the three research areas

Land degradation		Cropland			Rangeland		
		K	T	S	K	T	S
1	No	19	0	29	3	0	0
2	Light	18	17	25	23	1	7
3	Moderate	42	55	17	36	24	5
4	High	14	26	10	32	65	69
5	Extreme	7	2	18	7	10	19

K=Kaynakas; T=Tomoroco; S=Sirichaca

Rainfall analysis

Changes in rainfall amount and distribution were investigated for the rainy season (November to March) at the weather station of Sucre, with data from the years 1951 to 2001. Figure 2.2 shows the enormous variability in rainfall amount during the period November-March (300-900 mm) and December-January (50-450 mm). The trendline for average rainfall amount during the rainy season (November-March) gradually declines since 1985 (Figure 2.2A). For the months of December-January (Figure 2.2B), this trend is even more pronounced. During the last 15 years total rainfall in these two months has not reached the – previously normal – amount of 300 mm.

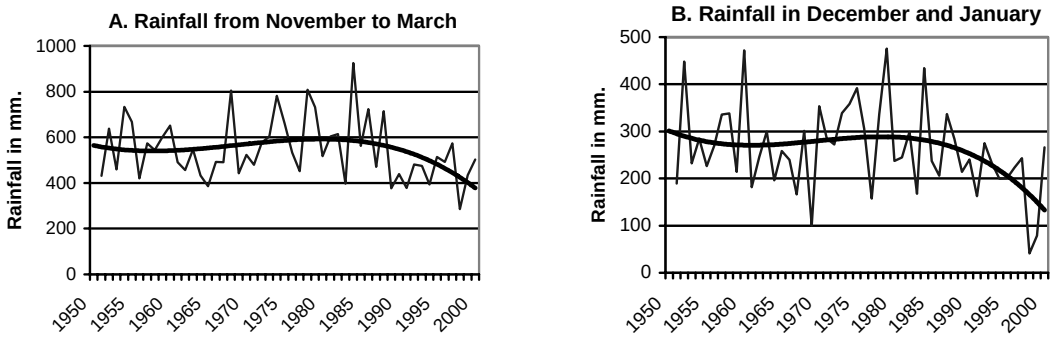


Figure 2.2
Total rainfall amount from 1950 to 2002 in Sucre, north-Chuquisaca, Bolivia

For the changes in rainfall distribution, dry spell occurrence was analysed. A dry spell is considered a ten-day period without considerable rainfall, i.e. with less than 8 mm of rainfall in one day or 10 mm of rainfall in two consecutive days. Figure 2.3A shows an increased number of dry spells from December to February. The most extreme case was the year 1998/99, with four dry spells and 69 days without considerable rainfall. Figure 2.3B shows a sudden increase in the duration (accumulated number of days) of dry spells from December to February since 1985.

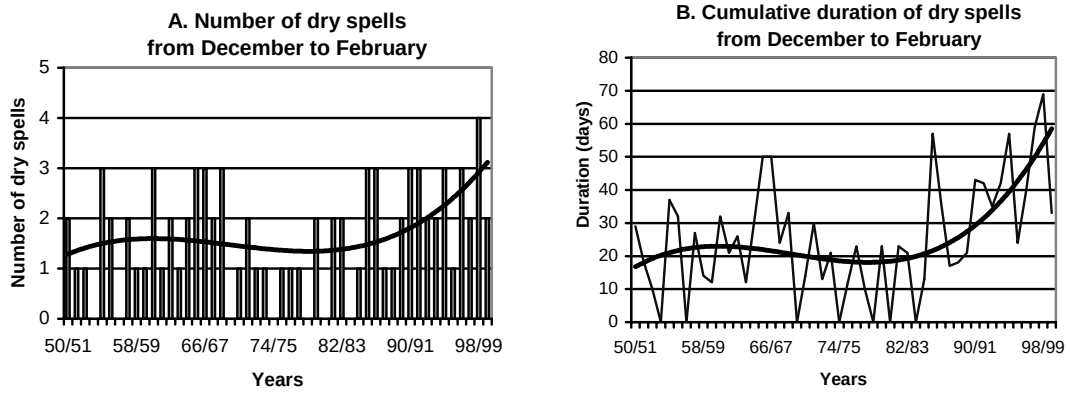


Figure 2.3
Number and cumulative duration of dry spells from 1950 to 2002 in Sucre, north-Chuquisaca, Bolivia

2.5 Discussion

Cropland degradation

Population growth is a basic parameter for any analysis of land degradation. Population pressure on natural resources and its influence on land degradation have been widely discussed (Mazzucato and Niemeijer, 2000). In some cases, population growth has led to technological innovation and land degradation did not occur. The most famous example is the Machakos region in Kenya, where favourable market conditions triggered agricultural intensification and set the region on a development path of induced innovation (Kessler,

2003). Boserup (1965) argued that where rates of population growth are too high and/or where knowledge about better land husbandry practices is not available, land degradation is inevitable.

Table 2.9 presents the number of families in each research area in 1963 and 2003. It shows a tremendous increase in number of families over four decades. In this region, where land is still divided among all sons, this increase has led to land fragmentation and a decline of available cropland per family. Furthermore, total cropland area decreased by 22% between 1963 and 2003 (Table 2.10). In Tomoroco and Sirichaca a more than double the number of people produces on even less cropland than in 1963. As a consequence of reduced self-sufficiency in the region, poverty, high rates of seasonal migration (70% in Sirichaca) and a constant struggle for survival are now general phenomena. Only in Kaynakas, where abandoned cropland equals new cropland, has the available area for cropland remained the same. In Sirichaca, where almost one third of the cropland has been abandoned since 1963 and no new cropland has been found, it is evident that all potential cropland is already in use. In the other research areas there is still potential for new cropland fields.

Table 2.9
Number of families in 1963 and 2003 in the three experimental villages

Number of families	Kaynakas	Tomoroco	Sirichaca	Total
In 1963	5	7	9	21
In 2003	10	18	18	46
Increase (%)	100	157	100	119

Table 2.10
Changes in cropland between 1963 and 2003 (%) in the research areas

	Cropland in 1963	Abandoned cropland since 1963	New cropland since 1963	Cropland in 2003	Difference 1963 - 2003
Kaynakas	100	-33	+33	100	0
Tomoroco	100	-29	+20	91	- 9
Sirichaca	100	-31	0	69	- 31
Total	100	-31	9	78	- 22

In Sirichaca the permanent cropland fields are not much affected by land degradation: only 18% show moderate land degradation, while high to extreme land degradation was not observed (Table 2.11). This underscores the crucial function of these fields for Sirichaca's cash crop production and is a hopeful sign for the future. Given that all abandoned cropland is severely degraded, in Sirichaca a kind of natural selection has taken place over the past decades. The best – and generally flat – fields are kept intact with higher amounts of fertiliser and dung, while marginal cropland was intensively used (without fallow periods) and abandoned once it became useless. In Tomoroco and Kaynakas 77% and 55% of permanent cropland, respectively, has been moderately to extremely degraded over the past decades (Table 2.11). In Tomoroco even 84% of new cropland is heavily affected. Generally, this new cropland consists of marginal fields on steeper erosion-prone slopes, as better quality cropland is no longer available. This definitely endangers the future of subsistence farming in

this village. In Kaynakas 65% of new cropland is not or slightly affected by land degradation, which indicates that new cropland of good quality is still available, especially alongside the river with possibilities of irrigation.

Table 2.11
Land degradation from 1963 to 2003 on different types of cropland (%) in the three research areas

Land degradation		Kaynakas			Tomoroco			Sirichaca		
		P	A	N	P	A	N	P	A	N
1	No	14	0	52	0	0	0	47	0	-
2	Light	31	12	13	23	1	18	35	0	-
3	Moderate	37	42	27	71	50	78	18	18	-
4	High	15	26	4	6	39	6	0	31	-
5	Extreme	3	20	4	0	10	0	0	52	-

P: Permanent cropland; A: Abandoned cropland; N: New cropland

In general, land degradation over the past decades on cropland has had a great impact on the agricultural production capacity. In each research area one-third of the cropland fields have been abandoned (Table 2.10), while new cropland was difficult to find and was of a marginal quality. The general tendency in the region is that land degradation will continue to force farmers to abandon their fields in the near future. Farmers are very well aware of this tendency (soils are called “tired”) and consider it a grave problem. They see land degradation as the result of two important changes that cannot be controlled: a different rainfall regime and less available cropland. Statements like “If I had more land and if rains would be better, than there would be no problem” are quite common. In the following paragraphs these changes are shortly discussed.

The “crazy rains”, i.e. less rainfall, higher intensity rain showers and longer drought periods are always mentioned by farmers as the main cause for yield declines and slower vegetation growth. Figure 2.2 confirms the farmers' observation of decreased rainfall (in this case over the last 15 years). Figure 2.3 provides evidence that rainfall in the past decades was less homogeneously distributed and that longer drought periods are increasingly common. A probable explanation is the increased effect of *El Niño* since the late 1970s (Preston et al., 2003). Thinner soils with lower soil organic matter content have reduced the amount of water that can be stored in the soil profile. In combination with an increase in the occurrence and duration of dry spells this will increase crop production suffering from ‘drought’.

Less available cropland and smaller plots due to fragmentation and the abandoning of non-productive cropland, have led to changes in land management. According to farmers, some decades ago a rotational fallow period on each field was respected. Nowadays, most fields are farmed every year and the restorative effects of a fallow period – essential for the biotic rebuilding of porous soil architecture and the bringing back of nutrients to satisfy plants’ requirements over time (Shaxson, 2002) – are lost. Moreover, most cropland fields are fertilized only once every four years, with generally bad quality dung in low quantities (5 t ha^{-1}) (JGRC, 2002). Hence, both chemical and physical soil degradation are very common on cropland and affect soil productivity.

Table 2.12
Soil loss (SL) and productivity loss (PL) loss compared for cropland (%) in the three research areas

Soil loss and productivity loss		Kaynakas		Tomoroco		Sirichaca		Average	
		SL	PL	SL	PL	SL	PL	SL	PL
1-2	No/light	47	30	30	22	57	40	44	31
3	Moderate	31	30	58	30	18	22	36	27
4-5	High/extreme	22	40	12	48	25	38	20	42

Table 2.12 shows that in all research areas productivity loss is higher than soil loss. In Tomoroco – the most extreme case – only 12% of the cropland fields show high to extreme soil loss, while 48% of these fields are affected by high to extreme productivity loss. Hanson et al. (2004) show that soil degradation leads to decreased infiltration rates and more runoff. Yield loss is often caused by water-stress, not by soil loss (Shaxson, 2002). This is also the case in the Bolivian valleys, where 30% of annual rainfall was found to runoff on 8% sloping cropland (JGRC, 2003a). Due to crust forming, these sandy-loam soils produce runoff even on 10% sloping fields during 3 $mm.h^{-1}$ rainfall events (JGRC, 2003a).

Especially for subsistence farming, where pressure on available land is higher and inputs for soil improvement are not sufficient, this combination of reduced water and nutrient availability is an enormous constraint. Hence, farmers are right that their soils have become "tired" (produce less) due to a changed rainfall regime and less available cropland. The fact that they consider these factors beyond their control has changed many farmers in passive observers of ongoing land degradation. There exists, for example, a widespread conviction that rainfall changes are a punishment by the angry "Mother Earth" (Zimmerer, 1993). This passiveness, together with a – historically justified – belief that institutions cannot help them, has limited information spreading and training concerning the available better land management practices; most institutions are simply not worried either about land degradation either. Although most development projects mention the problem and call themselves "integrated" or "participatory", none of them seriously works with farmers on SWC. In one major regional project, erosion control was defined as an important objective, however, in the evaluation report the topic was no longer even mentioned (IFAD, 1993). Apparently, such projects consider land degradation and its causes as too complicated. They prefer – like farmers – short-term activities instead of applying multidisciplinary approaches with important socio-cultural components and activities. Farmers' logical response is a kind of survival strategy, where subsistence farming with inappropriate land management is combined with a desperate search for alternative income (migration).

In order to mitigate cropland degradation, farmers should apply adequate land management practices that increase infiltration and restore soil fertility. For this to occur, farmers and institutions must join efforts and break out of the present vicious circle of passiveness.

Rangeland degradation

On rangeland, land degradation over the past decades has increased even more than on cropland. Table 2.13 shows the predominant high-to-extreme soil losses on rangeland (mainly due to gully and badlands formation), while vegetation cover losses are generally light to moderate. In other words, in all research areas, over the past decades soil has been lost more rapidly than vegetation cover. The most evident case is Sirichaca, where 88% of rangeland shows high-to-extreme soil loss, while high-to-extreme vegetation cover loss is found on only 38% of rangeland. This is because in the year 1963 vegetation cover in Sirichaca was already low; consequently, changes (or losses) have also been relatively low (with no vegetation cover, nothing can be lost). In Sirichaca land degradation on rangeland already was a problem long before 1963; during the past decades the situation has worsened.

Vegetation degradation occurs when rates of aboveground removal – in the research areas principally for fuelwood extraction and grazing – exceeds recovery rates (Shaxson, 2002). Although during the rainy season the land colours green with young sprouts, the lack of vegetation is felt by all farmers and has a direct impact on daily living conditions. Shortage of fodder results in animals with poor health conditions that easily die of diseases and can only be sold for low prices. Lack of fuelwood, which increases distances for collecting the necessary quantity of wood for cooking, puts a high extra load on the women especially. Both aspects and their causes are briefly discussed in the next paragraphs.

Table 2.13
Soil loss (SL) and vegetation cover loss (VC) compared for rangeland (%) in the three research areas

Soil loss and Vegetation cover loss		Kaynakas		Tomoroco		Sirichaca		Average	
		SL	VC	SL	VC	SL	VC	SL	VC
1-2	No/light	23	48	1	15	7	35	10	33
3	Moderate	22	18	22	58	5	27	16	34
4-5	High/extreme	55	34	77	27	88	38	73	33

In semiarid regions, livestock provides farmers with a complementary source of food and cash and serves as a savings account. In the Andes, the animal dung is also an essential input for potato cropping. Therefore, farmers generally have a small herd of 5 to 50 sheep and goats and sometimes a couple of cows or oxen. According to the farmers, compared to 40 years ago, each family has only half as many animals but the total number of animals in the village is more or less the same. However, herd size can change rapidly over time and is very susceptible to drought periods. In the region, periodically a kind of natural selection takes place and the equilibrium between the carrying capacity of rangeland and the number of animals is re-established. For example, in Peru goatherds decreased by 49% on average during the drought of 1982 (Perevolotsky, 1991) and overgrazing was found to be the direct cause of a decrease in herd size per family (Swinton, 2003). All farmers affirm the lack of – good quality – fodder. Nowadays less vegetation must feed the same number of animals. Due to soil degradation, lower infiltration rates and higher runoff, vegetation recovery is even more difficult. Stroosnijder (1995) shows that in semiarid climates, during normal rainfall

years, more than 50% annual runoff causes a drastic reduction in dry-matter production. Moreover, an important shift in type of animals has occurred, with mules and cows (in the 1960s) having been replaced by goats and sheep. Especially in the dry period, when animals have free access to all fields and vegetation is more vulnerable, goats and sheep have a devastating effect, as their grazing inhibits recovery of rangeland vegetation (Rowntree et al. 2004). Erosion data show that on soils without a grass-cover (like most heavily grazed rangeland in the region) soil loss is 100 times higher than on three-year long untouched rangeland (JGRC, 2003a). Although farmers are aware of the consequences of overgrazing (i.e. the increase of animal diseases), they are not willing to give up goats and sheep voluntarily.

Regarding fuelwood, which according to farmers was formerly found everywhere, people now have to walk for six hours to carry home one load (which lasts more or less for two days). Despite costs, some families now buy fuelwood directly from a provider who comes to the village. This is illustrative for the enormous deforestation (or de-vegetation) that has occurred and – consequently – the increase of rangeland degradation. Farmers also assert that many good woody species have disappeared over the past decades, and that the ones left are much smaller. This also implies that farmers in this region actually cut living branches or trees, and do not only use dry and fallen wood as in other parts of the world (Nagothu, 2001). Moreover, goats in particular completely eliminate the possibility of sustainable forest management and high stocking densities disrupt the natural regeneration of native woody species.

Although the human impact on vegetation cover loss is recognized by most farmers, yet they blame less rainfall as the main cause: where before some bushes recovered quickly after having been cut, nowadays they die due to a lack of water. Obviously the observed rainfall changes influence vegetation growth, however, field observations also show that during a good rainy season previously cut bushes hardly recover. Hence, even in good rainfall years too much water is lost by runoff. Moreover, tree management has changed over the years and branches are cut shorter every time in order to avoid long walking distances.

It can be concluded that the combined effect of soil degradation, less rainfall and inappropriate vegetation management activities (grazing and cutting) have severely affected rangeland and prevent vegetation’s recovery.

2.6 Conclusions

The described methodology, with active farmer participation, proves to be a useful tool for land degradation assessment and for understanding its impact in a region where such data are not available. Thanks to its execution in representative areas and the active involvement of farmers in fieldwork, it allowed a judgement of the seriousness of degradation for larger areas in a relatively short time. This is especially important in regions where land degradation data are required to justify investments in soil and water conservation activities.

For the north-Chuquisaca region of the inter-Andean valleys the methodology revealed that both cropland and rangeland have undergone severe degradation over the past decades (Photos 5-6-10). In this region, where most soils are fragile and heavy rainstorms are

common, human activities in combination with a changed rainfall regime have accelerated land degradation.

On cropland, the intensive use of fields has increased soil degradation and consequently led to less water and nutrient availability. Soil productivity has reached levels where even subsistence farming is often no longer worth the effort. Many cropland fields have already been abandoned and new cropland is hardly available. Only some flat permanent cash-crop producing cropland fields have maintained their 1963 productivity levels. If adequate land management practices are not applied soon more cropland will be lost, which will serious endanger the future of farming in the region.

On rangeland, vegetation loss started already more than a century ago. The inability of vegetation to grow and recover due to continuous grazing (Photos 7-8) and cutting (Photo 9) has resulted in severe soil loss. Although the number of livestock has remained the same as in 1963, their impact on the scarcer vegetation is much bigger. Yet, the quick recovery of vegetation on many rangeland fields, and low measured soil loss under a well-established grass cover (JGRC, 2003a), proves the rangelands' resilience capacity. For such a recovery to be sustainable, a drastic reduction in animal number is required, together with well-planned rangeland management practices at village level.

Farmers are very well aware of the decreasing production capacity of their cropland and rangeland. However, most farmers have become passive observers of land degradation; they have no access to information about better land management practices, they consider the impact of changed rainfall and less available cropland as beyond their control, and do not believe that institutions can help them. As a consequence of this passivity and the lack of requests from farmers to find solutions, institutions do not take the initiative to tackle land degradation.

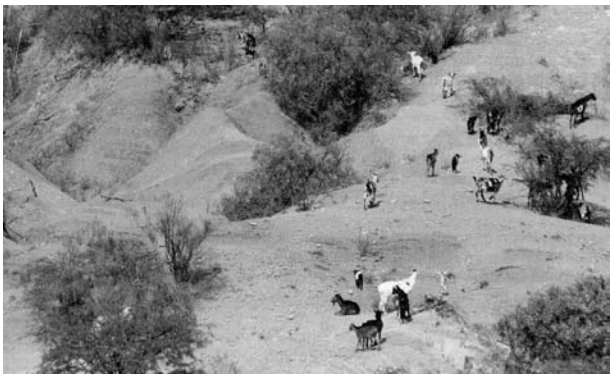
Despite these findings, land degradation in this region is not completely irreversible. Considering the possible development paths for similar regions with high population growth and a gradual loss of resource productivity (Kessler, 2003), partial rehabilitation seems to be the most feasible future scenario. However, urgent actions are required, both from institutions and farmers. Development projects, after having re-established a relation of trust with farmers, should raise awareness concerning the human causes of land degradation, and work on the sustainable introduction of better land management and SWC practices. This requires the application of a strategy that takes into account existing limitations for the adoption and scaling-up of SWC practices at farm household, village and institutional level. In Chapter 5 the details of a SWC strategy for the Bolivian valleys will be presented and discussed.

Follow-up to Chapter 3

Although most farmers have become passive observers of land degradation, they are concerned; with the means they have they try to conserve their cropland. Which soil and water conservation practices do they employ? And, which other practices in the region are available that are both effective in tackling land degradation and easily replicable by farmers? In the next chapter I respond to these questions, by means of discussing all available practices for adequate runoff control and soil management.

Photo 5: Erosion gully in Tomoroco

Photo 6: Severe rill erosion (on the road to Tomoroco)




Photos 7-8: Free grazing by goats and cows

Photo 9: Recently cut tree for fuelwood

Photo 10: Erosion gully on a steep cropland field

Chapter 3

Soil and water conservation in the inter-Andean valleys of Bolivia

"I used to take away all the stones from my land, but now that I've learned that stone barriers can protect the soils, I will start thinking on how to build them"

(Villager from Talahuanca)

3. Soil and water conservation practices in the inter-Andean valleys of Bolivia

Abstract

Traditional ways of Andean farming can no longer fulfil the increased demand for food of the growing population. Sound land management techniques, combining runoff control on cropland and adequate soil management to improve soil quality, are essential. Improving soil quality without controlling runoff is not very effective in this region; neither is only runoff control (the traditional approach of SWC projects). Although a large stock of SWC practices is available in the inter-Andean valleys, only four practices can be promoted without major restrictions: diversion ditches, stone barriers, mixed cropping, and improved manure use. Combining these practices is the most promising short-term alternative for combating land degradation, given that these practices are generally most effective and at the same time most easily replicable by farmers. These practices, which are all based on local knowledge, must be promoted by means of adequate strategies and policies. At the same time, further participatory research to identify new alternatives is required.

Key words: Runoff control; Soil management; Effectiveness of practices; Replicability of practices; Soil and water conservation; Bolivia.

3.1 Introduction

The previous chapter concluded that land degradation in the inter-Andean valleys of Bolivia is a serious problem that must be tackled by joint actions of institutions and farmers. Although counteracting actions are required on rangeland also, the most logical start is to focus attention on agricultural areas, which are more scarcely available and more important for farmers than rangeland. Although it is likely that land degradation already started 200 years ago (UN, 1951) or even earlier (Coppus et al., 2003), inadequate land management is currently the direct cause of both soil loss and soil productivity loss on cropland (Chapter 2). External (economic) forces have accelerated the destruction of the productivity and sustainability of Andean agriculture (Altieri, 1996). Traditional ways of farming can no longer fulfil the increased demand for food of the growing population. Particularly in the inter-Andean valleys, soils can simply not sustain farming with short or even no fallow periods. Therefore, besides adequate strategies and policies (which are discussed as from Chapter 5), pathways out of this unsustainable situation must consider the development of sound land management practices.

Such practices should focus on two essential aspects: 1) *runoff control*, to reduce soil loss and improve water infiltration; and 2) *soil management*, to improve soil quality and nutrient availability to the crops. The objective of this chapter is to discuss available SWC practices that address both essential aspects, and to decide which are most adequate. Technical validation data and adoption rates by farmers are important inputs to make this decision. Local knowledge is the starting point of the inventory, given that ample evidence

suggests that throughout the history of the Andes region, important experiences in SWC have been developed here. Major emphasis is given to the SWC practices validated by the Japan Green Resources Corporation (JGRC) project, most of which are based on indigenous knowledge and traditional land management practices. Participatory research has been the most important methodology used to gather the required information.

3.2 SWC in the inter-Andean valleys

This section gives a short historical overview of SWC and natural resources management in the inter-Andean valleys of Bolivia, with emphasis on the Department of Chuquisaca.

In pre-Colombian times (more than 500 years ago), farming in the inter-Andean valleys was a sustainable activity. Small kin-groups, known as *ayllus*, maintained a shifting cultivation system on dispersed plots within various agroecological zones, which ensured access to a wide range of products and served as a protection against the considerable uncertainty of farming. In neighbouring Peru, the Inca occupation resulted in the widespread construction of the famous Inca-terraces and other forms of traditional land management practices (Sandor and Eash, 1995). These agricultural systems were productive, sustainable and tuned to the socio-cultural features of Andean livelihoods. In the inter-Andean valleys of Bolivia the Inca influence was less. Only in the Cochabamba region farmers nowadays still manage knowledge regarding ancient terrace construction (Zimmerer, 1993). Elsewhere in the inter-Andean valleys, conservation works were only sporadically constructed; farming was mainly a small-scale activity, and population densities in pre-Colombian times were low.

During the colonial era, starting in the 15th century, most of these *ayllus* persisted. At the same time, large haciendas occupied most of the remaining land and introduced a Spanish-based land management system; with larger agricultural fields, new crops, animal traction, (more efficient) downhill ploughing, and new livestock (goats, sheep and cows). Farmers that worked on the haciendas came from the (nearby) *ayllus* and from the mining region in the Department of Potosi. The former preserved small traditional conservation practices from their *ayllus* (for details see sections 3.5 and 3.6). During the following two to three centuries, the hacienda farming system, with a combination of Spanish- and traditional agricultural practices, was able to maintain adequate production levels. However, pressure on the cultivable lands increased due to (1) population growth, (2) the hacienda system of land lending, and (3) the demand of higher production levels by the landlords (Heath et al., 1969). The haciendas expanded and, as a consequence, marginal land on steeper slopes was cleared for cultivation. Due to more intensive use of cultivable lands, traditional conservation practices were no longer able to control erosion and maintain soil fertility.

The Agrarian Reform Law in 1953 brought enormous changes: it abolished the existence of large haciendas and gave peasants property rights over their land. Although farmers now were responsible for their land, agricultural production barely increased (Heath et al., 1969). Despite higher production demands and the need for more adequate land management practices, agriculture has hardly undergone any modernization during the last centuries. Farmers' technology and agricultural tools are primitive (IFAD, 1993; Simmons, 1974) and similar to that from classical times in Europe (Simmons, 1974). Some hand-tools and ploughs still date from the Conquest times or even earlier. Governmental institutions

should be largely blamed for this. Heath et al. (1969) concluded that the Bolivian Land Reform was not a real reform, because farmers had no access to credit, tools and information. The extension service was also highly ineffective. Farmers judged that extension agents were completely incompetent to deal with their problems (Heath et al., 1969). At present, extension services remain extremely inadequate, with only one agricultural agent for each 7,000 farming households.

The increase in land degradation is, therefore, also the result of the lack of serious (governmental) actions to tackle the problem. For example, IBTA (Instituto Boliviano de Tecnología Agrícola, the nation's agricultural research institution) mainly concentrated on new seed varieties for cash crops in the productive lowlands of Bolivia. In the inter-Andean valleys only sporadically some new crop varieties were introduced during the last decades, generally in combination with external inputs like fertilisers and pesticides. According to Pacheco and Valda (2003), farmers' dependence of these products and higher debts, were one of the main reasons that forced them to expand their agricultural land. This expansion was, obviously, towards more marginal and degradation prone areas.

The most serious attempt to tackle land degradation was the North-Chuquisaca Agricultural Development Project executed between 1983 and 1992 by IFAD and the Prefecture of Chuquisaca. Among its specific objectives, it aimed at "stopping the erosion process on agricultural fields and rehabilitate land for production" (IFAD, 1993). The project's evaluation report mentions that "in various valleys the tendency of erosion was reversed and most fertile areas were rehabilitated" (IFAD, 1993). However, looking around in the villages, SWC practices promoted by this project cannot be found, and erosion is far from being reversed. Largely simultaneously, from 1987 to 1999, the FAO project "Fertisuelos" focused on soil fertility improvement. Improved fertilizer use and various soil conservation practices were tested on demonstration plots and later promoted to farmers. Although this project trained farmers in 36 communities in mainly fertilizer use, very few of them still apply the proposed measures, due to lack of money to purchase the fertilizers.

Of the numerous NGOs, which are increasingly present in the rural area of Chuquisaca since 1953, only few execute activities related to sustainable agriculture or natural resources management. If present, such activities are found among the additional objectives. NGOs main objectives generally deal with farmer organizations and the management of small (mainly non-farm) productive projects (de Zeeuw, 1992). However, due to the very small scale of execution and the lack of scaling-up strategies, the impact of NGOs' natural resources activities is generally almost negligible.

From this short overview can be concluded that SWC is a barely developed activity in the inter-Andean valleys. Discussions at institutional level and in workshops generally end up in vague and traditional rhetoric about "erosion control" and "technology transfer", instead of designing adequate strategies and practices based on farmers' real needs. For soil and water conservationists, a lot of work is still to be done in this region.

3.3 Methodology

In the period 1999 till 2003 the JGRC project validated several SWC practices by means of three different research methods: erosion plots; demonstration farm; and participatory

research. Main difference between these methods concerned farmers' involvement in the set-up of the research and their participation in execution, monitoring and evaluation of the results. All three methods are briefly explained in this section.

Erosion plots

The erosion plots were established in collaboration with the University of Sucre on the experimental fields of the Faculty of Agronomy. Farmers were not involved in the research. Main objective of the erosion plots was to investigate scientifically the effect of the chisel plough for animal- and mechanized traction on runoff and soil erosion, in comparison with conventional tillage for both kind of traction. The effect of different groundcover percentages (bare soil versus fallow) was investigated also. Overall results on the erosion plots were not very reliable, due to repeatedly extremes in rainfall regime (heavy rainfall events and frequently long dry spell). Therefore, in this chapter only few results of the erosion plots will be presented.

Demonstration Farm

The demonstration farm was established on a largely abandoned agricultural land of 3.6 ha nearby the village of Yamparaez, 40 kilometres from Sucre. Only the best parts of this land (about 1 ha of mainly flat fields) were recently used for agriculture; the rest (with moderate slopes of 5 to 10%) showed advanced progress of land degradation and was used as grazing area. The farmer-owner participated in the design of the demonstration farm, mainly by means of indicating the restrictions of his land, and by giving information about land use in previous years.

Table 3.1
Experiments conducted by the JGRC project on the Demonstration Farm.

Experiment	Surface (ha)	Details
Stone dikes	0.10	With annual crops
Earth bunds	0.21	With annual crops and different distances of bunds
Infiltration ditches	0.14	For improving rangeland
Infiltration ditches	0.14	With annual crops
Live hedges	0.23	With local shrubs
Live hedges	0.11	With falaris grass
Half moons	0.12	With annual crops
Tillage methods	0.15	With chisel plough and no-tillage
Improved crop rotation	0.16	Including legumes in the rotation
Intercropping	0.15	With main crops with legumes
Mixed cropping	0.11	With main crops with legumes
Fertilizer use	0.13	With chicken, sheep and cow manure
Fertilizer use	0.14	With different quantities of sheep manure
Mulching	0.10	With wheat straw and litter
Pasture growth	0.25	Pasture growth with different grazing intensities
Forestry experiments	1.36	Three kinds of different forestry plantations

The final outlay and the experiments to be conducted were, however, designed by the project team (Table 3.1). In all experiments, traditionally tilled control-plots were used. The farmer, together with regular BSc students of the Sucre University, was responsible for land preparation, crop management, and day-to-day monitoring of the demonstration farm.

The experiments were conducted and evaluated over a period of three years. Not only yield differences were measured, but also soil quality was regularly analysed on some of the plots. The demonstration farm was frequently visited by farmers from the surrounding villages and from the project's study villages. Given that not in all experiments successful quantitative results were obtained, in this chapter only the most interesting results are presented and described.

Participatory Research

Participatory Research (PR) was conducted in the three experimental villages (Photos 11-12). PR on the farmers' fields was the most important research component of the JGRC project. In each village a group of Conservation Leaders (CLs) was selected to conduct the experiments (for more details about the selection process and the tasks of the CLs see Chapter 7).

In the three villages together a number of 28 CLs participated in the research. After having received training in SWC and improved land management, each of the CLs chose the SWC practices to be investigated on his/her farm (Table 3.2). The experiments consisted of a combination of two or maximum three practices. A test-plot was always installed to measure and observe the differences. The CLs executed all the physical work on their PR plots, while the project provided inputs like seeds, manure and fertiliser. All PR plots were fenced in order to avoid damage by grazing animals.

Table 3.2
Total number of experiments on the PR plots in each experimental village

Experiment	Tomoroco	Kaynakas	Sirichaca
Stone dikes	4	4	2
Bench terraces	1	2	
Live hedges		2	
Half moons		1	3
Individual terraces		1	
Legumes and green manure	5	5	4
Improved manure use	6	4	3
Intercropping	1	4	3
Mixed cropping		3	3
Vertical tillage and no-tillage	4	2	4
Mulching	2	2	1

Due to the dependency on the CLs' compliance in conducting the experiments, valuable and reliable results were obtained on 20 out of the 28 PR plots. Moreover, extremely variable rainfall characteristics frequently resulted in delayed plant growth and yield losses. Overall, the PR plots generated valuable data and information concerning the applicability of the investigated SWC practices in this region. The frequent visits of villagers to the research-sites

motivated many farmers to start experimenting themselves. In this chapter I will often refer to the most important results of the experiments on the PR plots.

3.4 Soils in the study villages

The inter-Andean valleys can be characterized as a mountainous desert environment with very limited soil development (Coppus et al., 2003). According to the same authors, the magnitude of erosion is such that it must be assumed that this process has taken place over periods of many thousands of years under different climatic conditions. However, it is believed that the acceleration of the erosion process is partly associated with the introduction of goats and cattle in the 16th century (Coppus et al., 2003).

Farmers in the Andes often classify soils according to their indigenous knowledge (Sandor and Furbee, 1996). Also in the inter-Andean valleys farmers name soils in their native language, and they generally know some of the most important soil properties. The soil colour and texture, combined with fertility, are the variables most often mentioned to distinguish soils. This knowledge is used during the planning of agricultural activities, when principally the soil's water retaining capability is taken into account.

Soils in the study villages mainly belong to the major soil group of Leptosols, which have an effective soil depth of < 30 cm, or < 20% fine earth to 75 cm (Landon, 1991). Most important property is the presence of very stony unconsolidated material. Mean depth of the A-horizon on all PR plots is about 13 cm; the B-horizon is found to be 32 cm deep. The depth of the A-horizon on plots with steeper slopes is generally much less than 13 cm.

The texture of most soils is sandy-loam, with clay percentages below 15% and a sand fraction of about 60%. The B-horizon generally contains more clay, and principally on the flatter agricultural lands a hardpan is often found. This is confirmed by penetration resistance data at field capacity, which show low values for the A-horizon (200 kPa) and high values for the B-horizon (2000 kPa). A value of 2000 kPa is considered critical, as it is above 2000 kPa at field capacity that root growth is impeded except through cracks, channels and points of weakness in the soil. It is also likely that moisture uptake by the plant will be restricted above 2000 kPa (Cass 1999). Bulk density (1.48 g/cm^3) and particle density (2.7 g/cm^3) show normal values for sandy-loam soils (Landon, 1991).

Table 3.3
Stoniness of the PR plots in the experimental villages, as percentage of volume of soil

Village	Percentage stones	Diameter of the stones		
	(> 2 mm)	2 – 10 mm	10 – 50 mm	> 50 mm
Tomoroco	24	11	7.5	5.5
Sirichaca	25	14	9	2
Kaynakas	45	17	22	6

Source: Soil analysis conducted by the JGRC project

All PR plots show high proportions of stones in the A-horizon; on only 10% of the plots less than 10% stones are found. In Table 3.3 stoniness of agricultural plots in the three experimental villages is presented. Without taking into account the bigger stones that often

have already been removed by the farmers, in Kaynakas almost half of the soil (45%) consists of stones. Due to the selective removal of smaller soil particles by water erosion, this percentage will only tend to increase. It is evident that stones pose serious limitations to soil productivity. Especially the small to medium sized stones cannot be removed from the fields by hand, and will always complicate soil tillage.

Water availability to the crop is one of the main limitations for obtaining higher production levels in the Bolivian mountain valleys. Coppus et al. (2003) found that in the inter-Andean valleys most soils have lost their water conservation function, and are very sensitive to erosion. Infiltration rates are rapid to moderately rapid, and the measured water holding capacity of 30% is normal for sandy-loam soils. Nevertheless, frequent dry spells, bad rainfall distribution and high evaporation rates restrict water availability during the cropping season. Soils on all PR plots rapidly get very compact and hard when drying up after a rainfall event. Moreover, experiments on the erosion plots showed that 30% of annual rainfall runs off on 8% sloping unprotected cropland. Due to crust forming, these sandy-loam soils produce runoff even on 10% sloping fields during 3 $mm.h^{-1}$ rainfall events (JGRC, 2003a).

Table 3.4 shows the chemical properties of soils in the study villages; data are mean values of three samples from all 28 PR plots (n=84). Most striking is the very low soil organic matter content. Only 19% of all investigated plots have an adequate level of organic matter, which is the main reason for the very low soil productivity. Organic matter sources are scarce in the villages: crop residues are always removed from the fields by grazing animals, pastures hardly develop during the dry season, and farmers do not use compost. Manure, mixed with some dry crop residues, is only applied on the potato fields; generally once every four years. Differences between plots in available phosphorus to the plants are enormous. Although the mean value for P is adequate according to Bolivian standards, 44% of all soils show lower values than recommended (JGRC, 2003b). The plots that showed high P values had all received abundant manure fertilization recently. Concerning pH values, about 70% of the soils have lower than recommended pH values; application of some additional lime is thus necessary and will also increase availability of phosphorus. Finally, potassium and magnesium show more than adequate values and pose no restrictions.

Table 3.4
Chemical soil properties in the study villages (averages from 84 samples)

	Measured average values	Interpretation according to Bolivian standards classification		
		(too) low	Adequate	(too) high
pH (1:5)	6.3	< 6.5	6.5 – 7.5	> 7.5
Organic C (%)	1.7	< 2.0	2.0 – 4.0	> 4.0
Organic N (%); *Kjeldahl method*	0.1	< 0.2	0.2 – 0.5	> 0.5
P (ppm); *Olsen method*	10.5	< 6.0	6.0 – 15.0	> 15.0
K (me/100g); *Melich extraction*	0.9	< 0.2	0.2 – 0.6	> 0.6
Mg (me/100g)	1.8	< 0.5	0.5 – 1.0	> 1.0

Source: Soil analysis by CIAT (Centro de Investigación Agrícola tropical) in Santa Cruz, Bolivia

In view of the physical- and chemical soil properties in the study villages, land management practices for improving soil productivity should focus on:

1) Reducing soil loss by runoff;
2) Increasing soil organic matter content;
3) Increasing soil water availability to the crops.

In the next two sections (3.5 and 3.6) all available SWC practices in the region are presented. By considering their main objective, the practices are roughly divided in runoff control practices and soil fertility management practices. Runoff control is often regarded the basic objective of SWC, because – with most practices – simultaneously soil loss from the field is reduced and water infiltration in the soil is increased. Traditionally, most SWC projects focussed on this sole objective, and on conducting cross-slope practices or line interventions. They believed that soil loss must be controlled first to improve yields. Nowadays a more holistic view is generally accepted, in which erosion control is a consequence of better land management. I support this view; runoff control practices must be combined with soil (fertility) management practices. Most practices discussed in the following sections therefore serve both objectives. Local names (when existent) are presented in parenthesis.

3.5 Runoff control practices

The following runoff control practices will be discussed in the section:

- Diversion ditches
- Furrowing
- Stone barriers / Stone dikes
- Gully control
- Terraces
- Earth bunds
- Live-barriers
- Individual terraces
- Infiltration ditches
- Half moons

Diversion ditches (larck'a)

The construction of diversion ditches – a traditional practice in the region – is conducted by all farmers. The objective is to drain off excessive water to nearby situated natural drainage ways, during high intensity rainfall events. The diversion ditches are constructed on places where runoff water enters the field, as well as in the middle of some of the bigger agricultural fields. The first type is a permanent structure; the latter one is generally made during the preparation of the field and in some cases permanent.

Traditional diversion ditches have a channel slope of 1-10%. Slopes are thus not uniform in a ditch, and ruptures frequently occur on places where water and sediment accumulate. Most diversion ditches are not or rarely maintained; some farmers try to improve the ditches'

stability with sods, especially in sections with steeper slopes. The size of a diversion ditch depends on the soil type and the expected maximum amount of runoff water. In practice most ditches are as wide and deep as the blade of a spade.

The improvements introduced by the JGRC project refer to the diversion ditches' channel slope and the establishment of a grassed waterway. At first, farmers were sceptical concerning a uniform channel slope of 1 or 2%; but once they saw it working well, this improvement was rapidly adopted. Most diversion ditches in the study villages are nowadays constructed with the A-frame (Photo 13) and the recommended channel slope. Only few farmers have adopted the grassed waterways as a stabilising measure within the ditches; this is generally seen as unnecessary due to the gentle slope of the improved diversion ditches.

Furrowing (surk'ar)

The traditional practice of furrowing is mainly practised on potato fields, which are ploughed with sloping furrows in order to avoid too wet conditions for the crop. During high intensity rainstorms, furrows can quickly drain off excess water. In "the design" of the furrows, several soil properties are taken into account (e.g. soil humidity, clay content and stoniness), as well as slope of the field and the farmer's rainfall forecast (when a wetter than normal rainy season is expected, channel slopes of the furrows will generally be steeper). Within a field, furrows with different channel slopes can often be observed; where more infiltration is required, less-sloping furrows are designed to diminish water velocity. Farmers affirm that ploughing of – principally – potato fields is always done according to the experiences with a particular field, especially the behaviour of runoff water. Observed erosion problems due to malfunctioning furrows (too steep or too flat) were always contributed to changed rainfall characteristics and difficulties in forecasting the rainfall regime during the wet season.

Given that traditional furrowing is generally quite successful as a runoff control practice, no improvements were suggested by the JGRC project. However, for inexperienced farmers this practice is difficult to replicate; it requires profound knowledge of soils, and even then variable rainfall intensities can reduce the efficacy of furrowing.

Stone barriers (perkas) or stone dikes

Examples of stone barriers date back to the colonial era, when on the large communal fields stones were removed and deposited downstream. Most of these traditional stone barriers are 0.5 to 1.5 m high, and terraces haven been formed upstream. After the Agrarian Reform, farmers replicated similar but smaller stone barriers on their own fields, also with the main objective to clean the field by removing the bigger stones. However, most farmers clean their fields from stones by leaving piles of stones in the middle of a field (Photo 14) or by making boundary bunds (Photo 15). Boundary bunds are found to reduce erosion with 40-88 t/ha/y on cultivated fields; piles of stones do hardly affect erosion rates (Clark et al., 1999).

The improvement introduced by the JGRC project was to build stone barriers on the contour lines of fields (Photos 16-17) by using the A-frame. These are afterwards strengthened by a live barrier (Photo 18). The recommended height and width of a stone barrier is 30 and 40 cm respectively. After the accumulation of sediment behind the barrier

this height should be increased. Stone barriers were the most widely adopted and replicated SWC practice in the study villages, mainly because of their visual impact as a sediment trap, and the accumulation of water in the soil around these practices. Stone barriers were most successful on fields with slopes until 15%. On steeper slopes, where the required distance between stone barriers is smaller to make them work adequately, farmers generally complain that a higher number of barriers reduces the cultivable area and complicates land preparation.

During the first two years of PR activities, no productivity differences were found between fields with and without stone barriers. In the third year however, differences became notorious on most plots. Table 3.5 shows average yield for four crops on 10 plots. The only variable was the presence of stone lines. On 8 of these plots higher yields were measured when stone barriers were present. Although not conclusive from a statistical point of view (due to the low number of plots), a tendency can be observed in obtaining higher yields on fields with stone barriers.

Table 3.5
Average yield on PR plots with and without stone barriers (year 2003)

Crop	Number of plots	Yield with stone barriers (t/ha)	Yield without stone barriers (t/ha)	Percentage difference
Potato	2	13.4	10.2	31
Broad bean	4	17.2	12.3	40
Vetch	2	11.1	5.8	91
Lupine/tarwi	4	8.6	6.4	34

Source: JGRC project

Gully control (reparos or ñit'ichis)

Rills and small gullies (< 1 m deep) in agricultural fields are generally repaired by means of land levelling during land preparation. Bigger gullies are repaired by only half of the farmers, and only on some of their fields. Control of these bigger gullies is generally conducted with branches and stones, and the dikes in the gully are 0.2 to 0.5 m high. Sometimes sods of grasses are also used to diminish runoff flow velocity and stabilize the initial gully. Some of these dikes are temporal; farmers construct them after preparing the land and take them away after the rainy season has ended. In this case, the materials are used again during the next cropping season. Gullies on rangeland are not controlled; this leads to the general impression among visitors of the region that farmers do nothing to control soil erosion.

The number of dikes within a gully is often insufficient to control runoff during heavy rainfall. The JGRC project suggested to construct more dikes, and to increase their height at the sides to better control the water flow. Although initially these improvements were well adopted, only few improved gully control measures were replicated. Apparently, more dikes complicate land preparation; farmers simply prefer to level their land.

Terraces (terrazas)

In Chuquisaca ancient Inca terraces are only sporadically found. In the study villages the oldest terraces are 40 year old. They are situated in Kaynakas and not in use for agriculture;

they have a height of about 1 to 1.5 m high, and a mutual distance of 15 to 35 m. According to the villagers, such practices are not built anymore; the technical know-how seems to have disappeared from local knowledge.

The JGRC project introduced bench terraces with a stone border (for place where stones are available) (Photo 19), or an earthen border covered with grasses under a slope of 50%. Soils in the terraces were improved by adding considerable amounts of manure and organic material. Especially in Kaynakas, where water is more easily available from springs, the bench terraces were rapidly adopted and replicated. They were generally used for vegetables; where irrigation water was not available, annual crops were cultivated on the bench terraces. In comparison with the generally low productivity levels in this rainfed region, in all cases exceptional good yields were obtained. These higher yields, combined with the high amount of labour invested during construction of the bench terraces, motivated farmers to maintain these SWC practices adequately.

Earth bunds

Earth bunds for controlling runoff on agricultural fields are new in the region. The JGRC project introduced earth bunds on fields where stone barriers cannot be built due to the absence of stones. The practice consists of building a barrier of earth on the contourline, which is dug out downstream of the bund (Photo 20). Because runoff water will accumulate upstream of the earth bund, and sediment is deposited there, a terrace will be built in time. This practice is also known as “slow-forming-terraces”. The same name is often given to stone barriers where accumulation of soil behind the barrier leads to “slow” formation of a terrace. In Kenya the construction of earth bunds is known as Fanya Juu, and has been quite popular in semi-arid watersheds (Thomas and Biamah, 1991). Research results with such terraces elsewhere in the inter-Andean valleys of Bolivia, in the Department of Cochabamba, showed positive effects on potato and wheat yields, even within the first two years after construction (Oblitas and Tammes, 1997).

The JGRC project positively validated earth bunds on the demonstration farm, where barriers were constructed with a mutual distance of 6 and 12 m. Three years after construction, these practices were completely consolidated, and soil loss was minimized. However, replications in the villages encountered severe problems: several earth bunds collapsed during high intensity rainstorms. The proposed height for earth bunds (30 cm) is not sufficient on fields where high runoff rates occur. These small earth bunds are therefore not recommended. Building bigger and/or more densely spaced earth bunds is generally no alternative for most farmers; these imply higher labour investments and loss of cultivable land. Hence, earth bunds should be promoted with care, and only than when farmers are willing to meet with the higher labour requirements for making solid earth bunds.

Live-barriers

Live-barriers are unknown in Chuquisaca. In Cochabamba, however, live-barriers as a runoff control measure to stabilize steep cultivated hillsides, have been intensively studied by a DFID project. This project found that associated live-barriers on the contour, consisting of

grass (*Phalaris tuberorundinacea*) and legumes (especially *Vicia villosa* ssp *dasycarpa*) were most successful and best adopted by farmers (Sims and Rodriguez, 2001). Sedimentation of soil above these live-barriers allows terraces to form slowly over the years, and, moreover, high value forage is produced. This combination of visual short-term impact and usefulness, strongly contributed to the popularity of live-barriers in the villages of the DFID project. Similar experiments by the JGRC project revealed that moisture availability was often a strong limiting factor for the establishment of the live-barriers. Sims et al. (2001) mention that areas of higher moisture (with irrigation) and greater agricultural activity present the best conditions for the adoption of live-barriers. In the study villages of the JGRC project, live-barriers were most successful when combined with other SWC practices such as stone barriers or earth bunds. Live-barriers alone are too susceptible to long drought periods. Moreover, live-barriers need always be protected against free grazing, which is a major limitation in villages where regulations for controlling free grazing do not exist.

In the dryer inter-Andean valleys of Chuquisaca, fodder shortage is always a problem and free grazing is difficult to control. Due to these constraints, live-barriers are only recommended as an additional SWC practice that helps to stabilize e.g. stone barriers.

Individual terraces

On abandoned agricultural fields, planting fruit trees is often an alternative. Individual terraces control runoff and harvest water on such fields. These planting pits, with a diameter of 1.5 m, are constructed at a distance of 3 m in a triangle form, and are generally protected by stones at the lower end of the terrace (Photo 21). Mixed successes were obtained in the villages of the JGRC project, with two factors being most determent. First, the texture of the soil must allow adequate water infiltration; if not, trees will have problems of asphyxiation and terraces can overflow. Second, the subsoil must be well prepared, and manure or other organic material should be added to help trees growing. Where these factors were taken into account, individual terraces showed excellent results. However, in the later established replications in the villages, the individual terraces were generally not constructed according to these criteria, and plant growth was disappointing.

Infiltration ditches

Infiltration ditches are used to control runoff and enhance water infiltration. They are not based on indigenous knowledge. Nevertheless, projects have often tried to convince farmers to establish this labour demanding practice. Infiltration ditches introduced by the JGRC project were very similar to the earth bunds, with the only difference being that in this case the excavated earth is deposited down stream (Photo 22). Results on the PR plots of the JGRC project showed that infiltration ditches do not significantly increase water availability and do not influence crop yield. There was however a notorious effect of infiltration ditches on trapping sediment, which otherwise would have been largely lost by runoff from the field. After the first wet season, infiltration ditches with a depth of 0.40 m were often half filled with sediment. Due to the accumulation of sediment, infiltration however diminishes; water was often found standing in the ditches even two weeks after the last rainstorm. Given that

infiltration ditches were established on the contour line, problems of flooding did not occur. Similar to farmers' objections against earth bunds, loss of cultivable area and high labour requirements were the main reasons mentioned for not replicating infiltration ditches on agricultural fields. However, some were constructed on rangeland, especially fields situated nearby the hilltops. On these places farmers consider water infiltration important for grass growth and for water availability in downstream-situated springs. Moreover, the fact that standing water in the infiltration ditches serves as drinking water for farmers' animals, also motivated some farmers to establish infiltration ditches on their pasture fields.

Half moons

Half moons (or *demi-lunes* in French) are a runoff control practice that showed astonishing adoption rates in Niger. In this African country, half moons based on indigenous knowledge (with a diameter of 3 m or smaller) are used. These half moons have proved to outperform stone barriers in yield rates, especially in drought years (Hassan, 1996). The JGRC project started conducting experiments with half moons on its demonstration farm, and later introduced them on some PR plots. Half moons were only established on the most degraded agricultural fields. In the design of the field layout, 40% of the total surface was covered by half moons; the rest of the area was used for harvesting runoff water. Half moons were investigated for different crops and on different soil types. Overall results were disappointing: on most soils standing water in the half moons and asphyxiation of the crops resulted in low yields. Only on the sandier soils of the village of Sirichaca, better yields per square meter were obtained with maize (Photo 23). Considering yields per hectare, results of these half moons were also negative compared to the traditionally cultivated test fields.

Farmers were initially interested in the half moons, principally because of their potential to harvest water and overcome problems resulting from drought. However, half moons are permanent structures and do not permit land preparation with animal traction. Due to this limitation, and adding the disappointing yield results, half moons were not replicated.

3.6 Soil management practices

The following soil management practices will be discussed in the section:

- Conservation tillage
- Crop rotations and green manure
- Mixed cropping and intercropping
- Improved manure use
- Spate irrigation
- Mulching
- Composting

Conservation tillage

Tillage in the region is traditionally done with animal traction (a pair of oxen) using a wooden plough, usually a mouldboard plough (Photo 24). How often and when the land is ploughed, is influenced by the farmer's experience with his land, expected climatic conditions (rainfall), and the availability of e.g. money, labour, time, oxen and tools. Improving traditional ploughing thus requires farmer-specific advices; this is very difficult. However, it is necessary; due to shallow ploughing and excessive pulverization, on many agricultural fields a compacted layer at 15-20 cm depth has been formed over the years, which impedes water infiltration and root growth. The JGRC project experimented with two conservation tillage techniques to improve land preparation: vertical tillage and zero tillage.

Wall (1999) reports about experiences in the region with single-row direct seeders designed for animal traction. Significantly higher wheat yields were obtained with zero tillage and vertical tillage in comparison with conventional tillage. Due to difficulties in operating these seeders, an adapted model was tried out by a joint project of the Centre for Research, Training and Extension in Agricultural Mechanization (CIFEMA) and the San Simón University (UMSS) in Cochabamba. Experiments of the JGRC project with this zero tillage equipment were not positive: for all tested crops (maize, wheat and tarwi) yields under zero tillage were lower than under conventional tillage, due to the more compact subsoil that limited root growth.

In the same experiments, yields were consistently highest on plots where prior to conventional tillage a chisel plough pass was conducted. This vertical tillage equipment for animal traction, developed by CIFEMA and the JGRC project, makes narrow fissures in the soil with a depth of 12 to 18 cm. When conducted in the dry season, vertical tillage enhances water infiltration during the first rains. Experiments on the PR plots demonstrated that during the first two months of the rainy season, when water shortage is often critical, chisel ploughed fields contained on average 3% more water than the test plots. Later these differences disappeared and soil humidity on all plots was similar. Farmers also clearly noticed the beneficial effects of the chisel plough and were very interested in acquiring one. However, three aspects limit the widespread adoption of this equipment: 1) its costs of about 50 US$; 2) the absence of oxen in the dry season (a time when they are generally outside the village and grazing in some remote valleys); and 3) the extra time required for land preparation (10 hours per hectare).

Despite these limitations, vertical tillage seems more likely to be adopted than zero tillage. Zero tillage requires better soils; less compact and with more organic matter. Implementing zero tillage would be one step too far. In this sense, vertical tillage, in combination with other practices, can be a first step towards establishing sustainable conservation tillage systems.

Crop rotations and green manure

In Andean agriculture, crop rotations are employed for soil fertility reasons: given that manure is generally used for potato crops, crop rotation on a recently harvested potato field makes residual nutrients also available for the other crops. Moreover, crop rotations help

combating plagues (soil nematodes) and avoid soil mining. In the study area, most common crop rotation is potato-maize-wheat-barley, followed by a fallow period with a highly variable length depending on the farmer's land availability and the importance (i.e. productivity) of the field. Due to population pressure and land scarcity, there is a clear tendency of reducing length of fallow periods or even skipping it.

The use of legumes in crop rotations was well known in pre-Colombian times (Ravines, 1978). Legumes like broad bean, vetch and lupine are nowadays still used in the region in certain crop rotations and mixed cropping systems, with the deliberate purpose of increasing soil fertility. However, the use of legumes as green manure is unknown. Green manure is here understood as digging legumes into the soil at maturity (before harvesting) to improve or restore soil fertility (Photo 25). Also other crops like oats and barley (which can contribute P to the soil) are never used as green manure. Sims et al. (1999) found that especially lupine (or "tarwi" in Quechua, *Lupinus mutabilis*) produces abundant biomass (21 ton/ha) and contributes the greatest amount of N to the soil (152 kg/ha). However, on the PR plots, experiments with different kind of legumes – including tarwi – yielded only 5 to 15 tons of biomass per hectare, which is barely sufficient to raise soil organic matter content with 0.2 percent. On the other hand, experiments on the demonstration farm showed that on fields where during two consecutive years a mature leguminous crop had been dug into the soil, potato yield was twice as high as on fields with a normal crop rotation. An improved crop rotation with green manure is thus potentially very interesting.

The major limitation concerning green manure is the farmers' resistance to incorporate a mature flowering crop into the soil before harvesting. The JGRC project found that the most viable alternative was the use of a native green manure species, "Q'ita Alfa" (*Medicago polymorpha*); a local legume not suitable for consumption. However, according to Bunch (2003) this alternative will not be adopted by farmers. Based on 20 years of experience with green manure around the world, he concludes that green manures should provide at least one major benefit other than improving the soil. Whenever possible, green manure species must be chosen that can be eaten, fed to animals, or provide some other benefit which farmers need (Bunch, 2003). Hence, although incorporating flowering legumes is ideal from a soil nutrient-recovering point of view, maybe the best acceptable alternative is to first harvest the crop, and than dig all remaining biomass into the soil.

Mixed cropping (phawachis) and intercropping (th'aqachis)

The use of leguminous crops is also frequently observed in traditional mixed cropping systems in the region. Most farmers use mixed cropping to diversify production and assure yielding of at least one of the crops. The main crop is sown as usual, and the legume (principally tarwi or broad bean) is scattered in smaller quantities over the whole field (Photo 26). In some cases intercropping is applied, with several small rows of the secondary crop in between the furrows of the main crop. Although in such mixed cropping systems crops will often compete for nutrients and water, farmers also mention that synergies occur between the crops. A typical example of tutorship between crops is that of vetch growing on maize stems. Another objective of mixing different crops is the protection of the main crop (potato or wheat) against pests and diseases, by sowing e.g. quinoa or linseed on the field boundary.

Organic farming has been promoted by several NGOs in the Andes region. Altieri (1999) reports of an intercropping system of potato and tarwi that overyielded potato monoculture, and that substantially reduced the incidence of virus diseases. Based on traditional knowledge, the JGRC project also experimented with intercropping systems in which more space is given to legumes (Photo 27). Farmers were generally very enthusiastic about the results, declaring that it is less risky and that intercropped fields look much nicer. Although slightly better, yield results on the PR plots during the first three years of research were not significantly higher in comparison with monoculture fields. Nevertheless, by the end of the project many farmers had started to work with intercropping, whereby principally the combination of tarwi and vetch with one of the main crops was most popular.

Improved manure use

Manure from sheep, goats and – to a lesser extent – cows, is used by farmers to improve soil fertility before cultivating potato (Photo 28). Most manure comes from permanent stables, which are made of local materials and are generally unroofed. A treatment to improve the C:N relation of the manure before applying it to the soil is rarely given; in only one village (Kaynakas) some farmers purposely decompose manure two weeks before using it. Straw and other organic leftovers are usually mixed with the manure in the stable, where they undergo natural decomposition. Only small quantities of manure are applied to the soil: 2-5 ton/ha.

Due to the limited availability of manure, some families collect dry excrements from the fields just before land preparation starts. Rotating kraals are also used to fertilize the land during the night. These kraals are made of locally available thorn branches and are moved every 3 to 7 days to another place on the same field. The advantage is that manure and urine are directly applied to the soil; the disadvantage is that without a guard the sheep and goats are very susceptible to wild animal attacks. Another similar pre-Colombian practice is the use of “majadas”: animals are attached to a rope and left in the field during the night. In both cases the manure is never directly turned under after withdrawing the animals, and excrements are often left drying up under the sun. In synthesis, concerning both quality and quantity, manure use faces serious constraints and is far from optimal.

Several activities of the JGRC project focussed on improved manure use, especially better conservation methods. A small (2 by 2 m) manure bin made of local materials and with a removable roof was validated to improve manure quality (Photo 29). Together with stimulating farmers to collect dung on their land and deposit it in the manure bin, this practice also resulted in increased amounts of manure. Research by the JGRC project on several PR plots revealed that doubling the manure use (from 5 to 10 ton/ha) results – for one hectare potato crop – in an average increase of production value of 280 US$. Given that these extra 5 tons of manure cost approximately 120 US$, on average a net-gain of 160 U$ can be obtained during a normal rainy season. By using the proposed manure bin, net-gains will increase even more, and the risky initial investment in buying additional manure can be avoided. Because organic manures are generally deficient in phosphorus, it is recommended to add locally available rock phosphate, which is inexpensive and by far the most effective.

Given the crucial importance of soil fertility, better and more efficient manure use should receive major attention in any SWC project in the region.

Spate irrigation (lameo)

On fields situated along the main river in Kaynakas, some farmers still practice the technique of "lameo". This is a traditional way of enriching the soil by means of spate irrigation and sediment harvesting. When the river rises after a rainstorm (especially the first rainstorms of the wet season), flowing water is captured by altering the river's course allowing it to flood the fields. Special inlets and temporary ditches are made, water flows in, and the sediments carried by the river are mixed with the existing soil during land preparation. By studying the sedimentology and geomorphology in the Bolivian Andes, Zimmerer (1995) demonstrated that a system of spate irrigation was in use as early as 3500 years ago.

Lameo positively affects soil's height, fertility, moisture content and mineral salt content. Moreover, according to the farmers, it helps to improve the health of the potato plant, by decreasing the amount of nematodes. This technique is preferably used on fallow fields that are about to be re-used for cropping, because risks of water erosion, due to uncontrolled flooding, is lower on fallow fields than on bare agricultural fields. Given that this practice can only be applied on very few fields, it was not actively promoted by the JGRC project.

Mulching (chaqui jalpas)

Directly covering the soil with a layer of wheat or barley mulch after sowing, is traditionally done by only very few farmers; most families prefer to use the straws for feeding their animals or for making adobes. Farmers affirm that mulching has several advantages, such as retaining soil humidity, increasing soil organic matter and protecting the soil from erosive rainstorms. However, they also argue that straws are often taken away by the wind, which is an important reason for preferring to feed these leftovers to their animals. Partially incorporating mulch into the soil is considered too laborious.

Research on the PR plots of the JGRC project demonstrated that soil humidity under a mulch cover of wheat straws (with 200 g of mulch on each m^2) was consistently higher than on the control plots (Table 3.6). Soil temperature, which was only measured on two PR plots, was also lower on the mulched plots. As a result of these differences, higher yields were measured on all mulched plots. Principally in the first stage of crop development, plots with mulch showed important visible differences with the control plots; plant emergence was sooner and plant growth was more vigorous.

Table 3.6
Soil humidity, temperature and yield on PR plots with and without wheat straw mulch

		Soil humidity (% at 5 cm depth)		Temperature (°C at 5 cm depth)		Yield (t/ha)	
Plot	Crop	Mulch	Test	Mulch	Test	Mulch	Test
1	Vetch	8.3	4.9			0.26	0.17
2	Potato	12.3	9.1			19.0	16.7
3	Broad bean	7.2	5.1	29°C	31°C	18.7	15.0
	Wheat					1.37	0.67
4	Maize	6.3	4.2	24°C	32°C	5.8	3.5

Given farmers' resistance to leave wheat straw as a mulch cover on their fields, forest organic material was tested as mulch cover on the JGRC project's demonstration farm. This litter, which was collected from a nearby situated forest, consisted of (semi-decomposed) leaves, twigs and other organic residues. During three years, litter mulch consistently resulted in higher yields than a wheat straw mulch or no-mulch. Although a Duncan 5% test showed that the measured differences were not statistically significant, further research on using litter as a mulch cover on agricultural fields is recommended.

Finally, worth mentioning is also the experiment of the JGRC project with stone mulch on abandoned- and pasture fields. Given the abundance of stones, a carpet of stones was laid out on the previously slightly ploughed soil, and grasses were sown in between the stones (Photo 30). Results were spectacular: grasses grew faster thanks to higher humidity, soil erosion was completely eliminated, and overgrazing was avoided because grass-roots were protected by the stones. Similarly, stone mulch was also used around recently planted trees, in combination with (and on top of) a mulch cover of organic material.

All these alternatives were investigated at the JGRC project's demonstration farm; it would certainly be worthwhile trying them out on the farmers' fields also. Other promising alternatives for growing material for mulching should also be investigated, i.e. using grasses and local shrub varieties at the borders of the fields.

Composting

Experiences with composting are not available in the region. The JGRC project investigated aboveground compost stacks and underground compost pits; both were used for increasing soil fertility in vegetable gardens. The aboveground compost stacks were better accepted by farmers thanks to their shorter decomposition time (3 to 4 months) compared to the underground pits (one year). The former are however more laborious. Although validated on a small scale, most participating farmers were enthusiastic, and indicated that composting was an opportunity to re-use weeds and other kind of organic material that would otherwise have been wasted. Given the limited availability of organic material that can be collected for composting, it should be emphasized that composting (possibly in combination with earthworms) is only interesting for small-scale usage, principally in vegetable gardens.

3.7 Discussion

SWC practices in the inter-Andean valleys of Bolivia are widely available. However, the validation study conducted by the JGRC project revealed that only few of them are technically effective and at the same time easily replicable by farmers. Table 3.7 gives an overview of all SWC practices that were discussed in the previous sections. It presents my personal judgement concerning (1) effectiveness of a practice (provided that it is properly executed), (2) replicability of a practice (whether farmers are able and willing to conduct it), and (3) the overall conclusion (ranking of the most promising SWC practices for the inter-Andean valleys). Also, for each practice, the main bottleneck for widespread adoption is presented, i.e. the principle constraint or difficulty.

Table 3.7
Evaluation of available SWC practices in the inter-Andean alleys

Judgement criteria* / Practice	Effecti-veness	Replica-bility	Main bottleneck(s)	Conclu-sion
Diversion ditches	+	0/+	Adequate channel slope	+
Furrowing	0/+	0	Susceptible to rainfall extremes	0
Stone barriers	+	0/+	Availability of stones	+
Gully control	0	-	Requires solid constructions	0
Terraces	+	0/-	High labour investment	0
Earth bunds	-	0	Susceptible to rainfall extremes	-
Live-barriers	0	0	Susceptible to droughts	0
Individual terraces	0	0	Water logging and overflow	0
Infiltration ditches	0/-	-	Not adequate for cropland	-
Half moons	-	-	Water logging and overflow	-
Conservation tillage	0	-/0	Costs of the equipment	0
Green manure	0	0/-	Farmers' resistance	0
Mixed- and intercropping	+	+	Mixing appropriate crops	+
Improved manure use	+	0/+	Constructing the manure bin	+
Spate irrigation	0	0	Risk of flooding and erosion	0
Mulching	0/+	0	Availability of straw	0
Composting	0/+	0	Availability of organic material	0

** With: + = positive; 0 = neutral; - = negative*

This overview shows that only four SWC practices receive an overall positive conclusion. However, even these four practices have to overcome certain limitations before successful results and widespread adoption can be achieved. All the "neutral" judged practices have limitations that are more serious. Certain farmers only will adopt these practices, and more participatory research and (technical) assistance is required for their widespread adoption.

In any case, as argued at the end of section 3.4, none of the above practices alone can improve agricultural production. Only constructing physical practices such as stone barriers or diversion ditches is not very effective, because cross-slope techniques do little to improve soil quality between the barriers (Helin, 2003). Soil quality should be improved simultaneously, because a degraded soil is less able to absorb rainfall and the result is greater runoff and erosion (Helin, 2003). Improved manure use is one of the most essential and most easily applicable practices; tremendous amounts of manure are nowadays left unused. Improved manure use, in combination with stone barriers, diversion ditches and adequate mixed cropping systems, is the first recommended step towards establishing more productive and sustainable agricultural lands. Meanwhile, the other discussed practices should be further investigated and validated. Many of them are very promising; however, the research conducted by the JGRC project has been too short to generate conclusive data and results. Validating SWC practices always requires at least five years of research.

Besides the above-mentioned practices, future research must also focus on new SWC alternatives. Given that blending traditional and modern technologies is important (Ellis-Jones, 1999), participatory research is essential. Experiences from agroecology and traditional Andean agricultural management and knowledge systems (Altieri, 1996) can definitely enrich the current available stock of SWC practices. However, operationalizing

local knowledge is still in its infancy (Winklerprins, 2004). It requires a lot of patience and energy to understand "why a farmer does what he does". Local knowledge is often not visible or tangible for scientists, and farmers are often not very willing to give explanations due to a lack of confidence. Building a partnership between farmers and researchers requires them having the same objectives; this is rarely the case. Long-term and "slow" experiences like Farmer Field Schools are very appropriate for combining local and scientific knowledge, and for generating technologies that aim at locally adapted and adoptable practices.

3.8 Conclusions

A large stock of SWC practices is available in the inter-Andean valleys, both for controlling runoff and for improving soil management. Only four practices are readily available and can be promoted without major restrictions: diversion ditches, stone barriers, mixed cropping, and improved manure use. All these practices are based on local knowledge. Combining them is the most promising short-term alternative for combating land degradation, given that these practices are generally most effective and at the same time most easily replicable by farmers.

In general, practices based on local knowledge were more successful than the newly introduced practices. Given that also some new practices (e.g. individual terraces, composting and vertical tillage) showed promising results, further participatory research on farmers' fields is recommended. Other – and often maybe better – practices will then become available. However, the ongoing progress of land degradation does not allow us to wait eternally for "the best solution". Action is required now; farmers must invest in SWC. This chapter has made clear that several SWC practices are readily available. All that is needed now is a strategy that motivates farmers to make investments in SWC. There is no doubt that households who do not practice better and more sustainable land management systems, will suffer increased poverty in the future.

Follow-up to Chapter 4

During the execution of field activities in the JGRC project, the final validation of all SWC practices as discussed in this chapter, were not yet available. Rather, activities such as workshops, visits to the Participatory Research plots and training sessions contributed to the final validation. In a quite early stage, two years after the start of the project, a set of six SWC practices was selected to be conducted village-wide through SWC contests between organized groups of farmers (see Chapter 7). These practices were: stone dikes, diversion ditches, bench terraces, gully control, individual terraces and live hedges. They were selected for their short-term visible impact, for the higher labour investments needed to construct them (which consequently is a good selection criteria of most interested families), and for their applicability in SWC contests. In the following Chapter I will analyse the adoption of these six practices, with emphasis on the decisive key-factors influencing farm households' decisions to invest in them.

Photo 11: Participatory Research plot in Kaynakas

Photo 12: Participatory Research plot in Tomoroco

Photo 13: Construction of the A-frame in Tomoroco

Photo 14: Piles of stones in Sirichaca

Photo 15: Stones used for boundary bunds

Photo 16: Stone barrier in Tomoroco

Photo 17: Stone barriers in Sirichaca

Photo 18: Stone barrier with a live-barrier on the Experimental Farm

Photo 19: Bench terraces

Photo 20: Earth bunds

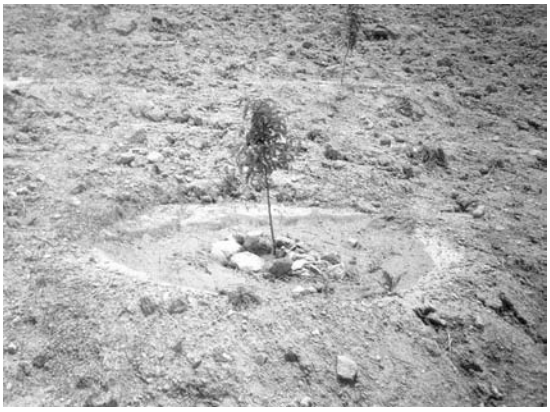


Photo 21: Individual terrace

Photo 22: Infiltration ditches

Photo 23: Half moons in Sirichaca

Photo 24: Tillage with a traditional mouldboard plough

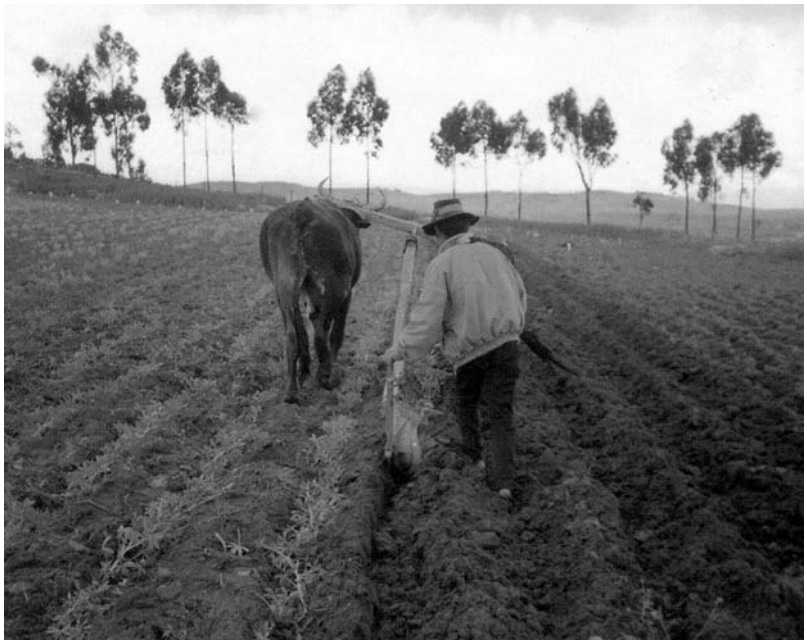


Photo 25: Green manure, digging legumes into the soil

Photo 26: Mixed cropping, wheat with vetch

Photo 27: Intercropping in Sirichaca

Photo 28: Manure for potato field

Photo 29: Manure bin constructed outside the stable

Photo 30: Stone mulch

Chapter 4

Decisive key-factors influencing farm households' soil and water conservation investments

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Applied Geography 26, 40-60 (2006)
DOI: 10.1016/j.apgeog.2005.07.005

"We ourselves are to blame for this situation:
we see how the rains take away our lands and the dung
we've put on it, but we do nothing and prefer to leave
and work elsewhere"

(Villager from Tomoroco)

4. Decisive key-factors influencing farm households' soil and water conservation investments

Abstract

In the inter-Andean valleys of Bolivia decisive key-factors influencing farm households' soil and water conservation investments were determined. The household's progressiveness most influences the decision how much to invest; dynamic and responsible families are among the first. Economic stratum is also important; more income from agriculture leads to higher investments in conservation practices. These practices are preferably executed on fields where the required effort is least and where the impact is highest. Based on these results, four concrete recommendations are given for a SWC strategy that aims at motivating farmers for the adoption of SWC practices.

Keywords: Soil and water conservation; Adoption and investments; Farm households; Factor analysis; Progressiveness; Economic stratum; Strategy development; Bolivia.

4.1 Introduction

Land degradation in the inter-Andean valleys of Bolivia is a serious problem, and soil and water conservation (SWC) actions are plainly justified (Chapter 2). However, achieving successes in SWC is difficult. Although farmers are well aware of the decreasing production capacity of their cropland, they have become passive observers of land degradation (Chapter 2). Most farmers execute only some traditional and very basic land management practices (Chapter 3), while formerly introduced new SWC practices have been rarely adopted. Even improved local-knowledge-based SWC practices that have proven to reduce erosion rates (JGRC, 2003b) are not easily adopted. Hence, the limited adoption and spreading of SWC practices is not a technical problem that can be solved by research (Lapar and Pandey, 1999), but rather a socio-cultural and economic problem, with many constraints playing a role. In Bolivia, constraints at two levels should be tackled. At institutional level, the information flow to farmers about adequate conservation practices is constrained, due to the absence of an extension service and the inability of municipalities and projects to fill this gap. At village- and farm household level, farmers are often not sufficiently prepared and motivated to execute and eventually adopt SWC practices.

This chapter focuses on the latter level and responds to the need to understand the reasons for adoption, partial adoption or non-adoption of SWC practices (Erenstein, 1999). Given that a more adequate understanding of factors and household specific incentives that favour adoption would benefit SWC programmes (Ruben and Vaessen, 2000), this chapter's goal is to contribute with concrete recommendations to the formulation of an adequate SWC strategy for the inter-Andean valleys of Bolivia. Two objectives are aimed as follows.

The first objective is to determine key-factors at farm household level influencing the decision *how much* to invest in SWC practices. In this objective farm household characteristics are taken into account related to economic-, socio-cultural- and physical

aspects. So why do some farmers invest more than others, and, more importantly, how can this information be used strategically to persuade non-investors to invest in SWC? The hypothesis is that there exists at least one decisive key-factor at farm household level that is significantly correlated with SWC investments. This knowledge will help design a more adequate SWC strategy, and will reveal additional activities that are essential to be executed in order to achieve the active participation of more families in SWC activities.

The second objective is to determine key-factors at field level influencing the decision *where* to invest in SWC practices. In this objective field characteristics are taken into account. So why are certain fields more important to farmers than others? The hypothesis related to this objective is that there exists at least one decisive key-factor at field level that is significantly correlated with SWC investments on certain fields. This knowledge can be used to focus SWC activities on these – for farmers – most important fields while avoiding investments in fields where a priori no success can be expected. Accordingly, farmer motivation will increase and SWC programmes can be more successful.

4.2 Adoption and SWC investments

Adoption has been an important topic in discussions about SWC ever since extension services became aware of the disappointing results of knowledge transfer, in particular about SWC technology. Rogers (1958) was one of the firsts to measure adoption, and used the time at which a practice was adopted as a classification criterion. Worried about the little impact of conservation programs, Leagans (1979) stated that understanding why farmers do what they do might improve the quality of policy and programming decisions at various levels. Ervin and Ervin (1982) considered adoption a decision-making process, and tried to include a wide range of personal-, physical-, institutional- and economic factors into their classical conservation decision model for the use of SWC practices. It considers three stages: (1) the perception of the erosion problem, (2) the decision to use SWC practices and (3) the determination of soil conservation effort. However, only perception of the erosion problem is often not enough to take the decision to use SWC practices (Semgalawe, 1998). Farmers must also be aware of the existence of alternative and adequate SWC practices to solve the problem, and must perceive these measures in a positive manner (Napier et al., 1991; de Graaff, 1996). Additionally, Ellis-Jones and Mason (1999) argue that also the recognition of the causes and effects of land degradation is an important precondition that must be met, before farmers even consider conservation technologies.

Even when farmers perceive the problem and are aware of possible solutions, they can decide not to use SWC practices. Many different factors, known as the barriers to adoption, can lead to the non-acceptance of alternative and even indigenous SWC practices. Because farmers are considered economically rational, research has focussed principally on detecting the socio-economic barriers. Numerous factors as diverse as education, age, land tenure security, income, distance from market, labour, farm size, slope and even caste have been investigated (Lapar and Pandey, 1999; Paudel and Thapa, 2004; Tenge et al., 2004). In some cases education, age and gross farm sales have found to be related to adoption (Green and Heffernan, 1987). But, not surprisingly, the conclusions of these studies always were case-specific, and there are more contradictions than similarities between them. Therefore, Lapar

and Pandey (1999) concluded that in different locations the variables that influence adoption are different, and that generalization is not possible.

To understand the driving forces behind human behaviour in relation to the adoption process, it is important to understand the rationale behind what motivates people to undertake action. Deci and Ryan (1985) distinguish between intrinsic motivation (doing something because it is inherently interesting or enjoyable) and extrinsic motivation (doing something because a reward is expected). Intrinsic (or self-determined) motivation can promote sustained environmental behaviour (Osbaldiston and Sheldon, 2003), while extrinsic motivations provide less durable changes (de Young, 1996). Regarding environmental sound activities, like SWC, where short-term economic benefits are hard to obtain, intrinsic motivation should be aimed at when developing strategies. This is supported by Ryan et al. (2003), who show that farmers' attachment to their land and their desire to practise good stewardship (both intrinsic motivations) enhance the adoption of conservation practices.

Hence, adoption can not be fully explained by models and easily measurable economic- and social factors. Decision-making is strongly influenced by non-rational and subjective aspects (Kessler, 2003); e.g. intangible factors related to human behaviour. Adoption requires a favourable mental attitude Leagans (1979), and it is influenced by farmers' feelings and aspirations (Giampietro, 1997). Some farmers will, therefore, never adopt SWC practices, even if they are economically feasible. Although those farmers will be regarded by many people as ignorant or laggards (following Rogers (1958)), Vanclay and Lawrence (1994) assert that some aspects of farmers' resistance must be considered legitimate aspects of human behaviour; not as deficiencies in their attitudes. Concerning the adoption process, both de Graaff (1996) and Ellis-Jones and Mason (1999) refer to the importance of a farm household's ability and willingness to undertake SWC practices. Although the household's ability generally depends on a wide range of obvious socio-economic factors, its willingness is often also influenced by strictly personal and behavioural factors. This potential willingness to adopt is related to individual characteristics, and can explain differences in adoption behaviour (Feder et al., 1985).

Now some lines about SWC investments. Previously I mentioned that adoption is a decision-making process. When a farmer decides to start experimenting with SWC practices, he will first make minor investments. In time, provided that the willingness and ability to do so exist, gradually increasing SWC investments are made. This should eventually lead to the scaling-up of practices to all fields (i.e. major SWC investments). Hence, adoption is not a simple dichotomous term that distinguishes adopters from non-adopters (Enters, 1996). The intensity of use of SWC practices has to be taken into account (Feder et al., 1985). In this sense, a SWC practice should be considered "adopted" only when its execution is sustained and fully integrated in a household's farming system.

In this chapter I refer to SWC investments as investments in labour and time (or soil conservation efforts, according to Ervin and Ervin (1982)). Usually, when talking about SWC investments, one considers first of all its economic feasibility, i.e. the on-site land productivity gains obtained from conservation activities. Obviously, the farm household's perceived benefits of conservation, and the expected losses due to degradation, influence the decision to invest (Shiferaw et al., 2004). Also, the functioning of factor markets plays an important role (Pender and Kerr, 1998). But keeping in mind the previous discussion about

adoption, and considering that SWC investments are part of the adoption process, the influence of non-economic factors on the farmers' willingness and ability to undertake SWC practices must be taken into account.

The comprehension of the factors influencing farm households' SWC investments will help policymakers to design more effective SWC strategies, and manage conservation programs more successfully. Also extension services, which are often blamed for non-adoption (Nowak, 1992), will benefit. In this chapter, the decisive key-factors influencing farm households' SWC investments (*how much* and *where* to invest) will be determined. Subsequently, several concrete recommendations will be given for a SWC strategy in the inter-Andean valleys of Bolivia, which are also useful – and often applicable – in other parts of the world.

4.3 Methodology

Set-up of the research

The research was conducted during one year in the experimental villages Kaynakas, Tomoroco and Sirichaca, situated in the inter-Andean valleys of the north-Chuquisaca region in Bolivia (Figure 1.1). These experimental villages (in this chapter referred to as "the villages") were chosen on the basis of some important geographical, climatic, cultural and socio-economic differences (Table 1.1). The villages together are considered representative for the north-Chuquisaca region, with altitudes of 2,500 to 3,100-m a.s.l.

At the start of the research, the Japan Green Resources (JGRC) project had already worked for more than one year in the villages. Activities executed by that time were the communal workshops, and participatory research with selected farmers about adequate SWC practices. In addition, in each village a SWC contest had been organized, which counted with the participation of almost 80% of the families. Among these participants, in each village 20 families were selected for this research, taking into account the following criteria:

- Sufficient variety in age (younger and older families)
- Sufficient variety in socio-economic stratum (poor and rich families)
- Sufficient variety in participation level (active and passive families)
- Good spatial distribution of the families within the village

Thanks to training during the contests, at the start of the research all selected families had basic knowledge about SWC, and about how to execute most important physical SWC practices. Hence, it is assumed that all families found themselves in a similar starting-situation, and that all were about to take the decision to continue or not with SWC investments.

Data collection during the research was done by a team of three Bolivian agronomy students, who lived and worked during a period of one year in each of the three villages. Previously to the research, the students were trained in data collection techniques and in the interpretation of all data and categorizations to be used. During execution, regular team-meetings were held to assure consistent data collection and to discuss progress. In order not to influence the results, the students were forbidden to stimulate farmers to invest in SWC, or

to give them technical advice. With the same goal to increase objectivity, the families were not aware of the purpose of the students' visits. Discussions about SWC or questions about the farmers' investments were avoided whenever possible.

Given that a good relationship between students and farmers is crucial in this kind of research, a methodology of gradual confidence building was used. During the first half-year the students focussed on getting accepted by each family, by means of helping them with the daily work (ploughing, sowing, weeding, etc.), and by dedicating themselves to casual talk and to farmers' favourite topics. Additionally, they regularly invited farmers to chew coca leaves with them; an important Andean custom that contributes to confidence building, and creates the opportunity for a quite chat. During these conversations many important data were collected. In all cases a relationship of mutual trust was established within half a year, and students were completely accepted. In the second half-year more specific attention was given to more sensitive topics, e.g. questions about income and other wealth-related topics. Visits were no longer previously announced, which made it possible to talk also with other family members (especially the women). Moreover, the surprise factor enabled closer observations of relationships among the family members, and other aspects that during pre-announced visits generally could not be discovered.

Determination of SWC investments

In this chapter a *SWC investment* is defined as the farmer's effort to execute or maintain at least one of the SWC practices presented in Table 4.1. After one year, SWC investments were evaluated, and each family was categorized in one of the following five categories, according to the students' observations and measurements:

1. No investments: no effort at all, not even the existing SWC practices were maintained
2. Minor investments: only regular maintenance to the existing SWC practices
3. Moderate investments: regular to good maintenance and some new SWC practices
4. Considerable investments: good maintenance and several new SWC practices
5. Major investments: everything was done to maintain and construct SWC practices

Table 4.1
SWC practices considered in the study

SWC practice	Description	Main purpose
Stone dikes	Dikes of at least two stones high and wide on contour lines	Control run-off, increase infiltration
Diversion ditches	Ditches build upstream of a cropland field	Safely divert run-off
Bench terraces	Almost flat terraces, usually with irrigation for cash crops	Reduce slope, increase infiltration
Gully control	Barriers of stones, branches and sods, placed in small gullies	Control run-off
Individual terraces	Small terraces for (fruit) trees on steeper slopes	Control run-off, increase infiltration
Living hedges	Trees and bushes planted along other SWC practices	Fix SWC practices

Table 4.2
Description of the farm household characteristics

Economic characteristics		Description
1	Cropland availability	Area of available cropland per household member.
2	Income from agriculture	Total amount of income obtained from trading agricultural products.
3	Sales possibilities	Facility of market access (distance, travel time, transport), existence of local buyers.
4	Opinion about crop prices	The household's opinion about current and future crop prices on local markets.
5	Importance of livestock	Amount of cattle, time dedicated to livestock activities, use of livestock products.
6	Income from livestock	Total amount of income obtained from livestock products.
7	Off-farm income	Total amount of income obtained from off-farm activities (in the village or Sucre).
8	Income from migration	Total amount of income obtained from migration (in the lowlands or elsewhere).
9	Fulfilment of basic needs	Grade of satisfaction of housing, potable water and food requirements.
10	Tools and equipment	Availability and quality of most essential agricultural tools and equipment.
Socio-cultural characteristics		**Description**
1	Families average age	Average age of all family members older than 12 years.
2	Family composition	Number of adult male and female family members.
3	Access to labour	Availability of labour within the family and facility of access to additional labour.
4	Education level	Average education level of all family members.
5	Natural resources knowledge	Level of knowledge of natural resources management within the family.
6	Dedication to agriculture	Amount of time dedicated to agricultural activities and commitment to agriculture.
7	Cultural feeling	Cultural identity of the family (typical clothing, customs and traditions, rites, etc.).
8	Future expectations	Expectations of adults and children concerning the future stay in the village.
9	Stability and wellbeing	Existence of conflicts and stress in the family and its general wellbeing.
10	Social relationships	The family's social relationships with neighbours and other villagers.
11	Dynamism	The willingness of a family to undertake activities and be active in the village.
12	Responsibility	Grade of compliance with promises, social activities and obligations in a village.
13	Participation	The willingness of a family to join and actively participate in new activities.
Physical characteristics		**Description**
1	Erosion problems	Grade of visible erosion and degradation on the family's fields.
2	Average slope of the fields	The average slope of all fields of a family.
3	Stones for SWC	Presence of available stones for SWC on the family's fields.

Determination of farm household characteristics

At farm household level, the farm household characteristics influence the decision *how much* to invest in SWC practices. During the research year, the students monitored 26 farm household characteristics, related to economic-, socio-cultural- and physical aspects (Table 4.2). For most of the qualitative characteristics, primarily the farm household's perception was taken into account. After this year, each farm household characteristic was categorized on a scale of 1-5 in order to permit easy statistical comparison with SWC investments.

Determination of field characteristics

At field level, the field characteristics influence the farmer's decision *where* to invest in SWC practices. Ergo, only those field characteristics were considered that farmers usually perceive, and their perception was used for the determination of all field characteristics. Although opinions of farmers and researchers will generally be similar, in certain cases it can differ. E.g. in the case of productivity, a farmer can consider that a field is quite productive (compared to his other fields), while from the researcher's point of view productivity of the same field can be low (compared to common standards). All 13 field characteristics (Table 4.3) were categorized on a scale of 1-5 and compared with respective SWC investments.

Table 4.3
Description of the field characteristics

Field characteristics		Description
1	Total field area	Size of the field according to the farmer
2	Productivity	The field's average productivity
3	Soil depth	The field's average soil depth
4	Water retention	The field's average water retention capacity
5	Erosion problems	Visible and perceived erosion problems
6	Stoniness	Presence of stones that hamper farming activities
7	Slope	The average slope of the field
8	Water availability	The present or expected future availability of water for irrigation
9	Physical protection	Protection of the field with fences, hedges, stonewalls, etc.
10	Access to the field	The facility of access to the field for the farmer and his animals
11	Distance to the field	Distance from the farmer's homestead to the fields (in time and km)
12	Stones for SWC	Presence of readily available stones for SWC on the field.
13	Security of land tenure	Farmer's land tenure rights for the field and existence of conflicts

Determination of decisive key-factors

In SPSS for Windows, the categorized farm household- and field characteristics were used to examine Spearman correlations between each characteristic and SWC investments. This was done separately for each village and for all data together. Statistical significance was tested at 0.01 and 0.05 level.

Next, Factor Analysis was used to reduce the 26 farm household characteristics and 13 field characteristics into a smaller set of non-correlated factors, named respectively the *farm*

household-factors and the *field-factors*. Factor Analysis is a statistical technique that helps interpret the consistency in a data set. In other words: Factor Analysis attempts to simplify the correlation matrix by accounting for a large number of relationships with a smaller number of factors. Thus, Factor Analysis does not create factors, but rather reveals them based on patterns of intercorrelations among the variables. In this case the Factor Analysis was exploratory, i.e. there were no a priori hypotheses about the final factor structure.

A Varimax orthogonal rotation was used to produce a rotated component matrix that facilitated the interpretation of variables that composed each factor. In such a matrix, the loading for each of the variables is given. A high loading represents a variable that is influenced strongly by the factor. Therefore, only variables with a minimum factor loading value of 0.4 were selected for inclusion in the new factors. Next, each factor was given a denomination according to the set of variables (or characteristics) it was composed of.

Factor Analysis also produced factor scores for each newly defined farm household- and field-factor. Once the values of these scores were calculated, again a Spearman correlation analysis was performed to identify relationships between SWC investments and each farm household- and field-factor. This analysis was also conducted for all villages together, and for each village separately. The decisive key-factors at farm household level (influencing the decision *how much* to invest in SWC) are those household-factors showing a 0.01 or 0.05 significance level in the latter correlation analysis. Similarly, the decisive key-factors at field level (influencing the decision *where* to invest in SWC) are all field-factors showing a 0.01 and 0.05 significant correlation level with SWC investments.

4.4 Results and discussion

Decisive key-factors at farm household level

In order to determine the decisive key-factors at farm household level influencing the decision *how much* to invest in SWC, first of all Spearman correlations between the farm household characteristics and SWC investments were investigated (Table 4.4 to 4.6).

Considering the economic characteristics for “all villages” (Table 4.4), those related to agriculture (*income from agriculture, sales possibilities* and *opinion about crop prices*) show significant correlations (at 0.05 level) with SWC investments. Especially in Tomoroco, families that economically depend on agriculture (with more available cropland, better sales possibilities and higher incomes from agricultural activities) invest more in SWC. In the other villages, the economic differences among families are less pronounced; in Sirichaca all families have good sales possibilities, while in Kaynakas trading of products is very limited due to difficult market access. Therefore, in the latter village none of the economic characteristics significantly influences SWC investments. Surprisingly, *income from migration* or *off-farm activities* does not influence the decision to invest in SWC. In all the villages, but in particular in Tomoroco, a tendency can be observed that families with fewer concerns regarding daily necessities (*basic needs* and *tools and equipment*) invest more in SWC practices.

Table 4.4
Spearman correlations of economic characteristics with SWC investments

Economic characteristics	Kaynakas	Tomoroco	Sirichaca	All villages
Cropland availability	0,004	**0,667**[b]	0,075	0,243
Income from agriculture	0,155	**0,613**[b]	**0,553**[b]	**0,530**[a]
Sales possibilities	0,176	**0,716**[b]	0,347	**0,489**[a]
Opinion about crop prices	0,293	**0,495**[a]	0,336	**0,409**[a]
Importance of livestock	0,335	0,217	0,315	0,315
Income from livestock	0,002	0,366	0,212	0,290
Income from off-farm activities	-0,234	0,071	0,130	0,108
Income from migration	-0,119	0,110	0,101	0,117
Fulfilment of basic needs	0,246	**0,491**[a]	0,184	0,232
Tools and equipment	0,089	0,400	0,072	0,197

[a] *Correlation is significant at the 0.05 level (two-tailed)*
[b] *Correlation is significant at the 0.01 level (two-tailed)*

Table 4.5
Spearman correlations of socio-cultural characteristics with SWC investments

Socio-cultural characteristics	Kaynakas	Tomoroco	Sirichaca	All villages
Family's average age	0,071	-0,077	0,378	0,132
Family composition	-0,150	0,194	**0,418**[a]	0,193
Access to labour	0,044	0,389	0,367	0,248
Education level	**0,525**[a]	0,311	0,386	**0,397**[a]
Natural resources knowledge	**0,650**[b]	**0,611**[b]	**0,711**[b]	**0,711**[b]
Dedication to agriculture	-0,061	**0,432**[a]	-0,221	0,060
Cultural feeling	0,046	0,088	-0,031	0,080
Future expectations	0,055	-0,306	-0,020	-0,232
Stability and wellbeing	**0,412**[a]	0,376	0,210	0,296
Social relationships	0,121	0,342	**0,625**[b]	**0,391**[a]
Dynamism	**0,467**[a]	**0,816**[b]	**0,717**[b]	**0,728**[b]
Responsibility	**0,415**[a]	**0,823**[b]	**0,555**[b]	**0,622**[b]
Participation	**0,480**[a]	**0,792**[b]	**0,748**[b]	**0,701**[b]

[a] *Correlation is significant at the 0.05 level (two-tailed)*
[b] *Correlation is significant at the 0.01 level (two-tailed)*

From the socio-cultural characteristics (Table 4.5), most important is *dynamism*. In all villages, dynamic families invest significantly more in SWC practices than other families. Closely related is the characteristic *participation*, which shows very similar correlation levels. *Natural resources knowledge* also has a consistent positive influence on SWC investments. Given that the project supplied the same information about the importance of natural resources management to all families (during the workshops executed previously to the research), a crucial aspect regarding this characteristic is what families have done with this knowledge. From the results becomes clear that families that have really assimilated this information, are better aware of the importance to maintain and execute SWC practices. Also, families with a higher grade of *responsibility*, i.e. families that can be counted on and that comply with promises, invest more in SWC practices. Among the lower significant

correlations *social relationships* is found. Especially in Sirichaca, better social relationships with other villagers positively influence SWC investments. *Education level* also shows a significant correlation with SWC investments; particularly in Kaynakas higher educated families invest more in SWC. Also in Kaynakas, *stability and wellbeing* is positively correlated with SWC investments. Finally, families in Tomoroco that are more dedicated to agriculture tend to invest more in SWC, while in the other two villages, surprisingly, the opposite occurs. For the other socio-cultural characteristics no correlations are found with SWC investments.

Table 4.6
Spearman correlations of physical characteristics with SWC investments

Physical characteristics	Kaynakas	Tomoroco	Sirichaca	All villages
Erosion problems	-0,127	**-0,437** [a]	-0,022	-0,224
Average slope of the fields	0,063	-0,255	-0,074	-0,076
Stones for SWC	-0,265	0,225	-0,299	-0,187

[a] *Correlation is significant at the 0.05 level (two-tailed)*

For "all villages", none of the physical characteristics (Table 4.6) shows correlation with SWC investments. Only in Tomoroco the presence of more *erosion problems* leads to higher investments in SWC practices. However, in general, more erosion problems, more sloping fields or more available stones for SWC, do not influence the families' decision how much to invest in SWC. Further on in this chapter I will show that these factors do have a significant influence on the decision *where* to invest in SWC practices.

In order to investigate correlations between all farm household characteristics, another Spearman correlation analysis was performed. With 26 variables (n), 325 cases of correlation (x) are obtained (with $x=(n^2-n)/2$). For the complete dataset (of the three villages together) significant Spearman correlations were found in 111 cases (34%). Due to this high amount of correlation between many farm household characteristics, Factor Analysis was performed to simplify the interpretation of the entire dataset. In total five independent and non-correlated factors were calculated, which together explain 67% of total variance in the dataset (Table 4.7). These factors are the *farm household-factors*.

Factor 1 is composed of eight economic characteristics plus education level. It is directly related to the farmer's possibilities to sell his products on local markets, and generate income with these activities. Therefore, this factor *(economic stratum)* distinguishes between economic active and passive families.

Factor 2 is composed of six important socio-cultural characteristics: responsibility, participation, dynamism, social relationships, knowledge of natural resources and stability and wellbeing. This factor *(progressiveness)* relates to the attitude of a family, with emphasis on its willingness (or motivation) to make progress and improve.

Factor 3 is a mixture of economic- and socio-cultural characteristics, which all together show a direct relation to the attachment of a family to his land. This factor is therefore called *importance of origin*; it distinguishes between families that are very attached to their land (not willing to migrate, little income from off-farm activities, important I-am-a-farmer-feeling) and others that are not.

Factor 4 is composed of the three physical characteristics, and is therefore called *field conditions*. Finally, in Factor 5 *(available workforce)* access to labour and family composition are included.

Table 4.7
Rotated component matrix for the farm household characteristics in the three villages (n = 60) [a]

Farm household Characteristics	Farm household-factors				
	Factor 1, Economic stratum	Factor 2, Progressi-veness	Factor 3, Importance of origin	Factor 4, Field conditions	Factor 5, Available workforce
Income from agriculture	0,800				
Sales possibilities	0,775				
Tools and equipment	0,752				
Income from livestock	0,744				
Fulfilment of basic needs	0,670				
Opinion about crop prices	0,662				
Cropland availability	0,561				
Education level	0,519				
Importance of livestock	0,511				
Responsibility		0,878			
Participation		0,857			
Dynamism		0,803			
Social relationships		0,784			
Natural resources knowledge		0,755			
Stability and wellbeing		0,613			
Future expectations			-0,844		
Income off-farm activities			0,822		
Income from migration			0,811		
Cultural feeling			-0,740		
Dedication to agriculture			-0,670		
Family's average age			0,630		
Stones for SWC				0,793	
Average slope of the fields				-0,731	
Erosion problems				-0,503	
Family composition					0,819
Access to labour					0,889
Explained variance (%)	27	17	9	7	7

[a] *Only factor-loadings bigger than 0.4 are shown*

The principal part of this analysis is the determination of one or more decisive key-factors at farm household level influencing the decision *how much* to invest in SWC, i.e. those farm household-factors showing significant Spearman correlations with SWC investments (Table 4.8). Consistently, in all three villages, *progressiveness* is the only farm household-factor that is highly correlated to SWC investments. Hence, it is evident that families that are willing and motivated to make progress are the major investors in SWC. *Economic stratum* shows in Tomoroco and in the whole dataset a 0.05 level significant correlation, which means that there is a tendency that economic better-of families also invest more in SWC practices.

Surprisingly, *importance of origin* has no influence at all on SWC investments. Hence, also for families that are not very attached to their land (in an economic and cultural sense), land is still important enough to invest in. *Field conditions* are not very influential either, although a tendency can be observed in the correlation scores of all villages to invest slightly more in SWC practices when field conditions do require (more erosion and steeper slopes) or permit so (more available stones). Finally, the farm household-factor *available workforce* only in Sirichaca slightly influences SWC investments. In this village, the few families with non-migrating male members are able to invest more in SWC practices.

Table 4.8
Spearman correlations of household-factors with SWC investments

	Farm household-factors				
	Economic stratum	Progressi-veness	Importance of origin	Field conditions	Available workforce
All villages	**0,308** [a]	**0,650** [b]	0,108	0,164	0,174
Sirichaca	0,109	**0,599** [b]	0,124	0,206	0,302
Tomoroco	**0,489** [a]	**0,679** [b]	0,052	0,120	0,193
Kaynakas	0,136	**0,556** [b]	0,051	0,197	-0,086

[a] *Correlation is significant at the 0.05 level (two-tailed)*
[b] *Correlation is significant at the 0.01 level (two-tailed)*

Two decisive key-factors are determined at farm household level: progressiveness and economic stratum. The first key-factor is far more important than the latter. Progressiveness can also be described as orientation to change, a factor that according to Hansen et al. (1987) can be considered analogous to a modernity orientation, and that strongly relates to the adoption of conservation practices. Progressiveness also has much to do with the earlier discussed willingness and intrinsic motivation of farmers to invest. Not surprisingly, the characteristics *responsibility*, *participation* and *dynamism* score high on this factor (Table 4.7); all three are strong indicators of intrinsic motivation. Therefore, the results support the statements made earlier in this chapter about the importance of acknowledging farmers' willingness as a crucial factor for adoption of SWC. Projects must, therefore, strongly focus on motivation in the broadest sense of the word; not with external incentives, but by changing the farmers' attitude. Capacity building and transfer of knowledge must be constantly emphasized, with convincing and motivating examples of practices that work. The combination of an extension service (or a SWC programme with extensionists) and farmer-to-farmer training and exchange programs, offer most incentives for adoption of SWC practices (Ruben and Vaessen, 2000). Hence, extension workers must work more closely with farmers, and – whenever possible – important elements of farmer-to-farmer training should be used. Moreover, given the importance of social networks in this kind of cultural economies (Mazzucato and Niemeijer, 2000), passive farmers must be involved in social activities, and their social relationships must be strengthened. In synthesis, efforts must focus on designing activities that influence attitudes towards change, creating as such a solid foundation for SWC that consists of motivated and trained farmers. The challenge is to break through the vicious circle of passiveness in which many farmer families find themselves, and

show them that promising alternatives are available; this will eventually enhance intrinsic motivation.

The second key-factor (economic stratum) is also in many previous studies found to be closely related to adoption. Higher status people tend to invest earlier in SWC practices, because they can assume risk associated with adoption (Hansen et al., 1987). This relates to the ability of farmers to invest, which was previously discussed in this chapter. However, given that the risks involved with the SWC practices executed during this research are very low, other reasons apparently are more important. A closer look at the loadings of the different farm household characteristics on this factor (Table 4.7) shows that generating income (either from agriculture or livestock) is crucial. The fact that also characteristics like *tools and equipment* and *fulfilment of basic needs* load high, is yet another argument that if a household has fewer concerns about financial liquidity, SWC investments are higher. Again, motivation shows up to be of great importance, in this case extrinsic motivation. If a financial incentive exists (the prospect of increasing or securing income from agriculture after executing SWC practices), market-oriented farmers – in the higher economic stratum – are more motivated to invest in SWC. Outsiders or farmers that can not sell their products on local markets, are less willing (and able) to execute SWC practices. Hence, it is not so much the SWC practices themselves that must be profitable, but rather the combination of activities that accompany the introduction of the practices. SWC programmes must, therefore, be more holistic, and should be integrated in a larger set of rural development activities. Hence, they must also focus on the income-generation function of agriculture and livestock, and enable farmers to fulfil their basic needs and buy some basic tools and equipment.

Decisive key-factors at field level

In order to determine the decisive key-factors at field level influencing the decision *where* to invest in SWC, Spearman correlations between the field characteristics and SWC investments were investigated (Table 4.9). A highly significant (0.01 level) correlation is found for *erosion problems*, which evidences that farmers are aware of the presence of erosion signs, and invest more on fields with more severe erosion problems. Also significant in the whole dataset and in two of the three villages separately are *slope* and *distance to the field*. This shows that major SWC investments are made on fields with steeper slopes, and also on the nearby-situated fields. Surprisingly, all typical soil quality related field characteristics (*productivity*, *soil depth* and *water retention*) have no influence on the decision where to invest in SWC practices.

In order to simplify the interpretation of the entire dataset, and account for correlations among the thirteen field characteristics, again Factor Analysis was performed. The field characteristic *total field area* was excluded due to its low statistical communality. From Factor Analysis, five independent and non-correlated factors were calculated, which together explain 73% of total variance in the dataset (Table 4.10). These factors are the *field-factors*.

Table 4.9
Spearman correlations of field characteristics with SWC investments

Field characteristics	Kaynakas	Tomoroco	Sirichaca	All villages
Total field area	0,090	**0,448** [b]	-0,013	**0,184** [a]
Productivity	0,069	0,091	0,070	0,108
Soil depth	0,019	-0,110	-0,088	-0,086
Water retention	**0,209** [a]	-0,061	-0,015	0,050
Erosion problems	**-0,232** [a]	**-0,453** [b]	**-0,267** [b]	**-0,326** [b]
Stoniness	0,013	**-0,286** [b]	-0,069	-0,115
Slope	-0,072	**-0,371** [b]	**-0,281** [b]	**-0,186** [a]
Water availability	0,082	**0,287** [b]	0,010	0,116
Physical protection	0,151	0,013	**0,257** [b]	0,078
Access to the field	**0,176** [a]	0,131	-0,141	0,086
Distance to the field	**0,287** [b]	**0,292** [b]	0,167	**0,268** [b]
Stones for SWC	0,171	**0,247** [a]	0,187	**0,174** [a]
Security of land tenure	0,172	-0,043	**0,414** [b]	0,138

[a] *Correlation is significant at the 0.05 level (two-tailed)*
[b] *Correlation is significant at the 0.01 level (two-tailed)*

Table 4.10
Rotated component matrix for the field characteristics in three villages (*n*=395)

	Field-factors				
Field characteristics	Factor 1, Soil quality	Factor 2, Surface conditions	Factor 3, Field location	Factor 4, Preferential conditions	Factor 5, Land tenure
Water retention	0,884				
Productivity	0,863				
Soil depth	0,778				
Erosion problems		0,769			
Slope		0,750			
Stoniness		0,660			
Stones for SWC		-0,562			
Distance to the field			0,893		
Access to the field			0,816		
Water availability				0,803	
Protection				0,723	
Security of land tenure					0,883
Explained variance (%)	23	17	13	11	9

In Factor 1, the field characteristics water retention, productivity and soil depth come together; it is therefore called *soil quality.* This factor distinguishes between fields to which farmers often refer to as good and bad fields. Factor 2 refers to the more visible field characteristics (erosion problems, slope, stoniness and stones for SWC), and is called *surface conditions*. In Factor 3 (*field location*), the distance and access to the field are included. Factor 4 gathers field characteristics that make a field more valuable from a farmer's perspective, i.e. the availability or possibility to obtain water (for irrigation) and the physical

protection (fences) of a field. Therefore, this factor is called *preferential conditions*. Factor 5 is composed of land tenure alone.

In order to determine one or more decisive key-factors, correlations between the five field-factors and SWC investments were investigated (Table 4.11). Most striking is the contrast between *soil quality* and *surface conditions*. Whereas the field-factor *soil quality* does not influence SWC investments (with the exception of Kaynakas), the field-factor *surface conditions* consistently shows a highly significant correlation. Steep sloping fields with erosion problems where stones are available for SWC, are the fields to be treated firstly. The field-factor *field location* shows highly significant correlations in all cases, except in Sirichaca (where flat lands provide good access to all fields). Hence, nearby-situated fields with good access are also among the first where SWC practices are executed. In all villages the factor *preferential conditions* of a field shows a light tendency of correlation with SWC investments, although only in Sirichaca this correlation is significant (at a 0.05 level). This implies that if a field counts with some preferential conditions, farmers tend to invest more. Finally, land tenure is significant correlated to SWC investments in all cases, except in Tomoroco. Farmers thus generally invest more in SWC practices on fields over which they have more secure tenure rights. This is in accordance with the results of a study by Tenge et al. (2004).

Table 4.11
Spearman correlations of field-factors with SWC investments

	Field-factors				
	Soil quality	Surface conditions	Field location	Preferential conditions	Land tenure
All villages	0,119	**-0,330** [b]	**0,265** [b]	0,107	**0,149** [a]
Kaynakas	**0,195** [a]	**-0,251** [b]	**0,292** [b]	0,170	**0,177** [a]
Tomoroco	0,052	**-0,494** [b]	**0,310** [b]	0,100	-0,006
Sirichaca	0,056	**-0,274** [b]	0,042	**0,213** [a]	**0,364** [b]

[a] *Correlation is significant at the 0.05 level (two-tailed)*
[b] *Correlation is significant at the 0.01 level (two-tailed)*

Three decisive key-factors are determined at field level: surface conditions, field location and land tenure. The importance of the *surface conditions* leads to the following conclusions. Farmers want to see short-term impact of their investments, and thus invest on fields with erosion problems. On steeper slopes, erosion problems are generally more severe than on flat fields, and are thus among the first to be treated. Hence, when starting with SWC investments, farmers want to solve current erosion problems; they are not yet interested in erosion prevention. The results also show that farmers execute SWC practices where the required effort is least, hence, where stones are available for the construction of stone dikes. Tangible short-term benefits and risk reduction enhance the probability of adoption and intensity of use of SWC practices (Baidu-Forson, 1999). Consequently, SWC programmes must focus their attention firstly on sloping and eroded fields with readily available stones. Since the impact of physical practices, such as stone dikes and diversion ditches, is more visible, practices whose short-term beneficial effect cannot be guaranteed, such as vegetation hedges, should be avoided during the first stage of a SWC programme.

Field location is a second key-factor; it also refers to the fact that farmers invest first in fields where least effort is required, i.e. on the nearby-situated fields with better vigilance and easy access. Thus, at the start of SWC activities, projects must not insist that farmers treat all their fields with SWC practices. Instead, farmers should start experimenting (generally with minor investments) where they consider their investments most worthwhile, and discover themselves the benefits of SWC practices.

Land tenure is the third and last key-factor. Nowadays, almost without exception, farmers in the villages work land over which they have no official land tenure rights. In many cases this limits SWC investments. Ergo, in order to increase the potential area for SWC, projects should pay attention to solving land tenure disputes, and help farmers obtain more secure land tenure rights. Obviously, this is done in close collaboration with local land tenure institutes or programs.

Surprisingly, farmers do not take the *soil conditions* of a field into account when deciding where to invest. However, this is partly true, because this field-factor is twofold explainable. Field observations during the research revealed that in fact most farmers do consider soil conditions, although with different outcomes. Some farmers prefer to invest in "good" fields in order to protect them, while others rather invest in "bad" fields with the objective to recover former productivity levels.

It can be concluded that the decision *where* to invest in SWC is principally influenced by the fact that farmers seek efficiency, and that they always try to achieve maximum short-term impact with the least possible risk of making investments or efforts in vain. Hence, farmers' decisions are completely logical; they must be strongly taken into account by any SWC programme, principally during the first stage of execution, when SWC practices have not yet proven to be clearly beneficial. This is the reason that top-down approaches and incentives for the execution of SWC practices have seldom worked (Kessler et al., 1995). For successful SWC, farmers must be motivated with positive stimuli to start experimenting. Moreover, when farmers continually experiment with SWC practices, final results will be more sustainable (Bunch, 1999). In this sense, intrinsic motivation will quickly grow when one successfully discovers something without being forced. In the case of SWC practices that work, this will eventually lead to sustained adoption.

4.5 Conclusions and recommendations

The farm household's progressiveness is by far the most decisive key-factor at farm household level that influences the decision *how much* to invest in SWC. Dynamic and responsible farmers, who are motivated to participate in project activities and willing to make progress, are among the first to undertake SWC investments. Additionally, the economic stratum a family belongs to is also considered a key-factor; farmers with higher income from agriculture – and to a lesser extent from livestock – and with fewer financial concerns will invest more in SWC practices. The decisive key-factors at field level (influencing the decision *where* to invest in SWC) are surface conditions, field location and land tenure. Farmers prefer to conduct simple SWC practices on the nearby-situated – preferably owned – fields with visible erosion problems, where short-term impact is more likely. Thus, especially

in the first stage of SWC activities, most farmers will not risk making investments that possibly turn out to be in vain.

From these conclusions and the previous discussion, four concrete recommendations are derived for a strategy that aims at motivating farmers for the adoption of SWC practices. Although directly applicable on the inter-Andean valleys of Bolivia, many aspects of these recommendations will also be very useful in other parts of the world, where SWC programmes have to cope with problems related to the adoption of SWC practices.

1) *Focus on most progressive farmers.* Farmers who are driven to make progress are more willing to experiment with SWC practices and to make investments. They should be involved in the first stage of a SWC programme, mainly through training in natural resources use (which is crucial for making SWC investments) and the execution of tangible activities. Given positive experiences with Farmer-to-Farmer training in the region (Hocdé et al., 2000), these progressive farmers can later transfer their knowledge to other farmers, and become the leaders of conservation activities in a village.

2) *Achieve short-term impact and success in SWC.* The execution of basic SWC practices on strategically located fields (on visible and eroded fields with easy access) will enhance the successful short-term impact of these practices. These kind of early and motivating actions, which are essential in motivating stakeholders in environment-related programmes (Kessler, 2003), will convince and motivate farmers for further investments in SWC. Farmer visits to successful SWC experiences in the village or elsewhere are, therefore, highly recommended.

3) *Enhance the profitability of agriculture.* Agriculture must generate income otherwise farmers will not be very interested in SWC. Technologies for increasing productivity should therefore be integrated with SWC practices (Bunch, 1999), in order to make agricultural production more competitive. Moreover, improving sales possibilities and market access are very important related aspects. Hence, investments in infrastructure are essential, and farmers must organize themselves to obtain better trading conditions.

4) *Invest in satisfying households' basic needs.* Households that have fewer concerns regarding daily necessities are more willing to invest in SWC. Therefore, satisfying basic needs (e.g. safe drinking water) and providing essential tools and equipment for the functioning of a household is important. Subsidising the acquisition of these products must be considered, especially in poor areas like the inter-Andean valleys where investments are indispensable. However, in order to increase farmer households' self-sufficiency and sustainability, this should be accompanied by activities promoting income diversification.

In this chapter we have achieved a better understanding of the key-factors that influence farm households' investments in SWC, and thus the eventual adoption of conservation practices. The previous recommendations have emphasized some major focus-points of a SWC strategy at farm household- and village level. The actual implementation of such a strategy will certainly reveal more aspects to be taken into account when it comes to motivating farmers for the adoption of SWC practices. For example, the enabling context at institutional level for implementing SWC activities must be created first. At this level, an efficient extension system must achieve that the necessary information about adequate land management and SWC practices actually reaches farmers. Especially in Bolivia, with its politicized institutional context, this is a major challenge.

Follow-up to Chapter 5

With the previous conclusions and recommendations, rightly focusing a soil and water conservation strategy becomes easier. However, the major challenge is still ahead: How to do it in practice? Only then we can determine the usefulness of the described conclusions. In the next chapter, I present and discuss the logical strategy for SWC, in which the four recommendations from this chapter are considered important fundamentals for working with farmers in SWC.

Chapter 5

Motivating farmers for soil and water conservation: A promising strategy from the Bolivian mountain valleys

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Land Use Policy (In Press, on-line available)
DOI: 10.1016/j.landusepol.2005.11.001

"Now we know that in order to protect our soils and make them produce more, we must work in groups, however, first of all we have to organize our village and start collaborating"

(Villager from Talahuanca)

5. Motivating farmers for soil and water conservation: A promising strategy from the Bolivian mountain valleys

Abstract

Successful examples of strategies that motivate farmers for the large-scale execution of soil and water conservation practices are scarce. This chapter presents a promising strategy for changing mostly passive Bolivian Andes farmers into active participators in natural resources conservation. In this logical strategy, first a solid foundation is laid of intrinsically motivated and genuinely participating villagers with a progress-driven attitude. Next, soil and water conservation activities are planned and executed within a holistic framework of rural development activities. Collaboration and the use of farmer-trainers enhance sustainability of all activities. Major emphasis is given to the human dimension of sustainable development as well as to six important fundamentals for working with farmers in soil and water conservation. Practical experiences with the logical strategy in five rural villages show its potential to motivate farmers for soil and water conservation practices and achieve sustainable changes. This chapter therefore calls for harmonized rural development policies that support strategies focussing on farmer motivation and truly integrated sustainable development.

Keywords: Soil and water conservation; Integrated sustainable development; Intervention strategies; Farmers' motivation; Genuine participation; Bolivian mountain valleys

5.1 Introduction

Of the roughly 850 million people living in chronic hunger, smallholder farmers constitute half (FAO, 2004). Most of these subsistence farmers live in less-favoured areas (LFAs), which are characterized by marginal lands, low agricultural production and limited market access (Ruben and Pender, 2004). In these LFAs, development projects have traditionally focused strongly on the Integrated Rural Development framework. However, in practice these programs are more multi-sectoral than truly integrated (Burkey, 1993) and have failed to recognize the differentiated nature of rural livelihoods (Ruben and Pender, 2004). The same is true for the heavily populated risk-prone areas of Latin America, where neither local processes of intensification nor top-down development projects have proved adequate in alleviating poverty and resources degradation (Pichón et al., 1999).

Over recent years, substantial progress has been made in understanding sustainable development. In an attempt to establish some common ground, Mog (2004) argues that sustainable development is like an unending process of change, which should be owned by organized communities. Sustainable development programs should guide this process. Many of the required changes are linked to people's behaviour and attitudes (Muchena et al., 1997). Learning-by-doing and similar participatory approaches are mentioned in numerous policy reports (e.g. IAC, 2004; UN Millennium Project, 2005). Hence, the local peoples' responsibility and crucial role in identifying promising development pathways is increasingly recognized.

However, few examples exist of larger-scale success stories about empowering local communities for self-development and ownership (e.g. Ohler et al., 2000). Even in the case of the widely accepted Sustainable Livelihood approach, operationalizing it as a pragmatic tool for development programs is still a challenge (Zoomers, 2001). The UN Millennium Project (2005) recently launched a practical plan that speaks of a new Green Revolution. In this plan, extension services are strengthened with village level para-professionals, and participatory methods are used for transferring knowledge of sound agricultural techniques. Although this approach is correct, it is still a plan. What we need are examples of practical strategies for motivating farmers to participate in such a Green Revolution.

This chapter contributes to filling this gap, and describes how farmers were motivated for soil and water conservation (SWC). It is based on experiences in the inter-Andean valleys of the north-Chuquisaca region in Bolivia (Figure 1.1), where land degradation over the past decades has enormously increased (Chapter 2). In this region, development policies have failed because farmers' strategies were not taken into account (Zoomers, 1998), and most SWC projects have been unsuccessful because farmers' perception of erosion was not understood (Zimmerer, 1993). I present a strategy in which farmers' perspectives and capabilities are addressed upfront; institutional interests and other biases are ruled out. From this farmer-based approach arise the activities that are logically required to motivate farmers for SWC and to achieve a sustainable impact: the logical strategy for SWC (henceforth "the logical strategy"). Crucial in this strategy are the human dimension of sustainable rural development and six fundamentals for working with farmers in SWC.

The logical strategy was developed and validated by the Japan Green Resources Corporation (JGRC) project. It strongly takes into account and is complementary to past and current participatory work with SWC in Bolivia, especially in the Cochabamba region (projects of the San Simón University and the Swiss-financed PROMIC) and in La Paz (the Pachamama Urupa project). The logical strategy is, above all, applicable in LFAs with a low development potential and little governmental interference. This chapter focuses on activities at the micro level: i.e. rural villages and farmer households.

5.2 The human dimension of the logical strategy

In this section I discuss participation and other human-related constraints to sustainable rural development that have shaped the human dimension of the logical strategy.

It is now widely acknowledged that the widespread and sustainable execution of SWC practices requires foremost the adequate involvement of local people. Based on the earlier work of Chambers (1983), an ever-growing set of participatory methods for collective analysis and learning is now available. Most of these Participatory Learning and Action (PLA) tools have proved successful in providing a catalyst for the village to discover and act (Tomas, 2004). Yet, participation is still heavily debated, since it is apparently not enough to obtain sustainable results. Different levels of actual participation strongly influence success or failure of development attempts (Pretty, 1997). Although many NGOs see participation as an end in itself, donors often see it more as an instrument to facilitate implementation (World Bank, 2002), and use it more as a means for information and communication than for shared

decision-making (Pretty, 1997). Eversole (2003) refers to two pitfalls with regard to participation.

The first pitfall is that participatory projects generally retain considerable control over the change process. Despite participation, local peoples' influence is often minimal. Henkel and Stirrat (2001) argue that development interventions, under the flag of participation and using PLA tools, have the same objective as earlier top-down projects; i.e. to make rural people "modern". Freire (1972), referring to top-down approaches, called this cultural invasion, i.e. the imposition of values. For development to occur, the power must be within the people (Freire, 1972). Ownership, the representation of local people in decision-making bodies, is thus required (Ribbot, 1999).

A second pitfall is that the diversity of local people is often neglected. All too often, claims of full participation refer, in practice, to situations in which only the vocal few are heard (Cornwall, 2003). Cooke and Kothari (2003) argue that participation is often used for "hidden" objectives of the most powerful in a community. Farmers are often not motivated but rather forced to participate, either by the project (using all kind of incentives) or by internal community power relationships (and the fear of being be excluded). Referring to the role of women, Cornwall (2003) concludes that participatory approaches only make a difference if they take into account issues of difference. The empowerment of local people, one of the main objectives of participatory development, should be reconsidered by asking: who is eventually empowered?

Achieving genuine (voluntary) participation, i.e. avoiding to get trapped in one of the participation pitfalls, is thus a major challenge. The human dimension of the logical strategy addresses this challenge. Andean farmers, like most farmers, are not used to participation. Having been "invaded" so many times by all kind of outsiders, a feeling of inferiority is omnipresent in Andean communities. In such a context, participation does not immediately work; people must first become self-confident and develop the capacity for collaborative thinking and working, based on equity. This evolves over time; it must be carefully built up. The excellent work of Burkey (1993) regarding self-reliant, participatory rural development should therefore be compulsory for all projects that hurry to reach their objectives. Burkey (1993) argues that self-reliance implies that a village and its people primarily rely on their own strength and resources. Freire (1972) calls this *concientização* (in Portuguese), referring to the process of awareness-raising in people regarding their ability to transform their reality by conscious collective action. In this chapter I will often use the word conscientization.

Following conscientization, people will become intrinsically motivated to participate. This intrinsic motivation leads people to do something because it is inherently interesting or enjoyable (Deci and Ryan, 1985). It is a person's inner will to achieve a certain objective, and generally refers to an attitude change that emerges during or after conscientization (JGRC, 2003c). Unlike extrinsic (or external) motivation, intrinsic motivation can promote sustained environmental behaviour (Osbaldiston and Sheldon, 2003, De Young, 1996). Hence, both conscientization and motivation precede genuine participation. This is precisely what the human dimension of the logical strategy is about. However, this process takes time, because people cannot be made self-reliant; they become self-reliant (Burkey, 1993). Likewise, genuine participation comes from within; it cannot be forced from outside. The human dimension is, therefore, a transversal theme during the whole process of working with people

in SWC. PLA tools are useful in enhancing this process, and will therefore be widely – and wisely – used throughout the whole logical strategy.

5.3 Fundamentals for working with farmers in SWC

The logical strategy considers six fundamentals for working with farmers in SWC. The first four fundamentals are derived from the recommendations given in Chapter 4 for a strategy that aims at motivating farmers to adopt SWC practices. The other two are based on experiences in the region.

The first fundamental is that in the first stage of any program with a SWC component, activities must *focus on the most progressive farmers*. These farmer-innovators, who are driven to make progress and willing to experiment with SWC practices, are a source of inspiration for other farmers (Reij et al., 1998). Training them in natural resources use fills the existing knowledge gap, while organizing them as a group is an important motivating factor and, in later stages, crucial for the scaling-up of SWC activities. Experiences in the region with Farmer Participatory Research (FPR) emphasize the importance of forming farmer groups to support experimentation and learning (Braun and Hocdé, 2000). Only when farmers are involved in developing better land management practices, will knowledge and research have relevance to livelihood strategies (Twomlow et al., 2002). In the logical strategy these farmer-researchers are called Conservation Leaders. Given that this group must lead conservation activities in the village, the first priority is their conscientization and insight into the existence of alternative SWC practices that could make their land use more sustainable.

The second fundamental is to *achieve short-term impact and success in SWC.* All kinds of early, motivating actions, essential in motivating stakeholders in environment-related programs (Kessler, 2003), must be conducted with the Conservation Leaders. Visits to other successful SWC experiences, intensive training and subsidies for the purchase of tools, materials and seeds are important tools. However, since self-help enhances people's capacity to innovate and adapt (Conway and Barbier, 1990), cost-sharing is essential. To ensure that the Conservation Leaders' efforts have impact, SWC practices should be executed on strategically located fields; i.e. with visible erosion and easy access.

The third fundamental stresses the importance of *enhancing the profitability of agriculture*; agriculture – and to a lesser extent livestock – must generate income, otherwise farmers will not be very interested in SWC. Technologies for increasing productivity should be integrated with SWC practices (Bunch, 1999), e.g. slope-conditioning physical SWC practices aiming at run-off control combined with more efficient manure use, composting, improved crop-rotations and other soil management techniques (Chapter 3). Some cropland fields should be taken out of production (or be reforested) in order to take optimum advantage of the little amount of manure, and use it in higher concentrations on other fields. However, given that intensification of agricultural production is considered useless under present regional market conditions (Rist, 2000), improving sales possibilities and market access are very important – related – aspects. Adoption of better land management practices is often associated with the commercialization of higher value crops (Pender, 2004), hence,

investments in infrastructure are essential, and farmers must organize themselves to obtain better trading conditions.

The fourth fundamental tells to *invest in satisfying households' basic needs* while working with SWC. This implies that investments in domestic water supply, nutrition, roads, energy services, etc. are essential. However, also smaller investments, in e.g. (agricultural) tools and basic equipment for the functioning of a household, must be considered. Many will argue that executing SWC practices in combination with subsidies for satisfying certain basic needs, is like using incentives for SWC. However, it must be understood that in LFAs like the inter-Andean valleys, SWC activities will not succeed unless also some short-term improvements are expected. The need for huge investments in rural development in countries like Bolivia (in combination with better policies) is now widely acknowledged (UN Millennium Project, 2005). These investments must, however, be made cautiously and subsidies must be used wisely. In combination with SWC execution, they must always go together with conscientization activities!

The fifth fundamental emphasizes the importance of *stimulating collaboration within a village*. Collective works are an ancient Andean tradition, which, however, has largely perished. Working together in groups has practical benefits when labour-demanding tasks (i.e. planting or harvesting) need to be done. This can be successfully extended to conservation works: a group can tackle bigger jobs, and it generates a sense of community care for the land. Moreover, group members are generally more committed to a group's goal than individuals are to their own goal (Hinsz and Nickell, 2004). Collaboration within the group of Conservation Leaders must be strengthened first; but eventually the whole village must be involved. Organized groups – no matter their objective – are also an excellent forum for providing training in SWC and related topics. Since Farmer-to-Farmer training has proved to be an excellent tool for knowledge transfer (Hocdé et al., 2000), farmers should be responsible for such training.

The last fundamental refers to *promoting income diversification*. Rural Andean households apply multi-activity strategies to diminish risks and survive in a heterogenic context (Zoomers, 1998). However, currently, much of the income diversification in LFAs is 'desperation-led' and limited to unskilled wage labour (Barret et al., 2001). Although migration is a traditional element of rural Andean livelihood strategies (Bebbington, 1999), due to limited off-farm activities in the villages, its duration has increased (Zoomers, 1998). Because migration has no negative influence on households' SWC investments (Chapter 4), the logical strategy does not discourage people to migrate, but rather intents to reduce its duration and improve its quality: i.e. more income in less time. Skill-training is one alternative, because it enables farmers to enter higher paid labour markets in urban areas. The other alternative is to promote non-farm rural employment (Berdegué et al., 2000) in the community or nearby. Such elements are hardly ever included in government policies (Reitsma et al., 1992). Hence, activities must be planned that raise income and that enable all villagers to take optimum advantage of their capacities and spare time. The aim should be an optimum combination of practical non-farm activities with the necessary agricultural and land care activities.

5.4 The logical strategy: an overview

The logical strategy focuses on working with SWC at village- and household level. The strategy's principal premise is that sustainable development is possible whenever the community is motivated to make progress. Such a progress-driven attitude can be generated by a process of conscientization, motivation and genuine participation in collective actions. The first phase of the logical strategy is therefore called "laying a solid foundation for sustainable development". It deals with generating a progress-driven attitude in people who are caught in a poverty trap, with a perception of a future with no way out. In the second phase, which is initiated when the first phase has been satisfactorily completed, development activities (including SWC) are planned and executed in a sustainable way.

The essence of the logical strategy lies in the strategically planned sequence of activities. The investment intensity increases parallel to the gradual generation of a progress-driven attitude. It is a mutually reinforcing process, with the villagers being the principal driving-force of the planning and execution of activities. However, given the holistic approach and the variety of integrated activities to be executed, implementation of the logical strategy requires a well-organized coordination unit, and the combined effort of various institutions (a development agency, municipalities, governmental organizations, NGOs, etc.). A crucial role is set aside for extension workers, who are the link between the village and the executing agencies. The successful implementation of the logical strategy depends on their capacity to understand the strategy's logic, and their ability to work closely and flexibly with the villagers in a relation of mutual trust. Hence, the logical strategy is not a rigid set of activities, but rather a framework for sustainable rural development based on SWC, that can be flexibly adapted to many cultural and geographical settings.

Phase 1: Laying a solid foundation for sustainable development

Self-reliant people with a progress-driven attitude thus comprise the required solid foundation in a village. Given that the lack of appropriate local organization and corruption on the part of the more powerful villagers are generally major problems (Hope, 1983), organizational aspects receive a lot of attention. Five conditions are used to measure the foundation's firmness (Table 5.1). These conditions must be satisfactorily complied with in order to start the second phase of the logical strategy. The extension worker is directly responsible for the implementation of activities in one or maximum two villages. He/she monitors and evaluates the village's progress in fulfilling the conditions (Photo 31). The activities during this first phase focus on working with the following target groups.

Table 5.1
Conditions used for measuring the foundation for sustainable development

1.	Organization and leadership (a well organized leading agrarian syndicate);
2.	Responsible participation (in village meetings and workshops);
3.	Effective collaboration (for village development);
4.	Mutual trust (between the village and the development agency);
5.	Environmental awareness (the importance of natural resources).

Working with the village leaders

For the execution of any future activity, it is essential that the extension worker establishes a relation of mutual trust with visible and hidden village leaders, and obtains their active support. Visible (or official) leaders are (ex-) members of the village board and persons who actively participate in village meetings. Hidden (or potential) leaders are generally younger persons, with a better than average education level and the potential to lead the village. By means of family visits, the extension worker identifies all village leaders, men and women alike, and invites them for a first meeting.

Several workshops with this group focus on essential aspects of a progress-driven attitude, e.g. leadership and collaboration, the role of the village board, natural resource use and SWC. An important motivating activity is a visit to a similar village where a solid foundation already exists; with active village leaders and a well-organized village board.

Working with the assembly

Once the support of village leaders is guaranteed, the extension worker organizes a series of five workshops with the assembly, to prepare and motivate the villagers for future activities. Participatory techniques, socio-dramas, radio soap-series, etc. are constantly used to involve the participants, make them reflect on their current situation, and discuss topics related to natural resources use and SWC. Since the lack of social harmony undermines the success of community-based approaches (Barrett et al., 2005), enhancing village collaboration and cohesion is an important objective.

Obviously, five workshops with the assembly are not enough to achieve an attitude change and the conscientization of the whole population of a village. Initially, attendance of the workshops will be low; however, when the news spreads that it is nice to participate, attendance will increase. Therefore, the series of workshops are repeated at least once during this first phase, applying different participatory techniques.

Working with Conservation Leaders

Village leaders most interested in SWC constitute the group of Conservation Leaders (Photo 32). This group of about ten farmers (male and female) receives intensive training in all aspects related to SWC. They will be among the first to generate the required progress-driven attitude. In view of the future scaling-up of SWC practices through Farmer-to-Farmer training, training techniques are also taught.

Conservation Leaders conduct SWC practices on their most visible and accessible fields. Basic physical SWC practices are executed first, in order to comply with the most fundamental (physical) conditions for sustainable farming (i.e. more infiltration and less run-off). Moreover, nutrient management techniques are taught and Conservation Leaders are stimulated to experiment with, for example, green manure, composting, better crop rotations, new varieties and efficient manure use.

Since Conservation Leaders are crucial persons in the logical strategy, they receive special support from the coordinating unit to conduct experiments and establish themselves as a prestigious group in the village. All support is based on the principle of cost-sharing, i.e. Conservation Leaders always pay a significant proportion of the costs of non-local materials.

Working with interest groups

With the objective of involving as many villagers as possible in practical activities, and to enhance village collaboration, villagers are stimulated from the start to organize themselves in interest groups. The women's group (Photo 33) is the most obvious group to start with, given that generally women already have regular meetings with health organizations. Assertiveness training for women – which according to Cornwall (2003) is often under-emphasized – receives major attention. Workshops to establish the women group formally are followed by the execution of practical activities, like skill-training workshops (e.g. weaving and painting, Photo 34-35) and vegetable gardening (Photo 36-37). Similar skill-training is generally the motivation for other villagers (mainly youngsters) to organize themselves in interest groups and learn the basics of sewing, carpentry (Photo 38), masonry, etc.

These group trainings are very important; villagers organize themselves and get actively involved in activities, a start is made with income diversification (responding to some priority needs in a village); and meetings with the groups are an opportunity to discuss topics related to SWC and village organization. Investments in these activities are minimal, and each organized group pays part of the costs of non-local materials and for contracting the trainer. For the later scaling-up of these skill-training workshops the best participants are used for Farmer-to-Farmer training in their village and neighbouring villages, reducing even more the costs.

Working with teachers & scholars

Teachers at local schools are trained in environmental education and on how to integrate natural resources topics transversally in the curriculum of each grade. Moreover, practical activities are organized to stimulate pupils to work in a sustainable way with the natural resources surrounding them. More awareness among children has often proved to produce remarkable attitude changes in parents, especially when the latter participate in activities like tree-planting, vegetable gardening and the evaluation of children's drawings.

All these activities contribute to the gradual generation of a progress-driven attitude in a village, and, thus, to the laying of a solid foundation for future development activities that require higher financial investments. The evaluation of the satisfactorily compliance with the five conditions (Table 5.1) is conducted with subjective criteria, and reveals whether a village is prepared to continue with the second phase (see Chapter 6). Within less than two years of starting activities, a solid foundation for sustainable development should have been laid. If this is not the case, the continuation of activities should be reconsidered.

Phase 2: Planning and sustainable execution; emphasizing SWC

During this phase, an ever-growing number of farmers will participate in the activities, and the foundation for sustainable development will become more solid. For the first 2-3 years, the extension worker is still actively involved in planning all activities, and in coordinating their implementation with local institutions. Higher investments are required in this phase, especially for basic infrastructure. The presence of a conscious and holistic-thinking municipality is crucial; in Bolivia they are responsible for coordinating investments in rural

development. Gradually, villagers will become more self-reliant and will be able to arrange institutional support (and investments) by themselves.

In this phase, major emphasis is given to SWC activities. The relation between adequate natural resources management and other development activities is constantly stressed. Integrating SWC within such a holistic framework of rural development activities is crucial for achieving sustainability during execution. The four major activities in this phase are executed in a mostly chronological sequence.

Planning village development

Adequate participatory planning at village level necessarily precedes the execution of development activities. In LFAs this is often a difficult task, because (long-term) planning is not compatible with farmers' short-term survival strategies. However, with farmers with a progress-driven attitude, participatory planning is possible; such farmers are motivated to improve. This activity is conducted by a multidisciplinary team of three rural planners (including the extension worker) during a period of three weeks intensive fieldwork, followed by a series of village meetings (Photo 39). The first step aims at achieving consensus about the desired future situation: the long-term Village Master Plan. It has a time horizon of ten years and, therefore, it is often called "the village's dream". Being an important conscientization tool, it gives villagers insight into their future opportunities. Its main input is the team's analysis concerning environmental problems in the village and underlying (socio-economic) causes, trends and opportunities.

The next logical step is to make people aware about their own role in fulfilling this dream. In three workshops the Village Development Plan is formulated. In this plan, with a tangible time-horizon of three years, key activities for village development are identified, including basic needs and alternatives for income diversification. By means of assigning responsibilities, people become aware of their own role in village development. This notion means a tremendous change. Suddenly the village has a direction and common future objectives; the need for collaboration becomes tangible. With the Conservation Leaders as promoters of SWC, activities related to natural resources management will obviously be included in the Village Development Plan.

Executing SWC practices

Before actually executing SWC practices, farmers must be trained. A useful training-tool is the SWC contest between organized groups of five to eight families, directed by Conservation Leaders (Photo 40) (for more details see Chapter 7). Various SWC contests are organized, each one dealing with two slope-conditioning SWC practices (stone lines, gully control, diversion ditches, terracing, etc.). The first SWC contest is crucial, and is an important indicator of those families interested in SWC. Although other families can still start participating in later contests, subsequent activities in this second phase are mainly executed with the initially interested families.

Practices are firstly conducted on the most visible and easily accessible fields, with the objective to achieve a short-term impact on the profitability of agriculture. Slope-conditioning SWC practices are therefore combined with other (agronomical) soil management practices. The execution of practices during the contest is done by means of

group-work, based on the ancient form of reciprocal work that Andean farmers used to employ. On completion of the SWC contest, usually after one month, quantity and quality of SWC practices are evaluated, as well as farmers' knowledge and demonstrated teamwork. In the final closing session, the results of all groups are discussed and recommendations are given. The winning group is honoured by the community, and given a small prize (e.g. twenty kilos of improved potatoes). As an acknowledgement of their effort, all the other groups are also given a small reward, such as seeds for green manure crops and vegetables. The SWC contest is a low-budget training tool, in which Farmer-to-Farmer training and the healthy spirit of competition are the most important elements.

Integrated farm household planning

With the participating families in the SWC contest, plans for profitable and sustainable farm households are made, with optimal use of available natural and human resources. Again, most activities and practices are planned on the fields situated nearby the family's homestead. The device is "more yield from less soil", i.e. improving fields where investments are easiest and most logical. This approach helps farmers understand the importance of efficient resources use. Consequently, it often leads to the (temporary) abandoning of less productive fields, where efforts and investments are less effective. Managing cropland fields at various altitudes, typical for many Andean farming systems, should however be maintained.

Integrated farm household planning is conducted under the guidance of the extension worker or other technical personnel with experience in participatory planning. A family visit takes about half a day's work and includes an analysis of the household's current situation. Based on the family's interest and capabilities, and taking into account the Village Development Plan, possible alternatives for improving the household's profitability are discussed and a final set of activities is formulated: the Integrated Household Plan (Table 5.2). The amount of activities considered in one plan depends on the family, and it can be extended later on.

All visible activities of this plan (such as SWC practices) are drawn on a map that visualizes the desired future situation (Photo 41). With this drawing hanging on the wall, the family is constantly reminded of activities to be executed. After systematizing all household plans, the extension worker makes a work-plan for all the activities that require collaboration and group work. Priority is generally given to the activities that are in greatest demand.

Table 5.2

Example of an Integrated Household Plan for the Bolivian mountain valleys

- Small vegetable gardens and orchards at family level
- Small water-reservoirs for irrigation and for animals
- Improved livestock housing made of local materials
- Introduction of small animals (chickens, ducks, pigs, etc.)
- Small family silos for conservation of post-harvest products
- Introduction of improved stoves (for saving fuel wood)
- Training in skills (e.g. carpentry, weaving, sewing, etc.)
- Training in SWC and improved soil fertility management
- Afforestation with commercial trees like pines and eucalyptus

Sustainable execution of development activities

For each development activity, all interested families work out an Integrated Project (IP), in which objectives, activities, obligations, financial contributions, sanctions, etc. are described. The extension worker ensures that the IP is truly integrated (Table 5.3) and that due attention is paid to *(1) preceding activities* (i.e. feasibility studies, conflict solution), *(2) sustainability-guaranteeing activities* (i.e. training, internal regulations) and *(3) natural resources management* (SWC, reforestation, etc.). Thanks to previous conscientization of villagers, the inclusion of these complementary activities will not be seen as "a condition" imposed by the extension worker, but rather "a necessity" to achieve sustainable results. By signing the IP, all participating families agree to comply.

Two kinds of IPs are distinguished. The first includes projects for infrastructural works requiring higher investments and professional supervision. In this case an external executer is contracted and the financial contribution of each participating family is fixed at a maximum amount. Execution is mainly done by means of reciprocal group work, like the traditional *ayni* (exchange of labour days) and *mink'a* (a meal in exchange for a labour day). The second kind of IP requires mainly practical training, e.g. in carpentry, reforestation (Photo 42), vegetable gardening, construction of silos, etc. In this case, the group elects one or more village-trainers. They receive intensive training in all the technical aspects, and provide Farmer-to-Farmer training to the other group members. All beneficiaries pay 10-20% of the costs of non-local materials. Village-trainers receive a financial discount, as well as a set of utensils for giving workshops (e.g. notebooks, pencils, a village trainer cap and T-shirt, etc.). This modality guarantees a sustainable execution, since village trainers are generally responsible persons and capable of giving follow-up and assistance whenever needed.

Compliance is essential during the whole process of execution. The executing agency and possible consultants must comply with the time-schedule and their promises, since non-fulfilled commitments with communities can lead to loss of credibility (Lopez Ornat, 1997). Also the group itself must comply with the obligations described in the IP. This sign of responsibility is crucial for the eventual feeling of ownership of all families towards the executed activities. Lack of compliance must always be sanctioned, even if this implies that execution of the IP must be (temporarily) stopped.

Table 5.3

Examples of Integrated Projects for the Bolivian mountain valleys

- Construction of small drinking water and irrigation systems, combined with watershed protection, family vegetable gardens, training in maintenance, etc.;
- Construction of a local access road, combined with erosion protection works and afforestation;
- Training in carpentry combined with afforestation and native forest protection;
- Training in weaving combined with small communal vegetable gardens and the construction of a women's workplace;
- Improvement of school infrastructure, combined with an ecological park, a school vegetable garden, training for teachers in environmental education, etc.

5.5 Experiences and discussion

The logical strategy was developed and validated during four years in five villages of the JGRC project. In two villages the strategy was unsuccessful. In the other three villages a solid foundation for sustainable development was laid within two years, and in two of these villages many IPs were executed in the following years. Nowadays, two years after the project's closure and despite limited institutional support, these villages are still actively involved in SWC and other development activities. Not only the people's life, but also the landscape in these two villages has changed (Photos 43-44); SWC practices and afforestation are widespread, and grazing is controlled by internal regulations. Two experiences are presented hereafter.

Experience 1: Tomoroco

Tomoroco is a relatively remote village with severely degraded lands. It received aid from several development organizations, however without success. Upon entrance of the project, Tomoroco was a disjointed village: the village board malfunctioned, communal works were not executed and many people migrated. Given scepticism and suspicion towards the project, the first months were extremely difficult. Regular visits, compliance and dedication by the extension worker, as well as intensive contacts with village leaders favourably changed this situation. When Conservation Leaders were chosen in the village board, and after the first round of workshops, the village started to move: participation increased, the women group had weekly meetings, a tree nursery was established, etc. After two years, according to the evaluation criteria, a solid foundation for sustainable development had been laid. Based on the Village Development Plan, many IPs were formulated and implemented. Nowadays, the village has changed and the people are different: board members are now chosen for their leading ability and knowledge; several interest groups manage new small-scale irrigation systems (Box 1); others execute skills like carpentry and sewing; tree nurseries generate income for many families; and some of the most able skill workers provide Farmer-to-Farmer training in neighbouring villages. Of all families, 80% have implemented SWC practices on their most important fields and vegetables are now sold on the local market. Given these new opportunities, migration has reduced. Although agriculture is

Box 1

Based on the positive results of a feasibility study, a group of eight neighbouring families – whom all had participated in the SWC contest – formulated an IP for a small drinking water and irrigation system. Included was the signature of the owner of the well, concerning the communal use of 'his' water, as well as the appointment of a group-leader in charge of the management and maintenance of the future scheme. Once each family had paid their fixed financial contribution of 20 US$, work started by planting 8,000 native trees around the well. Next, under the guidance of a technical engineer, the group constructed a water-tank on a central place, and laid the pipelines to their houses. All work was conducted in *ayni* and according to the internal regulations of the IP. Nowadays these families have water for domestic use and for irrigating small (300 m^2) vegetable gardens managed by trained women. They pay a monthly impost for maintenance and for the salary of the group-leader.

still a subsistence activity, the renewed communal spirit and willingness of people to undertake activities, gives realistic hope for continued sustainable development in Tomoroco.

Experience 2: Sirichaca

Sirichaca is a village where in the past 20 years about 40 institutions have executed activities. Thanks to its proximity to Sucre, cash crops and other commercial activities have always been important. However, due to land degradation, yields have declined and the seasonal migration rate has increased to about 70% of the male villagers. Upon entrance of the project, Sirichaca was a totally unorganized village, with members of the village board living most of the year elsewhere. After two years of intensive work with Conservation Leaders, with the women group and in establishing a tree nursery, results were very disappointing. The absence of village leaders during large periods of the year was fatal, and a progress-driven attitude was never generated. Nevertheless, the project started with Phase 2 and conducted activities such as the improvement of drinking-water wells, skill workshops and the SWC contest. Although many families participated in the SWC contest, afterwards the executed practices were not maintained and – in some cases – even removed. Most interest groups disintegrated as soon as the training ended, and the improvement of the drinking-water wells failed due to lack of agreement on how to collaborate (Box 2). Also, migration did not diminish, as it is still the best income generating alternative in Sirichaca. After three years, the project withdrew from the village. During the final evaluation, the villagers blamed themselves for not being sufficiently interested in the development of their village.

Box 2

Due to severe drinking-water shortage in Sirichaca, a group of ten neighbouring families formulated an IP for the improvement of their communal water-well. Included as a first step, was the fencing of an area around the well to avoid contamination of the water by animals. To enhance water infiltration, the families also agreed to plant native trees in this area and conduct SWC practices on their adjacent agricultural fields. Due to migration and other important activities, the group decided to work individually; each family was responsible for a specific (part of the) work. After a year, these works were only partially concluded and the obligations were not complied with. After some internal disputes, the group disintegrated and the main work, the improvement of the well itself, never started.

The Tomoroco experience shows the promising potential of the logical strategy to change non-motivated and mostly passive farmers into active participators in village development. The Sirichaca experience, however, shows that the strategy does not always work, and that, when certain requirements are not met, the strategy's impact is limited. The main requirements that must be taken into account for successfully implementing the logical strategy are the following:

1. The presence of a basic development potential in a village, i.e. interested leaders, agricultural development possibilities, and not too high migration rates.
2. Outstanding and dedicated extension workers, i.e. experts in coordinating fieldwork, in communicating with farmers, and in natural resources management training.

3. Permanent available support from several experts (in e.g. gender, participatory research and rural development) and logistic personnel.
4. Willingness of the development agency to invest two years in laying a solid foundation for sustainable development, often without obtaining short-term clearly visible results.
5. Total transparency in money-related aspects, e.g. in the case of Conservation Leaders (why they are favoured) and Integrated Plans (why financial contributions are required).
6. Adequate coordination with other institutions and development agencies. Due to not using incentives and the careful building-up of genuine participation, achievements of the logical strategy are rapidly undermined by activities executed with different approaches.

Some small-scale successes in SWC have been previously obtained in Bolivia. The logical strategy however aims at the widespread execution of SWC practices, which is one of the major challenges in severely degraded LFAs. The above requirements show the importance of developing a harmonized development policy in Bolivia, as well as the need for support from national and local institutions, to implement such a strategy. Recent research on farmers' strategies in the Bolivian mountain valleys comes to similar recommendations for the planning and implementation of development interventions (Zoomers, 1998). It emphasizes that the failure of development initiatives is often due to discrepancies between farmers' and development agencies' strategies. The logical strategy is complementary to the latter work in that it provides a logical sequence of practical activities adjusted to farmers' perspectives and needs. In these activities, theoretical concepts and ideas are combined with the complex reality of rural livelihoods. Most important: the activities constantly emphasize that investing time in farmer motivation, and achieving their genuine participation will pay out in more sustainable results. This issue, which is not mentioned by Zoomers (1998) and neglected by most development agencies, is one of the major contributions of the logical strategy to the current debate on development strategies. Hence, not only at village- and household level an attitude change is required, but also – and maybe foremost – at institutional- and political level. Although too early to deliver concrete evidence of sustainable impact, results so far show that the logical strategy has the potential to bring about such changes.

5.6 Conclusions

A new Green Revolution, as proclaimed by the UN Millennium Project (2005), will only be possible when accompanied by adequate practical strategies. The logical strategy is a promising example of such a strategy. Although validated in only few villages, the overall results show that alternatives are available for more successful interventions, and for widespread SWC activities in LFAs.

Two strategic choices have been crucial. First: to invest time in laying a solid foundation for sustainable development. Only when counting with the genuine participation of villagers, the participation pitfalls described by Eversole (2003) can be avoided. Especially

in a highly unfavourable setting like the Bolivian mountain valleys, development projects that do not pay sufficient attention to this human dimension will fail. Second: to embed SWC activities in a holistic framework of rural development, which is not multi-sectorial but truly integrated (Burkey, 1993). Once SWC activities are interwoven with other development activities, they will become a daily household practice; especially when farmer trainers are involved.

What comes next? More and above all larger-scale experiences are needed. Given its practical approach and initial low-budget activities (Phase 1), the logical strategy is easily adoptable by other development agencies. However, scaling-up and the allotment of larger budgets for development activities (Phase 2) can only be achieved within a favourable enabling context at institutional level. Hence, unfavourable rural development policies must be dismantled and replaced by harmonized institutional collaboration. The logical strategy and valuable lessons from several other Bolivian NGOs working with participatory SWC programmes should be merged in a national SWC policy. Given that such community driven development programs must be accompanied by democratic decentralization (Ruben and Pender, 2004), Bolivian municipalities should have a prominent role. They have a budget for local rural development and can actively participate in a SWC programme by contracting extension workers and by financing several low-budget activities described in the logical strategy. Moreover, universities should be involved to train these extension workers. Notably universities in Cochabamba and Sucre have proven to be interested and able to perform this task.

In Bolivia however, creating such a favourable enabling context at institutional level primarily depends on the political willingness to collaborate and “finance a process rather than a clearly defined project” (Burkey, 1993). In anticipation of this change, and given that the logical strategy’s lessons and concepts are applicable in many LFAs in comparable contexts, development programmes in other countries are challenged to generate similar experiences.

Follow-up to Chapters 6 and 7

In the following chapters I will analyse and give details of two of the most important aspects of the logical strategy for SWC: 1) laying a solid foundation for sustainable development; and 2) using SWC contests for extension and execution of SWC practices. These two aspects go hand in hand, and together they exemplify the followed approach for the challenge of achieving sustainable impact with SWC in the inter-Andean valleys of Bolivia.

Photo 31: Extension worker with a group of farmers

Photo 32: Conservation Leader giving training in Kaynakas

Photo 33: Meeting of the women group

Photos 34-35: Skill training for the women group

Photo 36: Women working in the vegetable garden of Kaynakas

Photo 37: Vegetable garden in Tomoroco

Photo 38: Carpentry workshop in Tomoroco

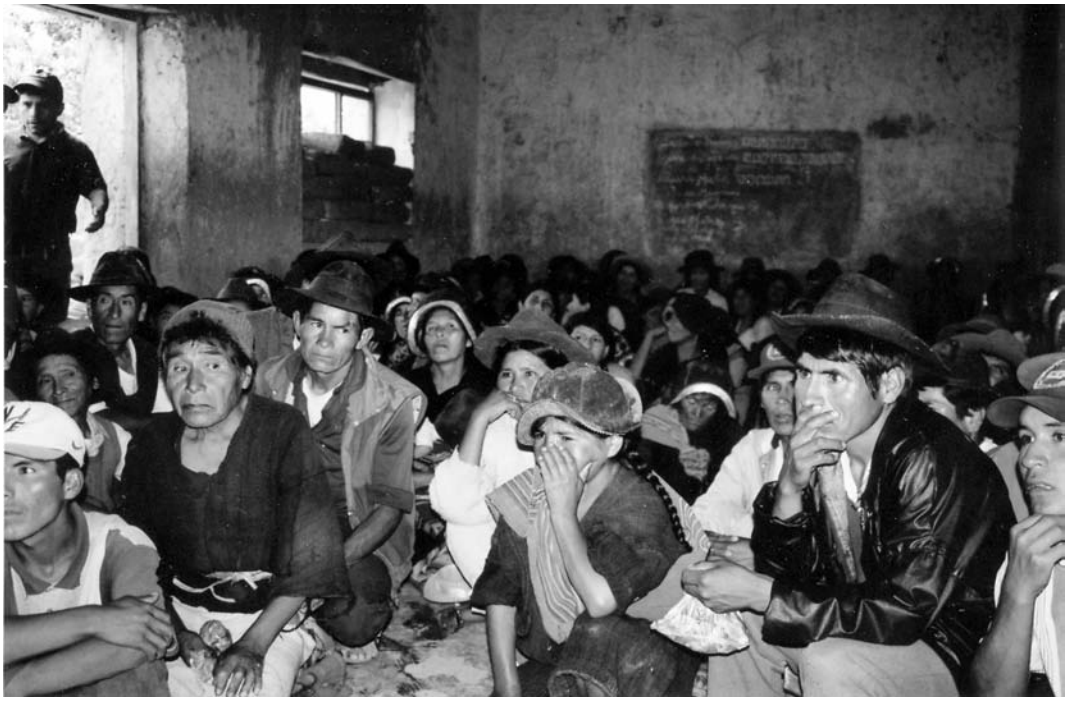

Photo 39: Village meeting in Tomoroco

Photo 40: SWC Contest in Patallajta

Photo 41: Farmer showing her Integrated Household Plan

Photo 42: Afforestation with pine trees in Kaynakas

Photo 43: Example of the integrated approach, with drinking water, irrigation, a compost stack, and a small vegetable garden

Photo 44: Fields with SWC practices in Kaynakas

Chapter 6

Laying a solid foundation for sustainable development in Bolivian mountain villages

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Environment, Development and Sustainability (In Press, on-line available)
DOI: 10.1007/s10668-006-9062-3

**"Never an institution has motivated us to talk like this,
we and our ancestors we've always been shy and
frightened to talk.
Maybe because of that our village is backward and poor:
nobody takes us into account"**

(Villager from Patallajta)

6. Laying a solid foundation for sustainable development in Bolivian mountain villages

Abstract

In Bolivia, recent decentralization policies have broadened the participation of local actors in development processes. However, development is far from sustainable, and poverty and natural resources degradation still increase. The challenge is to develop strategies that achieve the genuine participation of poor farmers in natural resources management and sustainable development. The logical strategy, which was developed and validated in five Bolivian mountain villages, is an example. In this strategy, first a solid foundation for sustainable development is laid, with activities focussing on five basic conditions for sustainable development in rural villages: leadership and organization, responsible participation, effective collaboration, mutual trust and environmental awareness. The results show that the existence of a solid foundation is crucial for the success of other development activities, such as soil and water conservation activities. However, given that two years after the project's withdrawal the firmness of the foundation had slightly weakened, it was concluded that a better integration of these villages in local development processes is essential to profit from the new dynamics. This is especially true for soil and water conservation. To achieve this integration, municipalities – with the support of international development agencies – must be encouraged to invest in laying this solid foundation in rural villages and in facilitating follow-up activities to keep the dynamic process going. This study shows that such investments result in better organized villages, more equality, and the genuine participation of more people in sustainable village development. Effective collaboration and accountability at institutional level are, however, required.

Keywords: Sustainable development; Soil and water conservation; Popular participation; Equality; Intervention strategies; Bolivian mountain villages.

6.1 Introduction

Without exception, reports about sustainable development in Bolivia are negative. Critiques that sustainable development approaches "have done little to eradicate poverty and nothing to resolve the degradation of the environment" (Hove, 2004), are well applicable to Bolivia. Despite more policy debate inside the government concerning poverty reduction, and notwithstanding significant changes in the dynamics of rural life (Zoomers, 2002), the situation of the rural poor has not improved. Recent economic growth has only benefited the wealthiest sector, while poverty and natural resources degradation have increased. As a consequence, it is improbable that Bolivia will comply with the first Millennium Development Goal, that aims at reducing extreme poverty and hunger by half in 2015 (ECLAC, 2005).

In Latin America, poverty goes hand in hand with inequality (SNV, 2005). The real lack of sustainability rests in inequality: i.e. in the concentration of power and wealth in the hands of a few (Fernando, 2003). This inequality strongly limits an active role of the people in sustainable development, and leads to more poverty and environmental degradation

(Roseland, 2000). Particularly the rural poor are excluded. Hence, a "stronger commitment to equity and social justice" is needed (Fernando, 2003). This implies that sustainable development must provide an empowering framework for community participation (Dubois et al., 2003). Sustainable development is too static, action is required (Keiner, 2004; Hove, 2004). Policies must go beyond the generalities of their laws, and must try putting the concept of sustainable development into practice (Cordero et al., 2005). Although turning this fairly abstract concept into practice requires a considerable amount of effort (Murdoch, 1993), it is a challenge that all developing countries like Bolivia must face.

Although Agenda 21 already in 1992 emphasized the importance of implementing National Sustainable Development Strategies (UN, 1992), in Bolivia, sustainable development is not yet being assumed as a state project (MDSP, 2001). It is still considered a governmental policy, rather then a state policy. As a consequence, objectives and policies change whenever the government changes; there is no continuity (NOVIB, 2000). Moreover, development policies are notably segmented in Bolivia; various ministries have specific objectives and there is no integrated policy (Urioste, 2002). Similarly to other Latin America countries, environmental policies have primarily focussed on the promulgation of laws (Cordero et al., 2005) and the formulation of norms (for e.g. biodiversity, water resources and land reform). Where integrated state policies are lacking, donors continue to respond to rural development needs with individual projects. These rural development and poverty alleviation programmes rarely address the multi-dimensional problems faced by rural areas (Dubois et al., 2003). They are, therefore, often not even perceptible to the rural poor (Zoomers, 1999).

Despite this lack of adequate strategies and tangible results in reducing poverty, Bolivia's decentralization policy has meant a great step forward in enabling sustainable development at the local level. The Law of Popular Participation (LPP) has broadened the participation of local actors. Decision-making power and funds have been transferred to local governments, while grass-root organizations and traditional authorities are now officially recognized (Bojanic, 2001). Although the LPP has failed to respond to production related problems of the population (Nijenhuis, 2002), there is now more room for bottom-up approaches and the involvement of NGOs and international donors in the development debate (Zoomers, 2002). The local level has developed its own dynamics, and receives considerable support from international development agencies (Nijenhuis, 2002). Within this ongoing process of local development, possible strategies of strengthening the sustainability of the process through genuine peoples' participation need to be examined.

This chapter concerns such a possible strategy. It deals with the challenge of involving poor farmers in natural resources management and sustainable development. It focuses on the Bolivian mountain valleys, where the Japan Green Resources Corporation (JGRC) project developed and validated a strategy to motivate farmers for soil and water conservation (SWC). Many aspects of this strategy are similar to e.g. Participatory Action Research, which is also people-centred and responsive to the needs and opinions of local people (Babbie and Mouton, 2001). The objective of this chapter is to examine the results of the first phase of the JGRC project's strategy. In this first phase, activities focus on laying a solid foundation for sustainable development in rural villages; i.e. on building and strengthening peoples' capacities to establish sustainable livelihoods.

6.2 Context and background

The JGRC project was conducted in the north-Chuquisaca region of the inter-Andean valleys in Bolivia (Figure 1.1). This semi-arid rural region, with altitudes between 2,500 and 3,200 meters above sea level, suffers from severe land degradation, poverty, migration and a constant struggle for survival. Chuquisaca is one of the least developed departments in Bolivia, with the second lowest Human Development Index in Bolivia, equalling only 0.49 (UNDP, 1997).

Due to the absence of an extension service and the failure of rural development attempts, farmers have lost hope of a better future. Nowadays, in most mountain villages in Bolivia, a generalized passivism can be observed (Chapter 2). In fact, there are currently no conditions for sustainable development in this region. Villages have disintegrated and they are left without leadership, and many farmers migrate in search of income generating opportunities elsewhere. Strong village organization and collaboration are hard to find. Moreover, the continuing use of all kind of incentive programmes that "made farmers participate", have generated a general distrust among the people regarding development projects' abilities to change rural living conditions.

When the JGRC project started in 1999 with the challenge of motivating farmers for SWC, it was confronted with the same constraints. SWC is not a priority; only the most progressive and dynamic farmers are interested (Chapter 4). Conducting SWC practices under these conditions makes no sense. First, a village and its people must be prepared for future actions, and farmers must be motivated to participate genuinely in development activities. This genuine participation, which is generally preceded by a process of conscientization and intrinsic motivation, is crucial. Bearing this in mind, the JGRC project developed the logical strategy for SWC (Chapter 5). This practical strategy consists of two phases: (1) laying a solid foundation for sustainable development and (2) executing SWC practices and other development activities that require financial investments and the active genuine participation of the majority of the villagers. This chapter investigates the hypothesis that executing SWC practices (and other development activities) is more successful in villages where a solid foundation for sustainable development is present.

The logical strategy was developed and tried out in three "experimental" villages of the JGRC project, from 2000 till the end of 2003. Validation of the logical strategy took place in two "validation" villages during the years 2002 and 2003. In four villages, an ex-post evaluation was held in 2005 (two years after the project's withdrawal). In section 6.6, results and actual impact of laying a solid foundation for sustainable development are discussed.

6.3 Basic conditions for sustainable development in Bolivian mountain villages

The bricks of a solid foundation for sustainable development are the people; self-reliant people with a progress-driven attitude (Chapter 5), based on equality. Only when this is accomplished, genuine participation in village development can be expected. Therefore, during the first phase of the logical strategy, the JGRC project focussed on generating such a

progress-driven attitude among the villagers; i.e. on changing passive farmers in dynamic farmers with better future prospects. For this purpose, five basic conditions for sustainable development in Bolivian mountain villages were formulated. In this section these conditions are described.

Organization and leadership
The village board, which is elected every year, is the leading and representative organization of a Bolivian rural village. A well organized village board, with active village leaders, is a basic condition for sustainable village development. However, these boards often consist of persons who consider their membership a kind of punishment. Village boards often lack leadership and vision, and their decisions are not complied with. Raising awareness regarding the role of the village board, and concerning the necessity of good leadership, is thus essential. When the village board is accountable and transparent, people will also feel more responsible for village development and for participating in decision-making. The final goal is the establishment of a respected village board, with responsible and progress-driven leaders, supported by an active assembly.

Responsible participation
Village meetings and workshops are events where people can actively participate in development decisions. However, they are generally not regarded very beneficial; they always start later than planned, and most people attend passively while only the most influential villagers talk. In order to avoid paying a penalty, families often send one of their children to these meetings as their representative. In this situation, only most influential villagers decide and the rest is not even consulted. Inequality is generally the cause; especially women are rarely heard. Stimulating the active and responsible participation of all villagers in village development is, therefore, essential.

Effective collaboration
According to Freire (1972), people must become aware regarding their ability to transform their reality by conscious collective action. Hence, collaboration is of utmost importance; working together for sustainable village development. However, in the rural area of Bolivia, the old tradition of reciprocal group work has almost been lost. Individualism and achievement of personal goals (money) have unfortunately become more important, although at the same time social networks have been kept intact. Effective collaboration among villagers, and principally re-establishing group work, is essential for sustainable local development. This means that all villagers respect the communal decisions, and that different groups within the village are officially recognized. A spirit of “let-us-do-it-together” should be created.

Mutual trust
Investments are desperately needed in rural Bolivia. In the past, most of the investments of development programmes have not achieved the expected results. As a consequence, development institutions are often no longer trusted, and collaboration with rural villages is very difficult. The establishment of a healthy relationship of mutual trust is, therefore, a basic

condition for executing sustainable development activities. This is especially important for the extension worker, and expressed in the behaviour of people towards him or her. Sincerity and transparency must be essential aspects of the extension workers' character.

Environmental awareness
Although the majority of the rural poor have a broad range of different income sources, and no longer invest in agriculture (Tacoli, 1998), land generally remains a family's most valuable property. Due to the absence of an extension service in Bolivia, natural resources management has not changed much over the years; farmers execute some traditional SWC practices, but their impact is insufficient to reverse land degradation (Chapter 3). Although most farmers are aware of declining soil productivity and vegetation loss, causes are generally not correctly identified. Awareness and basic knowledge regarding the importance of natural resources, together with the willingness to conserve them, are therefore essential for sustainable development.

6.4 Monitoring and evaluation of the foundation's firmness

Given that sustainable development is a gradual process, the *complete and continued* fulfilment of the aforementioned basic conditions takes a long time. Projects usually do not have this time. The JGRC project, therefore, did not aim at total compliance, but at the *satisfactorily* fulfilment of each basic condition within an acceptable time limit of two years. The project assumed that once this was achieved, the foundation for sustainable development in a village was solid enough to start the second phase of the logical strategy. The challenge was how to measure satisfactory fulfilment for each basic condition. Only when this is correctly measured, an adequate go/no-go decision can be taken regarding the start of the second phase.

Due to both the heterogeneity of the villages, and the difficulty of defining quantitative measuring criteria, the project team decided to use only subjective criteria for monitoring and evaluating the foundation's firmness. For each basic condition, the four most important qualitative criteria were selected: the 20 evaluation criteria of the foundation's firmness (Table 6.1). The village's level of compliance with these criteria was evaluated on a four-scale ranking:

- No compliance;
- Initial compliance;
- Satisfactory compliance;
- Good or total compliance.

In each study village, one extension worker of the JGRC project was responsible for all activities. Given that the extension worker is most involved in the village, he/she conducted the monitoring of all evaluation criteria. Due to the absence of quantitative indicators, all extension workers first harmonized their interpretation of the evaluation criteria in a central meeting, and then started monitoring the village's progress. This was done by means of regular evaluations, in order to obtain a sequence of progress reports from a village. These

showed exactly where progress was made, and which aspects required more emphasis. An example is given in Box 1.

Table 6.1
Evaluation criteria of the foundation's firmness

Condition	Evaluation criteria
Organization and leadership	A village board with responsible persons who know and comply with their duties
	Decisions taken by the village board (concerning e.g. communal works) are complied with
	Village board members who do not comply with the requirements of their role are substituted
	Village board members are elected for their leading capacity (and not as a punishment)
Responsible participation	Village meetings are held each month on fixed dates (*)
	Only village members and adult family representatives participate in village meetings (*)
	Village meetings and workshops start at the fixed hour with the required quorum
	There is an active and respected participation of all villagers (including women)
Effective collaboration	There are trained Conservation Leaders, willing to train other farmers (*)
	There exists a women-group whose members actively participate in village development
	The village actively tries to solve communal problems, e.g. regarding water use
	There is a good level of collaboration for executing communal works and group work
Mutual trust	The majority of the villagers participate in the meetings and workshops of the project (*)
	There is a friendly behaviour towards the project staff, e.g. sharing food and coca-leafs (*)
	The project is considered important and given priority during village meetings
	The villagers share confidential information with the extension worker
Environmental awareness	There are favourable opinions regarding natural resources conservation (*)
	The majority of the villagers has basic knowledge of natural resources (*)
	There is willingness to implement regulations for natural resources management
	Scholars are aware of the importance of natural resources conservation in their village

(*) For these evaluation criteria "total compliance" within two years is highly recommended

The aim of this monitoring and evaluation system was to achieve the satisfactory compliance of all 20 criteria. Once this was achieved, it was justified to start the second phase of the logical strategy. An ex-post evaluation of all criteria was conducted two years after the project's withdrawal.

Box 1

The first evaluation criterion for the basic condition "Organization and Leadership" tells that a village board must consist of responsible persons who know and comply with their duties. In Tomoroco, at the start of the project, being elected in the village board was considered a kind of punishment. The village board members were not interested, and they did not know their official duties. One year later, the village had achieved initial compliance in this criterion: the village board members knew their duties and were more enthusiastic. However, the biggest change came in the second year, when responsible and active villagers were chosen in the village board. This was a satisfactory result for the project. Total compliance with this criterion was achieved one year later, after two others with a progress-driven attitude replaced two malfunctioning members. The village board now completely consisted of responsible persons, who all complied with their duties. In the ex-post evaluation, it was observed that Tomoroco had maintained the total compliance with this criterion.

6.5 Working towards a solid foundation for sustainable development

In the JGRC project, activities were mainly conducted by means of group work. Group work is crucial in rural development, because it can make rural communities more dynamic, and it increases rural people's self-reliance (Mosher, 1969). Such self-reliant farmer-groups, where people have responsibility, feel ownership and are committed, are likely to contribute to sustained change (Hinchcliff et al., 1999). In each group member it awakens a better understanding of themselves and of the realities of their situation (Burkey, 1993).

Group work is traditionally a very important means of execution of all kind of collective work in this region, and reciprocal group work has widely been used in agriculture and other labour demanding activities at household level. Although, unfortunately, during the last decades this tradition has been largely lost, there still exists a potential for executing group work. The activities for laying a solid foundation for sustainable development are based on this tradition. They specifically focus on five groups: the village leaders, the assembly, the Conservation Leaders, interest groups and teachers & scholars. In this section, the activities for each basic condition are shortly explained.

Organization and leadership

Good leadership is crucial in rural villages. Therefore, during the first few months, the extension worker works intensively with a group of all official and potential village leaders; men and women alike. Exchange visits are very important to motivate this group; well-led villages are visited, where a solid organization and a good functioning village board already exist. Afterwards, in several participatory workshops, the village leaders analyse organizational constraints in their own village, and try to come with solutions. Moreover, functions of each member of the village board are discussed and – if necessary – re-formulated. Organization, leadership and the functions of the village board are also discussed in the village's assembly. In these workshops, the direct objective is to stress the assembly's role in demanding compliance and accountability of the village board.

Responsible participation

During all meetings and workshops, responsible participation is constantly stressed. This requires that also the extension worker shows responsibility, and always complies with scheduled meetings and promises. Moreover, the village board is encouraged to plan the assembly on fixed dates, and to start village meetings and workshops at the fixed hour. Likewise, during meetings of the group of Conservation Leaders and other interest groups, high importance is given to compliance. All these groups manage internal regulations that define e.g. obligations and sanctions for incompliance. Active participation in meetings of the assembly is stimulated by using techniques like group discussions, and by giving assertiveness training to certain interest groups (e.g. women).

Effective collaboration

Group work always aims at achieving set objectives through collaboration. Conservation Leaders (CLs) and the women group are the most important. CLs have to become a permanent source of knowledge regarding natural resources management, and must be able to collaborate with other farmers to transfer this knowledge. Experiences in Latin America show that this farmer-to-farmer training is an excellent tool for technology transfer (Hocdé et al., 2000), and for creating sustainable agriculture (Holt-Giménez, 2001). Establishing a cohesive women group is also essential, because women's influence and responsibilities are becoming increasingly important due to migration of the male population. Skill-training workshops, such as sewing or weaving, stimulate active and effective collaboration within this group. Other groups are also stimulated to collaborate, e.g. in tree-nursing or carpentry for young men. Once trained, these men can obtain better paid jobs in nearby villages or with local agencies, and the duration of migration can be reduced. Moreover, most talented craftsmen can become farmer-to-farmer trainers themselves, and collaborate as such to village development. Finally, collaboration at village level is stimulated by improving collective decision-making during the meetings of the assembly, and by means of executing a communal activity.

Mutual trust

As from the first visit to a village, the extension worker consciously works towards establishing and maintaining a relation of mutual trust with the villagers. There are no specific activities to achieve the fulfilment of this condition; regular visits to influential villagers, and investing time in social relations, are most important. The extension worker may never fail, and must comply under all circumstances; breaking a promise or showing an inadequate attitude towards the villagers might undermine mutual trust. This requires tact, being firm of principle, and having a self-sacrificing attitude. Likewise, transparency regarding the project's objectives and approach is essential; confusion on this point will cause misunderstandings, and can lead to disillusions among the villagers. However, all workshops and family visits provide excellent opportunities for enhancing this relation of mutual trust.

Environmental awareness

Raising basic awareness, regarding the importance of natural resources and related aspects, is a transversal theme in all group work. The workshops with Conservation Leaders are most in-

depth; they focus on physical SWC practices (e.g. stone lines, diversion ditches and bench terraces) and agronomical SWC practices (e.g. more efficient manure use, composting and green manure). Thanks to intensive training, the CLs are generally first in showing an attitude change. They will generally catalyse natural resources conservation at village level. Several workshops are also conducted with the assembly. They focus on the current situation of natural resources, and they are used to transfer basic knowledge concerning sound land management. During the activities with the other interest groups, the extension worker always includes environmental awareness raising, as well as practical activities like vegetable-gardening, afforestation and SWC. On local schools, environmental education is transversally integrated in the curriculum of each grade, obviously combined with many practical activities. By involving parents in various school activities, such as tree-planting, vegetable gardening and the evaluation of children's drawings, this work directly contributes to the laying of a solid foundation for sustainable development.

6.6 Results and discussion

In the three experimental villages (Tomoroco, Kaynakas and Sirichaca), changes in compliance with all evaluation criteria were monitored during four years. In the two validation villages (Talahuanca and Patallajta), where activities started two years later, monitoring was conducted for two years. In four villages an ex-post evaluation was conducted in October 2005, two years after the project's closure. In Sirichaca, due to disappointing results, an ex-post evaluation was not considered necessary.

Figure 6.1 shows the progress in compliance for all study villages. It indicates how many of the 20 evaluation criteria were respectively "not", "initially", "satisfactorily", or "totally" complied with in the course of the years.

The experimental villages

Figure 6.1 shows that, of the three experimental villages, Kaynakas had the most favourable starting conditions; only four evaluation criteria were not yet (at least) initially fulfilled in 1999. In this village the progress in compliance with the evaluation criteria was fastest, and a solid foundation for sustainable development was laid within less than two years. In Tomoroco this took exactly two years. In Kaynakas and Tomoroco, high participation levels and effective collaboration, in several organized groups, resulted in a very positive impact of the activities on village development. Four years after the project's start, the dynamics in both villages had changed: decreased migration; new income-generating activities; replications of SWC practices; good leaders in the village board; and people with more positive future prospects.

In Sirichaca, however, results were disappointing: eight criteria were never satisfactorily fulfilled, and a foundation was never laid (Figure 6.1). Organized groups in this village did not collaborate; migration rates among the male population remained high; village leaders were absent during large periods of the year; SWC practices were not maintained; and future prospects did not improve. The absence of a solid foundation for sustainable

development, principally the lack of leadership and a general disinterest to collaborate, resulted in the failure of most second phase activities.

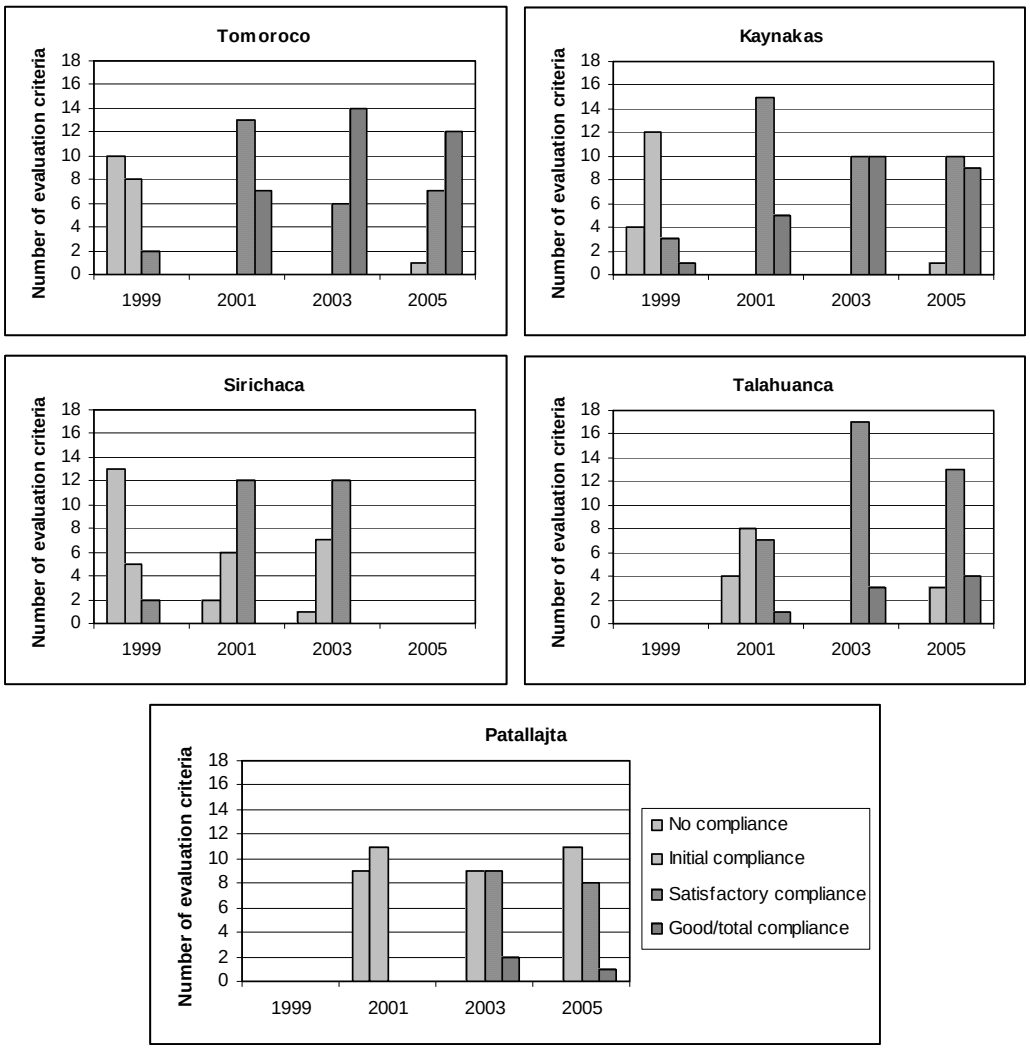

Figure 6.1
Progress in compliance with the evaluation criteria in each study village

Figure 6.1 also shows that after the project's withdrawal, compliance with the evaluation criteria in Kaynakas and Tomoroco declined. An analysis of the criteria reveals that this is to be attributed to decreased collaboration in the villages; the group of CLs is no longer active, and some other groups now work on an individual basis. The most positive conclusion from the ex-post evaluation is that all the other criteria have remained the same as in 2003. The current status of the five basic conditions in both villages is as follows:

- *Organization and leadership:* Both villages are well organized, with capable and responsible leaders being elected in the village board. The village board is the respected leading organ in these villages. Accountability of the village board is, however, still to be improved.

- *Responsible participation:* The regularly held village meetings are well attended, and seen as useful. Although decisions are nowadays no longer taken by a small influential group, and women participate in discussions, inequality still exists. Not all villagers have a similar active role.
- *Effective collaboration:* Groups with a tangible common objective remain active, e.g. the women group, user groups of small drinking water schemes, and tree-growers. In both villages, the groups of Conservation Leaders and carpenters are inactive: CLs feel they are no longer needed, while most carpenters now work individualistically.
- *Mutual trust:* In both villages, former staff of the JGRC project is still highly esteemed. This is not the case with staff of other organizations; they still have to establish their own relation of mutual trust.
- *Environmental awareness:* People are generally positive about SWC practices, and are aware of the importance of conserving natural resources. Both villages keep to internal regulations concerning natural resources management.

Although slightly weakened, the foundation for sustainable development is nowadays still solid in Kaynakas and Tomoroco. All respondents in the ex-post evaluation affirm that living standards have increased; that village organization is much better than before; and that they now have more positive future prospects than six years ago. The activity that has released most enthusiasm in both villages is the set-up of small tree nurseries, and the subsequent selling of trees to local municipalities. Vegetable gardening and sewing are also still important, and some women sell their products on local markets. Drinking water schemes are well maintained, and families pay their monthly financial contribution.

Concerning SWC, all respondents consider that the quality of their land has improved, and that the impact of the practices is positive. Maintenance of SWC practices was regular to good, but, with the exception of stone barriers in Tomoroco, physical SWC practices were almost not replicated during the last two years. However, non-physical SWC practices showed higher replication rates. The overall interest in SWC seems to have diminished; some farmers in Kaynakas have even removed SWC practices from their fields, and most CLs are no longer active as trainers (see also Chapter 7).

The validation villages

In the validation villages, the JGRC project worked for only two years. Figure 6.1 shows that in Talahuanca a solid foundation for sustainable development was laid within these two years, with all evaluation criteria being at least satisfactorily complied with. In Patallajta this was not achieved. Nevertheless, in both villages a Village Development plan was worked out, some group activities were initiated, and two SWC contests were organized. Due to the project's closure, other second phase activities were not initiated.

Figure 6.1 also shows that despite the short presence of the JGRC project in Talahuanca, this village was able to maintain a quite solid foundation for sustainable development after the project's withdrawal. Only three criteria related to effective

collaboration and environmental awareness slightly decreased. However, the analysis reveals that village's organization even improved over the last two years; 80% of the respondents in the ex-post evaluation are positive regarding this aspect. Nevertheless, only 60% of the respondents are positive concerning the current living standard and future prospects in the village, apparently for lack of execution of more second phase activities. This lack of follow-up is also reflected in the fact that SWC practices are well maintained in Talahuanca, but not replicated. People wait for being pushed and called for. The foundation for sustainable development is thus not yet solid enough; although people have a more progress-driven attitude than before, taking the initiative to make plans concrete is still difficult.

The case of Patallajta is quite similar to that of neighbouring Sirichaca (Figure 6.1). Before the intervention, village organization was very bad due to high migration rates, the dispersed location of farm houses, and a general passiveness and desperation among the population. The project was not able to reverse this situation within two years, despite a satisfactory participation of the majority of the population. Young leaders were not available, and the remaining population could not be convinced that effective collaboration was an essential condition for village development. Despite scepticism concerning alternatives to improve the productivity of their land, participation in the SWC contests was good, and a considerable amount of labour was invested in conducting SWC practices. However, severe drought in the last two years was a tremendous setback for the performance of the recently installed SWC practices. These adverse climatic conditions, combined with the early withdrawal of the JGRC project, and the absence of other institutions, has made the villagers of Patallajta nowadays unmotivated and feeling powerless facing their poverty. None of the respondents in the ex-post evaluation is positive concerning future prospects in the village.

The experiences show that successfully laying a solid foundation for sustainable development depends on the characteristics of each village. Barrett et al. (2005) mention that principally the lack of social harmony in villages undermines the success of community-based approaches. This is definitely true, although the Tomoroco case shows that this can be reversed. In villages where several constraints are present simultaneously, a foundation for sustainable development may never be laid, and successes of development projects will be very limited. Most important constraints are:

- High migration rates, indicating that young leaders are generally absent;
- Bad internal organization, indicating that people are not willing to collaborate;
- Lack of natural resources such as water, land (for agriculture) or vegetation (forests);
- Lack of initiatives and enthusiasm, indicating a general negativism and passivism.

The hypothesis formulated earlier in this chapter can be confirmed: executing SWC practices and other development activities is more successful in villages where previously a solid foundation for sustainable development is laid. This is the case in Tomoroco, Kaynakas and – to a lesser extent – Talahuanca, where people have changed, and where a new dynamic has led to several successful group activities and improved future prospects. Similar results have often been achieved by other participatory methodologies that focussed on empowering people to conduct their own analysis and take action. Especially from Latin America come interesting examples with Participatory Rural Appraisals (Chambers, 1997) and Participatory

Action Research (Fals Borda, 2001). However, the main question is always: "how sustainable are the results?" In the three aforementioned villages, developments over the last two years indicate that more support is needed. Despite their progress-driven attitude and willingness to participate, the villagers still require a catalyst to make them move forward. Four years in Tomoroco and Kaynakas have probably been to short for village development being really sustainable. Two years in Talahuanca was definitely too short.

Concerning SWC, longer lasting institutional support is even more essential. Local municipalities should be involved in organizing SWC contests, field visits, farmer-to-farmer training, etc. This way, Conservation Leaders can remain active, and they can generate income by receiving remuneration for their work. Other groups need similar support: for example, municipalities can help carpenter groups in the commercialization of their products. Only when this integration of activities at municipal level is successfully achieved, and when people become involved and actively participate in a dynamic regional development process, village development – build on the newly laid foundation – will be sustainable.

6.7 Conclusions

With the Law of Popular Participation now being well accepted and formerly established, the time is ripe in Bolivia to involve people in sustainable development (Nijenhuis, 2002; Zoomers, 2002). In five Bolivian mountain villages, mixed successes were achieved with a strategy that aimed at involving poor farmers in natural resources management and sustainable development. In two of the five villages, this foundation was never laid. The identified constraints were: high migration rates; bad internal organization; lack of natural resources; and lack of initiatives and enthusiasm among the population. In the other three villages, a foundation for sustainable development was laid within two years. In two of these villages this foundation – although slightly weakened – remained solid after the project's withdrawal, with a better internal organization, more equality, and the genuine participation of more people in village development. In the villages with a solid foundation for sustainable development, succeeding activities were more successful than in the other villages, SWC practices were better maintained and peoples' future prospects improved.

Empowering the rural poor, i.e. more equality, is an important driver for sustainable development (Fernando, 2003; Roseland, 2000). In the applied strategy, equality within a village is constantly stressed: e.g. better village organization, responsible participation and effective collaboration are considered basic conditions for sustainable development. Fulfilling these basic conditions is mainly an investment in time, in strengthening local capacities, and in working towards the generation of a progress-driven attitude in rural people. This is an essential investment, because just like a durable house, sustainable development needs a solid foundation. Moreover, it is a justifiable investment, because increased self-reliance among the poor, and the establishment of self-sustaining rural organizations, eventually favour balanced national development. If this is not taken into account, the risk of failure and non-sustainable execution of development activities is high.

In order to profit from the new dynamics in villages where a solid foundation has been laid, follow-up activities are essential. Sustainable development is a process, it takes time, and actions on several levels need to be taken to achieve poverty reduction and environmental

sustainability (Grima, et al., 2003). Agenda 21 calls repeatedly for "the widest possible participation" in sustainable development strategies (UN, 1992). Hence, rural villages must become integrated in local development processes, and municipalities – with the support of international development agencies – must be encouraged to invest in rural villages, and in facilitating follow-up activities. For sustainable development to become reality, also a framework for action at national level is required (Hove, 2004). In Bolivia, notwithstanding the presence of a Ministry for Sustainable Development, there is currently no policy to train human resources for sustainable development. This greatly limits the application of the concept to environmental management (MDSP, 2001). If sustainable development is going to be a state objective, segmentation in Bolivia must be overcome (Urioste, 2002). Hence, a solid foundation for sustainable development is as essential at institutional level as at village level; with more effective collaboration to harmonize strategies, and with institutions held accountable for their actions.

Follow-up to Chapter 7

We now know that, although with restrictions, laying a solid foundation for sustainable development is possible in the inter-Andean valleys of Bolivia. But is such a foundation also solid enough for achieving sustainable results in SWC? In view of advancing land degradation, widespread impact of SWC practices is required. How can farmers be motivated and mobilized to protect their land? In the next chapter I will focus on the SWC contests as a tool to execute SWC practices, and I will highlight the crucial role of the Conservation Leaders in conducting SWC practices. However, I will also discuss the constraints for achieving widespread impact.

Chapter 7

Using soil and water conservation contests for extension: Experiences from the Bolivian mountain valleys

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Environmental Management (Accepted)

When our Conservation Leader called us for a first training, I laughed at him and said "What are you going to tell us, you're a farmer like all of us?"
But he taught us some practical things quite easily;
I really liked this kind of training.

(Villager from Patallajta)

7. Using soil and water conservation contests for extension: Experiences from the Bolivian mountain valleys

Abstract

Soil and water conservation (SWC) contests between farmer groups were organized in five rural villages in the Bolivian mountain valleys. The contests aimed at quickly achieving widespread sustainable results. This chapter analyses the effectiveness of these contests as an extension tool. Mixed results were obtained. In three villages, participation rates in the SWC activities introduced in the contests were still high even two years after project withdrawal. These were all villages where a solid foundation for sustainable development had been laid before the contests were held. Two years later, most families were still involved in maintenance of the SWC practices introduced in the contests, and many farmers had started to experiment with different soil management practices. However, replications of these SWC practices were not widespread, Conservation Leaders did not continue with their training activities, and the quality of maintenance of the practices was often not satisfactory. In order to become a more effective extension tool and achieve widespread impact, SWC contests must receive continued support by a catalyst agency. Moreover, other SWC contests should also be organized in which practices are not predefined. Given that SWC contests are a low-budget extension tool, local municipalities could become more actively involved.

Keywords: Soil and water conservation; Farmer-based extension; Sustainable rural development; Farmer contests; Farmer-to-farmer training; Bolivian mountain valleys.

7.1 Introduction

Agricultural development programmes and extension services, both in developed and developing countries, struggle with frustratingly low adoption rates of soil and water conservation (SWC) practices. In response, Savenije and Huijsman (1991) called for a “making haste slowly” approach that focuses more emphasis on developing and implementing solutions together with rural people. Numerous experiences, principally from NGOs, have proven that these more participatory (slow) approaches often work and that sustainable livelihoods can be established. Successes to date, however, consist of scattered small-scale projects; wide-scale impact (haste) has yet to be achieved. The major dilemma remains combining breadth with depth (Farrington, 1998), In SWC extension in particular, participatory approaches are too limited in scope, while existing governmental extension services are often not participatory enough and not sustainable. Hence, strategies and accompanying methodologies and tools are needed that achieve sustainable results in a short time and on a wide scale.

Despite urgent calls to modify attitudes and develop strategies for the extension of SWC (Sombatpanit et al., 1996), in Bolivia the agricultural extension service has completely disappeared, and a governmental strategy for tackling soil erosion does not exist. NGOs have partially filled this gap, and several small-scale successes were obtained with the participatory introduction of SWC practices. However, these successes have not been

reproduced at a large enough scale to have an impact at national (or even departmental) level. Government officials are often not even aware of these experiences, and NGOs themselves generally do not have the capacity for wide-scale dissemination of technology options (Farrington, 1998). As a consequence, land degradation over the past decades has increased (Chapter 2), and rural poverty remains a serious threat to sustainable development in Bolivia.

In response, a project executed by the Japan Green Resources Corporation (JGRC) developed and validated a strategy to motivate poor Bolivian mountain farmers to engage in adequate natural resources management: the logical strategy for SWC (Chapter 5). Unlike other small-scale participatory experiences, the logical strategy not only aims at slowness but also at making haste, i.e. in finding participatory methodologies and tools that achieve sustainable widespread success in SWC. Scaling-up and integrating SWC in a future extension system at national level is the ultimate objective. One of the logical strategy's most innovative tools is conducting SWC contests between organized groups of farmers. The objective of this chapter is to analyse the effectiveness of these SWC contests as an extension tool. This is principally done by monitoring and evaluating farmers' participation in maintaining and replicating SWC practices after execution of the contests. The results will be used to discuss possibilities of using SWC contests in an extension strategy at national level.

7.2 Study area

The study was conducted in the five study villages of the JGRC project. They are situated in the north-Chuquisaca region of the inter-Andean valleys of Bolivia (Figure 1.1), which is a semi-arid region located at an altitude of 2,500 to 3,100 metres above sea level. The majority of the families in this region still manage a mixed farming system, with mainly subsistence agriculture and a flock of goats and sheep. Potatoes are still the main crop and the only crop that receives small amounts of manure. Other important crops are maize, wheat and barley. Animal traction is mostly used for land preparation. Chuquisaca is one of the least developed departments in Bolivia, with the second lowest Human Development Index (HDI) in Bolivia, equalling only 0.49 (UN, 1997). Similarly, a study by the JGRC project revealed that the Human Poverty Index (HPI) for the study villages is among the highest in the world (on average 45%), with lack of access to drinking water and health facilities being the principal constraints. Hence, the region is very poor and faces enormous socioeconomic and physical constraints.

In three of the study villages the logical strategy was developed and tried out over a period of four years: the 'experimental villages' (Tomoroco, Kaynakas and Sirichaca). The other two villages were 'validation villages' (Talahuanca and Patallajta); in these villages the strategy was validated for two years. The villages were carefully selected, in order to obtain a representative sample of villages for the north-Chuquisaca region. Therefore, geographical, climatic, cultural and socioeconomic characteristics are different between the villages. Rainfall varies from 350 mm/year (in Tomoroco) to 750 mm/year (in Kaynakas). Sirichaca has more flat lands for potato production, while the other villages have steeper and more erosion-prone slopes.

SWC is a barely developed activity in this region. Since the colonial era, when farmers started using a combination of Spanish and traditional agricultural practices to maintain

adequate production levels, practices have not changed much. As a consequence, once cultivable land began to be used more intensively, traditional conservation practices were no longer able to control erosion and maintain soil fertility. Most of the SWC practices currently found in the study villages are still based on traditional knowledge, but given their ineffectiveness in conserving soil and water, farmers have become increasingly sceptical about prospects for sustainable agriculture in their villages. Therefore, migration rates are high in most of the villages. Attempts of development agencies to promote improved SWC practices have not been successful, mainly because of failing intervention strategies and the lack of adequate extension tools.

7.3 Research methodology

The SWC contests were conducted in the 'experimental villages' in 2001 and in the 'validation villages' in 2003. In each 'experimental village' only one SWC contest, which focused on all physical SWC practices, was conducted; in the 'validation villages' two SWC contests were conducted, focusing on two SWC practices each. During the SWC contests, the number of labour days invested per family was monitored for each SWC practice. Moreover, the rate of participation in the contests (i.e. percentage of families actively involved in SWC activities) was evaluated in each village.

The most important data for this study were obtained in the ex-post evaluation in 2005, two years after the JGRC project's withdrawal from the villages. The ex-post evaluation was conducted in all villages, except Sirichaca. In this village an evaluation was not considered necessary, due to the disappointing results and low participation rates during the contests. In the other villages, a random sample of 30 families was taken for the ex-post evaluation. Although the diversity of farmers within each village is high, and farmers who are progress-driven and economically better-off tend to invest more in SWC practices than others (Chapter 4), this was not considered a variable. Hence, large families as well as, for example, widows were included in the sample. Similarly, farmers from the higher economic stratum (with more land) as well as very poor small farmers were considered.

In the ex-post evaluation, the percentage of families actively involved in both maintenance and replications of SWC practices was assessed by means of a field survey. If at least one type of SWC practice was properly maintained, the family was considered to be actively involved in maintenance. If at least one SWC practice was replicated on other fields after the project's withdrawal, the family was considered to be actively involved in replications. Similarly, the active usage of other (non-physical) SWC practices was evaluated during the ex-post evaluation.

Finally, in order to obtain data concerning the popularity of the executed SWC practices, quality of maintenance of these practices was evaluated within the same sample of families. For each family an average score was given for the quality of maintenance of each type of SWC practice, ranging from very bad (or abandoned) to very good. Based on these scores, and in order to be able to compare the villages, average scores for each village were calculated.

7.4 The need for more effective extension tools

Although Bolivia has tried out different extension service models (Bojanic, 2001), these were always technology-centred and top-down, with weak research-extension linkages. Most widely used was the Training & Visit extension system, in which knowledge trickled down from the research institutes to the extension worker and finally to the farmers. Farmer participation in this model was mainly functional. In 1991 a World Bank project strengthened the country's research capacity, but extension remained extremely weak, resulting in poor adoption rates of improved practices (Bojanic, 2001). In contrast to other developing countries, where low adoption rates forced extension agencies to apply more people-centred extension approaches, in Bolivia the governmental extension service simply disappeared. The research and extension component remained an independent foundation only for the study of potatoes. Currently, a demand-driven research and extension system (SIBTA, the Bolivian Agricultural Technology System) is in place that promotes innovative technologies in support of productive chains. Given the system's focus on promoting regional cash-crops, (poor) subsistence farmers are largely excluded.

In Bolivia, as in many other Latin America countries, NGOs fulfilled the more intensive extension tasks. Most NGOs aim at an empowering type of participation, in contrast to the functional type of participation of public sector organizations (Farrington, 1998). Several NGOs initiated experiments with Farmer Participatory Research (FPR), based on the farmer-first approach (Chambers et al., 1989). Their pioneering work with a large set of participatory techniques and innovative extension approaches has led to the realization that community participation and integrated (multi-sector) approaches are essential elements for success. In Latin America, farmer-to-farmer extension has had a notable impact and has led to adequate natural resources management in Mexico (Ramos, 1998), Honduras (Sherwood and Larrea, 2001) and Nicaragua (Braun and Hocdé, 2000), among other countries. Given that NGOs can spend considerable resources in a few villages, and often invest in time-demanding and costly face-to-face participation, they have achieved higher participation rates than governmental extension services. However, the principal constraint of these extension approaches is their limited scope: they are difficult to replicate on a wide scale in the absence of local support organizations (Farrington et al., 2002). With the prime objective of agricultural extension being to reach all farmers, this is a crucial constraint.

The JGRC project's logical strategy for SWC is not the first attempt to develop effective strategies that combine farmer participation at the grassroots level with extension and scaling-up. Killough (2005), for example, proposes "participatory extension through [the] accompaniment model". This extension approach is a middle road between the traditional extensionist-centred approaches and the more recent farmer-led approaches. In this model, professional extension workers help farmer-promoters conduct on-farm experiments and provide farmer-to-farmer training. Local empowerment (through the development of farmer leaders) and strengthening local institutions are primary goals of this holistic approach. It is therefore important that such extension approaches promote integrated human development. Evidence from Honduras shows that farmers would have likely abandoned SWC practices long ago, if the extension approach had not addressed essential aspects of the interaction

between human development and agriculture (Sherwood and Larrea, 2001). Farmers conceptualized this interaction and holistic approach as 'the human farm'.

Implementing such an integrated and farmer-based extension approach is urgently needed in Bolivia; only then can a wide-scale impact be achieved. Although municipalities have considerable budgets for rural development, they do not have the human capacity to provide this service, and they regard extension as a state responsibility. Hence, there is a need for (1) profound changes at institutional level to give priority to extension, and (2) effective extension tools that can be used in a farmer-based extension approach. SWC contests are an example of such a tool.

7.5 Using SWC contests within a farmer-based extension approach

Organizations in several countries have experimented with farmer contests or competitions. The State Farm Bureaus in the USA regularly hold such contests, in particular for young farmers. Management, growth and progress in farming operations are major factors in judging the contests. The outstanding farmers receive financial awards, which are usually made available by sponsors. Farmer competitions in New Zealand and Australia are more focused on developing technical skills and knowledge, with conservation and land management practices being one of the several competition modules. In developing countries all kinds of farmer contests are held, but rarely focused on SWC. Chuma and Murwira (1999) report of farmer competitions in Zimbabwe organized to stimulate the process of experimentation and revival of farmer knowledge regarding best farming practices.

The best results with respect to SWC have been achieved in two rural development projects in Bolivia and Peru, where SWC contests between farmers were used to speed up execution of SWC practices. Both projects make use of the 'learning from the best' principle, i.e. learning from the best families and villages (van Immerzeel and de Zutter, 2005). Knowledge management, i.e. combining knowledge and capacities from different farmers to find sustainable and fast solutions, is essential in this approach. The contests are used as a catalyst tool to disseminate this knowledge and motivate farmers to learn from the best, to experiment and innovate, and to win prizes by improving on what they have learned (van Immerzeel and de Zutter, 2005).

In Peru, the rural development project MARENASS (Management of Natural Resources in the Southern Highlands) uses farmer contests to promote new technological practices for improving natural resources management, agricultural production and living conditions. An important characteristic of the project is the transfer of decision-making and responsibility for planning and financial resources to the villages. Each participating village receives financial support to hire direct technical assistance (Posthumus, 2005). These external service providers can be farmers with much experience ("the best farmers"), consultants or technical staff members. When a contest is organized, the villages themselves select and contract these privatized services to provide training to a number of selected farmers. By means of farmer-to-farmer training, the trained farmers in turn teach the other villagers the new techniques they have learned. Contests are held both at village level, with farmers competing against each other, and on district level between villages (Posthumus, 2005). Jury members are selected by the participants; the families or villages that best apply

the recommendations provided by technical staff earn a cash prize. The innovations of MARENASS have been successful, and the project is still in progress (IFAD, 2005); in 360 villages about 60% of all households have been reached (De Zutter, 2004). Nevertheless, since internal problems in some villages limit their participation in the project, the impact of activities on watershed level is quite low (Posthumus, 2005).

In Bolivia, the SID (Strategies for International Development) project 'Pachamama Urupa' approaches the dual problems of soil erosion and rural poverty with the understanding that neither can be resolved without simultaneously addressing both. Competitions among villages are organized to encourage participation in natural resources management, and to recognize the most successful farmers (SID, 2005). SID hires farmers who are skilled in one or more of the land conservation and reclamation practices as part-time staff. These para-professional extension agents train selected farmers in about five villages, who in turn train all the other participants of the contest in their respective villages (Borda, 2002). The competitions are flexible enough to permit farmers to find their own solutions to their problems, i.e. to experiment and innovate. All farmers participate in the judging, which stimulates the sharing of knowledge and the adoption and improvement of the practices. The winning villages and families receive farm tools, seeds, and animals as prizes. Participation rates in the competitions are about 80-90%. The project has recently won the World Bank's "Development Marketplace Competition" for innovative ideas in international development.

The MARENASS and SID projects are quite similar; they aim at wide-scale adequate natural resources management through a farmer-based extension approach that builds on local knowledge and capacities. Massive participation in farmer contests and farmer-to-farmer training are crucial aspects of this approach. Moreover, progressive learning and improvement is stimulated through constant interchanges, the participatory judging process and the closing ceremonies. Two important differences between the projects are that:

- in Bolivia the practices being judged in a contest are specifically defined, while in Peru the contests have a more general character (e.g. soil conservation) and practices are not specified;
- in Bolivia money is not involved (and prizes are in the form of goods), while in Peru farmers are responsible for contracting the trainers, and cash prizes can be won.

Based on these experiences, SWC contests are undeniably a very promising tool for farmer-based extension strategies, and for achieving fast and widespread sustainable impact in natural resources management. In the following section we will focus on the SWC contests of the JGRC project.

7.6 SWC contests in the JGRC project

In the logical strategy of the JGRC project, SWC practices are executed within a framework of integrated rural development. They are always accompanied by – and often integrated in – other activities that aim at improving local livelihoods. An important feature of this strategy is the laying of a solid foundation for sustainable development before starting a SWC contest, with activities focusing, for example, on better village organization, responsible participation and effective collaboration (Chapter 6). The project's strategy stresses the human dimension of sustainable development: genuine participation of stakeholders is essential. The objective

of the SWC contests is to train farmers in basic SWC practices. Moreover, the contests encourage farmers to experiment and to decide which practices best fit their specific conditions.

Reflection and dialogue – two key features of Participatory Research & Extension (Percy, 2005) – are constantly used. Participatory research with a selected group of farmers, as well as farmer-to-farmer training and knowledge transfer, are crucial before, during and after the SWC contests. Lessons learned through the farmer-to-farmer movement that began in the Guatemalan highlands (Bunch, 1982) are, therefore, taken into account: e.g. to use small-scale experimentation, to start slowly and small, to achieve early recognisable success and to limit the introduction of technology. The essential multiplier effect is provided by the SWC contests and farmer-to-farmer training.

In this section we explain the SWC contests in more detail. In all the activities the project's extension worker plays a crucial role. At the end of this section we also present the differences between the approach of the aforementioned two projects and the JGRC project.

Activities preceding the SWC contests

Preceding the SWC contests, i.e. during the laying of a solid foundation for sustainable development in a village, SWC activities start with a group of about ten Conservation Leaders (CLs). CLs are chosen by the assembly, taking into account personal characteristics such as responsibility, honesty and willingness to innovate. They receive intensive training from the project's extension worker, aiming at the generation of a progress-driven attitude and at conducting experiments on their fields. Experimentation focuses both on physical SWC practices (stone lines, diversion ditches, bench terraces, etc.) and agronomical soil management practices (more efficient manure use, composting, green manure, etc.). CLs are also stimulated to establish some test-sites for comparing with- and without cases, with the objective of obtaining more visible results and make on-site comparisons. This might convince visiting farmers that the positive effects are indeed a result of the practices, and not of different physical conditions between their farm and the CLs' farms. Apart from experimentation and providing demonstrations on their own farms, CLs also have many less tangible tasks such as mobilizing the villagers to become involved in development activities. They are thus both promoters and technicians. Finally, training of CLs in techniques for knowledge transfer is given before and during the farm visits.

Once a solid foundation is laid in the village and CLs are sufficiently trained, the group decides when the first SWC contest will be held and which practices will be executed. In the dry season, practices like stone lines and gully control measures are considered and in the wet season practices that require digging such as diversion ditches and bench terraces. The village is informed in the assembly and by distributing information leaflets. During a period of at least a few weeks, families have the opportunity to decide whether to participate in the contest. CLs have an active role in motivating their neighbours, and in starting to organize groups based on vicinity. Eventually, each CL should lead a group of five to eight families. During these weeks of group formation, possible conflicts must be resolved, especially between neighbours. Given that effective group collaboration is crucial for a successful SWC contest, group formation should be given the required time.

Execution and evaluation of the SWC contests

A contest generally deals with two SWC practices. In a later stage a certain contest can be repeated and/or more integrated contests can be considered, combining different practices. The first contest is the most important one, because it serves as a selection tool for distinguishing the interested families (those with a progress-driven attitude) from the others. In this first contest a subsidy is given – as an incentive to all participants – for the purchase of a set of tools that are essential to conduct SWC practices. Each family pays 20% of the original cost. Families that start participating in a later stage have no access to the subsidized tools; these families should themselves catch up with the already executed practices.

Each SWC contest takes about one or two months. Twice a year a contest can be held; one in the dry season and the other one in the wet season. The criteria for evaluating the contests are clearly indicated before starting: 1) executed quantity, 2) quality of the work, 3) knowledge and 4) group collaboration. Major emphasis is given to training and learning during the contests. An essential technique for conducting most of the SWC practices is the adequate handling of the A-frame, which is used for establishing the contour lines in a field. This is generally taught during the first contest.

Once the contest starts, each group – under the guidance of their CL – decides how the work will be done. Reciprocal group work (or *"ayni"* in Quechua) is mostly used. In this system, farmers work on each other's farms on a rotation basis. It is especially useful for labour-intensive work, and hastens the pace of execution. The host family provides food; money is never used. Reciprocity in the Andes region is based on mutual trust. Torrico et al. (1994) argue that it still contains many religious aspects, and that, therefore, quality of the work is never discussed. Similar to the *"alayon"* – a traditional form of village cooperation in the Philippines (Moneva et al., 2000) – the *ayni* serves as a venue for group learning, problem solving and the promotion of equitability among farmers. SWC practices are mainly conducted on fields situated near the farmer's homestead; later they can be replicated on other fields. The project's extension worker regularly monitors group work, and assists the CLs in their training. In the beginning, CLs often encounter problems and feel uncertain; regular meetings help to solve this.

Once a contest has finished, each CL measures the quantity of practices executed by his or her group. The verification of this quantity, as well as the evaluation of quality and knowledge, is done by means of cross-visits with other CLs. Quality criteria are harmonized between CLs before starting the evaluation. Knowledge is evaluated by asking some practical questions. For these three criteria (quantity, quality and knowledge) scores of 1 (bad) to 3 (good) can be obtained. This is written down on evaluation sheets. Based on observations, the extension worker evaluates the fourth criterion: group collaboration and cohesion. All criteria are given the same weight-factor in the final calculation.

During the final closing ceremony the groups receive a reward for their efforts. Recognition of efforts is important because it engenders a sense of pride and it increases self-confidence (Cinnéide and Conghaile, 1990). The most recommendable rewards are seeds for green manure and vegetables, which contribute to more sustainable agriculture. Additionally, the winning groups also receive for instance potato, maize or barley seeds, all in small quantities. These prizes are useful products and their value is small enough to avoid

participating in the SWC contests for the wrong reason. In this respect, money or food must never be used as prizes.

Activities succeeding the SWC contests

Maintenance of the newly constructed practices is the first priority, and complementary vegetative and soil management practices are essential in order to achieve impact on soil productivity. Vegetative conservation practices (grasses, bushes or trees) also strengthen most SWC practices and make them more sustainable. They require, however, controlled grazing and strict rules at village level that are respected by all villagers. Hence, only when such regulations are collectively agreed upon will vegetative practices be viable and will SWC practices work.

Given the importance of vegetation, establishing tree nurseries in each village – preferably at family level – is part of the holistic approach of the logical strategy. By means of an Integrated Project (Chapter 5), a group of farmers interested in agroforestry is trained to become trainers in this topic. Through farmer-to-farmer training, technical knowledge regarding agroforestry practices can be spread to a large number of farmers. Similarly, other groups of farmers specialize in for example manure management (improved stables, manure storage and collection methods), composting or green manure practices.

The spreading and replication of SWC practices to all the other fields that need to be conserved is the responsibility of each family. Although, ideally, groups that participated in the SWC contest will continue to work in *ayni*, most families will have to do it on their own. The role of the CLs is to provide support whenever it is requested.

Differences with the MARENASS and SID projects

Although similar in many aspects, especially in considering SWC as being part of an integrated approach to sustainable rural development, the JGRC project conducted its SWC contests in a slightly different way than the MARENASS and SID projects. This concerned four crucial aspects:

1) The emphasis on training in specific SWC practices during each contest instead of leaving more space for experimentation. The reason: the SWC contests are foremost an extension tool, i.e. they aim at providing farmers with basic practical knowledge of some simple SWC alternatives. After the contests farmers experiment with innovations and will adapt and improve the practices.
2) The emphasis on laying a solid foundation for sustainable development before starting the SWC contests. The reason: only farmers with a progress-driven attitude will continue to experiment and innovate after the project's withdrawal.
3) The use of contests between groups instead of families or villages. The reason: to stimulate group formation and collaboration within a village (i.e. to maintain or re-establish the traditional work in *ayni*), and to contribute to better internal relations and knowledge exchange.
4) The subsidizing of tools to stimulate participation in the contests, but no (or insignificant) prizes for winning groups. The reason: not having the tools is often a major limitation for

participating, but once farmers participate, they must become convinced by the result of their work and not by the prizes they can win.

7.7 Results and discussion

Table 7.1 shows that similar numbers of family labour days were invested during the SWC contests in all villages. Groups generally worked two *aynis* (or two complete labour days) on each group member's fields. Stone lines were the most popular practice executed during the contests, with labour accounting for 40-70% of total labour days invested. In Tomoroco and Kaynakas – with more steeply sloping land – considerable investments were made in bench terraces, while in Sirichaca and Patallajta gully control works (especially the smaller ones) and earth bunds (due to the absence of stones) were given more attention.

Table 7.1
Average number of labour days invested per family for each SWC practice, during the SWC contests

SWC practices	Experimental villages			Validation villages	
	Tomoroco	Kaynakas	Sirichaca	Talahuanca	Patallajta
Stone lines	8.1	5.6	4.5	5.2	5.4
Diversion ditches	0.8	0.8	1.2	2.8	2.8
Gully control	0.3	0.6	1.8	0.5	2.5
Bench terraces	2.1	2.7	-	-	-
Earth bunds	-	0.1	1.6	0.2	1.1
Infiltration ditches	0.2	0.3	-	-	-
Individual terraces	-	0.5	1.4	-	-
Total	11.5	10.7	10.5	8.9	11.8

Source: M&E data in 2001 (experimental villages) and 2003 (validation villages)

Table 7.2
Percentage of families actively involved in SWC activities.

SWC activity	Experimental villages			Validation villages	
	Tomoroco	Kaynakas	Sirichaca	Talahuanca	Patallajta
Construction of SWC practices *(during the contests)*	86	75	48	84	66
Maintenance of SWC practices *(2 years after project withdrawal)*	91	69	-	84	53
Replications of SWC practices *(2 years after project withdrawal)*	78	25	-	20	30

Source: M&E data in 2001 and 2003 (during the contests) and in 2005 (during the ex-post evaluation).

Table 7.2 shows that the percentage of families participating in the construction of practices during the SWC contests was lowest in Sirichaca (48%) and Patallajta (66%); these are both villages in which a solid foundation for sustainable development was never laid. In Tomoroco the participation rate was highest with 86%. These data show that in the villages where activities concerning organization, collaboration and environmental awareness raising had already been successfully executed, the SWC contests were able to mobilize more people.

However, initial motivation is easy; continued motivation is what really matters (Savenije and Huijsman, 1991). The effectiveness of the SWC contests can only be properly measured by evaluating the continued use of SWC practices after the project's withdrawal. Table 7.2 shows the results of the ex-post evaluation, in which the percentage of families that have maintained and replicated SWC practices was assessed.

Concerning maintenance, in Tomoroco this percentage is highest and has even increased; nowadays 91% of all families perform adequate maintenance of one or more SWC practices. Quality of maintenance was moderate to good in Tomoroco (Table 7.3); stone lines and bench terraces were especially well maintained. In Kaynakas 6% fewer families are currently involved in SWC activities; some families have not maintained their practices or have even removed stone lines and gully control measures. In some cases stones from stone lines were used for fruit tree terraces; such farmers experimented with and adapted practices. Farmers often refine their practices under environmental pressure (Veihe, 2000). They may, for example, consider stones more effective for terrace building than for stone bunds. This is supported by Table 7.3: in Kaynakas the quality of maintenance is better for bench terraces than for stone lines. Bench terraces are popular and productive for vegetables.

Table 7.3
Quality of maintenance of SWC practices two years after project withdrawal.

SWC practices	Experimental villages		Validation villages	
	Tomoroco	Kaynakas	Talahuanca	Patallajta
Stone lines	+	+/-	++	+/-
Diversion ditches	+/-	+/-	+	-
Gully control	+/-	-	+/-	+/-
Bench terraces	+	+	n.a.	n.a.
Earth bunds	n.a.	n.a.	--	--

++ very good; + good; +/- moderate; - bad; -- very bad (abandoned); n.a. not applicable (not executed)
Source: Ex-post evaluation data in 2005.

Abandonment of SWC practices is highest in Patallajta, where two consecutive severe drought years and lack of impact of SWC practices caused general disillusion among the villagers. Migration increased and fields were left unattended. Table 7.3 shows that quality of maintenance is bad to moderate in this village; earth bunds, which were heavily damaged during a high-intensity rain storm, were all abandoned. In neighbouring Talahuanca, however, despite severe drought and similar damage to earth bunds, all participating families in the SWC contests are still actively involved in maintenance, except for earth bunds. The presence in Talahuanca of a solid foundation for sustainable development before starting the SWC contests explains the differences between both 'validation' villages. Maintenance of gully control measures was generally given little attention in all of the villages, although most people are of the opinion that these practices work very well.

Concerning replications, a field survey in 2003 revealed that in Tomoroco and Kaynakas wide-scale replications were conducted during the two years in which the JGRC project was in effect. All participating families in the SWC contests constructed new SWC practices. This was mainly attributed to the inclusion of SWC activities in other activities of

the JGRC project (namely Integrated Projects). Stone lines and diversion ditches were mostly replicated and covered large areas of the agricultural land in both villages. The average investment in these villages in maintenance and replications of SWC practices was estimated to be about 20 labour days per family during these two years (2001 to 2003).

However, more important from a sustainability viewpoint is what happened after the project's withdrawal (starting in 2003). Table 7.2 shows that in Tomoroco 78% of all families constructed replications of SWC practices in the subsequent two years; in the other villages this was much lower (about 25%). Especially stone lines were replicated, given their relatively low labour requirements. The differences between the villages are explained by the fact that Tomoroco has more potential land for constructing stone lines, while in Talahuanca and Kaynakas the most important fields had already been protected. Moreover, on the steeper slopes of Kaynakas, stone lines sometimes disturb land preparation. In this village bench terraces were found more useful, but their replication requires higher investments. Replications of stone lines were found in only one village outside the project area, near Tomoroco.

Hence, the SWC contests have achieved mixed results in the five villages. They were effective in three villages: Tomoroco, Kaynakas and Talahuanca. The most positive outcome is that in these villages (on average) more than 80% of the families are currently involved in one way or another in SWC activities, and this was achieved without using incentive schemes or cash prizes. Most villagers also consider the executed SWC practices useful, and more than half of the farmers plan to replicate more measures in the near future. The three villages have in common that they all have solid foundations for sustainable development, which were laid before the SWC contests were conducted (in the first Phase of the logical strategy). This has triggered a renewed interest in alternatives to improve living conditions, including better soil management. The most negative outcomes are that in two of these villages (Kaynakas and Talahuanca) replication rates are currently very low, and in all villages CLs are no longer active as trainers. It seems that the dynamics of the process came to a halt after the project's withdrawal. Some farmers cautiously experiment and replicate SWC practices, but most of them only maintain existing practices and wait for tangible results before investing in new ones. Similarly, the CLs find themselves in a vacuum; they are rarely asked for advice, and there is no common objective to keep the CLs' groups active. The catalyst of the process, the project, is no longer there. The CLs were expected to fulfil this motivating role after the project's withdrawal, but this has not happened.

On the other hand, in Tomoroco and Kaynakas the landscape has visibly changed due to the installed SWC practices, and internal regulations concerning controlled grazing are being complied with. According to the respondents in the ex-post evaluation, SWC contests work; 80% of respondents are positive about the actual impact of the contests. Most importantly: for many farmers the experiences acquired during the contests with alternative techniques and practices have served as a basis for experimentation. Under the marginal conditions of poor farmers, adapting innovations is more important than adopting innovations (Van de Fliert and Braun, 2002). The message that alternatives are available to improve productivity has come through; people are interested and have started to experiment with new techniques.

In this respect, it is interesting to observe the usage of other SWC practices that were not included in the contests, but are now practiced by interested farmer groups and CLs.

Table 7.4 shows that several of these practices are currently in use by a considerable number of families, especially improved traditional practices like crop rotations (including leguminous crops) and mixed cropping systems. Hence, knowledge transfer from farmer to farmer does also occur spontaneously. If these SWC practices would have been included in the SWC contests, their adoption rate could have been much higher. Therefore, a first recommendation of this chapter is to also conduct SWC contests in which practices are not previously defined. The contests described in this chapter filled an important knowledge gap and provided farmers with basic information. However, the failure of earth bunds and the removal of other practices by several families prove that only executing contests with some predefined practices is not enough. Stimulating people's creativity and having each individual family decide which management practices best fit their conditions is considered crucial in the MARENASS and SID projects (Van Immerzeel and De Zutter, 2005). Local adaptations of existing practices will become available sooner if more space is left for farmers' initiatives during the contests. Hence, the JGRC-type of contests can be maintained as a training tool, but other (more general) SWC contests should be organized as a follow-up activity.

Table 7.4
Percentage of families using other SWC practices two years after project withdrawal.

SWC practices	Experimental villages		Validation villages		Kind of practice
	Tomoroco	Kaynakas	Talahuanca	Patallajta	
Manure use	36	16	5	0	Improved traditional
Green manure	20	0	10	0	New
Crop rotations	60	28	30	15	Improved traditional
Strip cropping	24	12	15	0	New
Agroforestry	28	64	25	45	New
Mixed cropping	68	48	70	65	Improved traditional
Composting	40	20	-	10	New

Source: Ex-post evaluation data in 2005.

A second recommendation is to strengthen the role of local organizations in providing follow-up support to the SWC contests. The major weakness of the JGRC project was its incapacity to institutionalize the process: SWC activities continued at a high rate when the project fulfilled its catalyst function, but drastically decreased after the project's withdrawal. Of course, municipalities were always involved in the activities, but their genuine participation was not achieved. Longer-lasting institutional support in organizing and facilitating more SWC contests would have strengthened the CLs' role, and would have kept the dynamic process going. To some extent, farmers can respond to land degradation without external support, but they need continued provision of technical assistance and information in order to make progress (Paudel and Thapa, 2001). Farmers have often lost the self-confidence and capacity to adapt and innovate (Reijntjes et al., 1998); without external support they will continue to farm in the way they have in the past (Percy, 2005). Given that SWC contests are a low-budget extension tool, they can be easily organized by municipalities and local NGOs, for example. However, despite the involvement of local leaders during the SWC contests, the active involvement of many extension workers is needed, especially when larger areas are to be covered in order to achieve a wide-scale impact. This can be a major limitation for local

institutions; policies at the macro level that enable the implementation of a farmer-based extension approach are therefore required. Earlier in this chapter we already mentioned that in Bolivia profound changes at institutional level are required that give priority to extension. Only when such changes are made can SWC contests become an effective extension tool 'to make haste slowly'.

In Bolivia, to date, governments have never committed themselves to extension; strategies were not clearly defined and the extension service constituted a large burden on the state budget (Bojanic, 2001). Nowadays, many participatory approaches and tools are available (Chambers et al., 1989) that have proven their effectiveness over the last decades. Based on case studies in Thailand and Laos, Connell (2000) concludes that there are several opportunities for the institutionalization of participatory approaches in mainstream extension, but that they all require significant political commitment. Particularly regarding environmental problems, different interest groups often pull in complementary and opposing directions (Röling and Pretty, 1997). The challenge ahead for effective extension is to combine efforts. This has been done in Chile, where the government has contracted private technology companies to cater for the larger commercial farmers, and NGOs for small subsistence-oriented farmers. Rivera and Qamar (2003) for example propose a mixture of funding and service delivery modalities; governments could provide funding and NGOs could deliver the extension services. If the political willingness is present, this could also present an interesting opportunity in Bolivia.

7.8 Conclusions

The challenge we face in SWC is to quickly achieve widespread sustainable results; i.e. "to make haste slowly" (Savenije and Huijsman, 1991). Based on the success of SWC contests elsewhere in the Andes (van Immerzeel and de Zutter, 2005), the JGRC project used this innovative tool in five rural Bolivian villages to put "making haste slowly" into practice. Mixed results were achieved with SWC contests between farmer groups. On the one hand, in villages where a solid foundation for sustainable development had already been laid, participation rates in the SWC contests were high. Most farmers were still involved in SWC activities even two years after project withdrawal, without receiving any incentive. In these villages large areas are currently protected with physical SWC practices and farmers have also started to experiment with other soil management practices. On the other hand, in the same villages the renewed system of collaboration focused on SWC was lost when the project withdrew, and Conservation Leaders did not continue with their training activities. Despite the visible widespread impact of the contests, sustainability is thus not yet assured. Farmers easily become disillusioned and unmotivated in the absence of a catalyst to keep the process of SWC contests and farmer-to-farmer training going. Moreover, tangible results such as higher soil productivity take a long time to appear. Farmers are opportunistic; especially in poor regions like the Bolivian mountain valleys, they will grasp any opportunity to increase income.

Two recommendations were given in this chapter to make SWC contests more effective in an extension strategy. First, in addition to the contests described here, other SWC contests should be organized in which practices are not predefined; this will stimulate peoples'

creativity in developing adaptations of existing practices. Second, commitment is required from local institutions to support SWC contests as an extension tool; only then can Conservation Leaders continue their activities, and can a widespread impact be achieved. Given the responsibility of Bolivian municipalities for rural development, they must be the first to become actively involved in extension. However, steering and support with adequate strategies from departmental and state institutions is indispensable; this will motivate municipalities to take natural resources conservation and rural development more seriously. Without such support, any attempt to spread SWC practices via participatory extension methodologies – such as farmer contests – will likely fail; no matter how logical and well-designed the strategy may be.

Follow-up to Chapter 8

Both Chapter 6 and 7 emphasize the urgent need to involve municipalities in sustainable rural development activities, in particular natural resources management. SWC contests and solid foundation activities can be easily organized by municipalities, and do not require high financial investments. Without the active involvement of municipalities, quickly achieving sustainable results on a wide scale with SWC remains an illusion. It is nice to know that – most aspects of – the logical strategy for SWC can be successful; but this knowledge is useless as long as such strategies can not be scaled-up. Analyzing the prospects for scaling-up SWC is the topic of the next chapter.

Chapter 8

Prospects for scaling-up soil and water conservation activities in Bolivia

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The Journal of Environment & Development (Accepted internally)

The mayor of Poroma has never visited our village;
the municipality is not interested in developing this part of their jurisdiction.
Only when elections are at hand they show up and start to give us presents and ask for our votes.

(Villager from Kaynakas)

8. Prospects for scaling-up soil and water conservation activities in Bolivia

Abstract

Effective micro-meso-macro linkages and collaboration between motivated key actors are crucial for the scaling-up of SWC and related development activities. In Bolivia these linkages do not work; numerous constraints are identified within and between all institutional levels. Lack of human capacity to formulate sound policies and enable collaboration is the major constraint in the current political-institutional context. Small-scale successful projects with farmer-based soil and water conservation strategies therefore remain isolated experiences. The prospects for scaling-up such experiences are not hopeful. Policy-makers are disconnected from the field and neo-liberal principles still prevail. A radical attitude change is required from the national government: they must make the first step in defining a clear strategy, in expressing their commitment, and in demanding donor countries to help them with capacity building at the micro, meso-and macro level.

Keywords: Scaling-up strategies; Micro-meso-macro linkages; Soil and water conservation; Rural development policies; Institutional collaboration; Bolivia

8.1 Introduction

In most developing countries there is a growing concern among scientists and development workers about the limited impact of rural development programmes on the lives of the poor and their environment. In Bolivia, debates on this topic have shown that many people at different institutional levels are interested and willing to act. National governments however seem less concerned; other interests often prevail and real commitment to collaborate is absent. When it comes to converting agreements into practical actions, there is no clear vision on how to proceed and on how to integrate and tune actions to actually reach the poor.

Concerning soil and water conservation (SWC), experiences have shown that by using adequate strategies, Bolivian mountain farmers can be motivated to execute SWC activities (Chapter 5). Given the seriousness of land degradation (Chapter 2), scaling-up of such activities should be a key priority in Bolivian poverty alleviation efforts. Institutional support is therefore essential; especially from local municipalities. They should be involved in natural resources management, with practical activities, and within the scope of a dynamic regional development process. However, support and steering from departmental- and state institutions is also important; only then municipalities will take natural resources conservation and rural development more seriously.

Scaling-up requires good management at the macro level, which is rooted in and responsive to the micro level (Farrington and Lobo, 1997). Effective micro-meso-macro linkages and collaboration between motivated key actors are the backbone to successful scaling-up of SWC and related development activities. The crucial question in Bolivia is whether scaling-up SWC activities can be realistically achieved within the current political-

institutional context; i.e. what are the prospects? At a first glance, constraints seem overwhelming and several decades of failures to implement pro-poor strategies give little reason for optimism. However, small islands of success and valuable local experiences exist, generated by motivated people. In this chapter I will analyse the prospects for the scaling-up of such small-scale experiences.

8.2 Scaling-up SWC activities

The issue of scaling-up in natural resources management has become increasingly important over the last decades. Most publications are dedicated to the scaling-up of research innovations and specific technologies, i.e. the replication of practices. However, this technology-transfer paradigm is increasingly being replaced by the more holistic insight that scaling-up is not just about transferring knowledge, but involves building partnerships, promoting participation of stakeholders and strengthening local capacity to innovate (Franzel et al., 2001).

The same is true for the scaling-up of SWC activities: motivating farmers for SWC is part of an overall strategy towards sustainable rural development. In such a strategy, scaling-up a process of community-driven development is more important than scaling-up certain practices. In this section I will review the state-of-the-art in the scaling-up debate, and present some experiences with the scaling-up of development strategies, principally those aiming at natural resources management and community-driven development.

The most quoted objective of scaling-up is that “scaling-up leads to more quality benefits to more people over a wider geographic area more quickly, more equitably, and more lastingly” (IIRR, 2000). Gillespie (2003) adds to this that the aim of scaling-up community-driven development is “to motivate and empower the greatest number of communities to take control of their own development”. A distinction is often made between horizontal- and vertical scaling-up. Horizontal scaling-up is about expanding within the same stakeholder group (e.g. subsistence farmers) to more people through replication and adaptation. Vertical scaling-up is about expanding to other stakeholder groups, from the grassroots organizations to policy makers, donors, development institutions and investors at international levels (IIRR, 2000). Scaling-up is thus not the same as dissemination: dissemination promotes specific practices to pre-determined groups, while “scaling-up is multidimensional and takes into account political, social and economic factors in order to ensure a wide impact that is sustainable and equitable” (Middleton et al., 2003).

In a scaling-up strategy for SWC, horizontal- and vertical scaling-up are required at the same time. Wider geographical cover is essential to motivate more farmers for the adoption of SWC practices (e.g. through farmer-to-farmer training) and the involvement of institutions and an enabling policy environment are crucial to ensure continuing motivation and adoption. The main challenge in scaling-up is, therefore, how to build solid partnerships between all actors and sectors, and how to manage and sustain these partnerships. At all levels people must collaborate and be committed to achieve the same goal; from the grassroots level with concrete actions to the policy level with supporting policies. A comparison of three studies on scaling-up in natural resources management (Esmail, 1997; Lovell et al., 2002; Pretty and

Hine, 2001) results in the following summary of most important elements to be taken into account in scaling-up:

- Strong local organizational capacity (empowerment of rural villages);
- The involvement and support of government agencies and trained extension agents;
- The political will to democratize and invest in a rural development agenda;
- Shared visions across all institutional levels, and effective working linkages;
- Long-term funding (10-20 years) and support of catalytic agencies.

From this summary it becomes evident that scaling-up is a complex all-encompassing task that requires above all motivation and the genuine participation of all actors – from the top to the bottom – and their continuous and enabling cooperation. Scaling-up is a long-haul process needing political commitment and patience over long periods (Binswanger and Aryar, 2003). This requires institutions "to become more participatory, responsive, and transparent, with downward accountability" (Mansuri and Rao, 2004). Especially in a country like Bolivia, where top-down, short-term based and urban-biased policies are predominant, such a cultural change in the institutional environment towards more transparency and accountability requires more than political willingness alone. Donor countries must be involved and can function as a catalytic agent of the process. Middleton et al. (2003) report a scaling-up experience from Bolivia where an outside key institution was the driver of the process and crucial in building a critical mass of motivation amongst the participating organizations.

This role of key agencies in organizing individuals at all levels into institutions for collective action becomes also evident from the Landcare experience in the Philippines. A partnership of organized landcare groups (of farmers) and local government units, facilitated by ICRAF, enabled a farmer-led approach to scaling-up technology adoption (Catacutan and Cramb, 2004). On the other hand, the JGRC project experience in Bolivia provides evidence that the premature withdrawal of a catalytic agency can result in the standstill of the scaling-up process (Chapter 7). Fortunately, scaling-up is now increasingly part of poverty reduction strategies, and donors increasingly support countries to define and implement such strategies (Gillespie, 2003). It can no longer be ignored that sustainable rural development requires a model of partnership and close collaboration between government, NGOs, farmer organizations and the private sector. Such a collective movement towards a common goal is the only alternative to isolated projects and efforts that almost without exception have proven to be unsustainable in the long run.

8.3 Micro-meso-macro linkages and decentralization in Bolivia

In this section I focus on the decentralization process in Bolivia over the past decade, and describe existing micro-meso-macro linkages between actors at different levels. In the next section I will discuss prospects for scaling-up SWC activities within this context.

Due to the limited capacities of the state to deliver even basic services in large parts of the rural area (Booth and Piron, 2004), Bolivia started in 1994 a decentralization programme to municipalities by means of the Popular Participation Law (PPL). This law expanded the local governments' jurisdiction to the rural area and made them responsible for urban and rural development. It provided municipalities with significant financial resources, distributed

according to the municipalities' extension and number of inhabitants (an average rural municipality in Chuquisaca nowadays has approximately 500,000 US$ to spend per year). Moreover, the PPL transferred physical infrastructure (e.g. schools, roads, health facilities and irrigation schemes) to the local administration. The role of the population in local development was strengthened by acknowledging participatory planning as a key methodology for formulating Municipal Development Plans and by formerly establishing citizen-based oversight committees to influence and control local governments finance. In 1995 the PPL was complemented by the Administrative Decentralization Law (ADL), in which responsibilities and resources were transferred from the national to the departmental level. The ADL gave the nine Prefectures the task to respond to the needs of decentralization and support the (currently 311) local governments in the execution of their activities.

With both laws in place, formal micro-meso-macro linkages in Bolivia became clearer (Table 8.1). In practice, however, roles and competences of the different administrative levels were not clearly defined, resulting in many conflicts and a general situation of instability (Aguilar and Peres, 2002). Conflicts are particularly apparent within the meso level, mainly due to political reasons. Given that the departmental government is a direct political ally of the national government (the Prefect is nominated by the President), collaboration with municipalities ruled by the opposition is often difficult. Officially the Prefectures have to play a role of articulator between policy-makers (at national level) and the executors (at municipal level); in practice this often does not work out. Aguilar and Peres (2002) therefore conclude that in stead of supporting the lower-meso level, the Prefectures rather slow down the decentralization process by concentrating power at the upper-meso level. Moreover, contributing to this slow-down, the decentralization process in Bolivia is rather top-down. Decisions are still made at national level, and mandates from the national government must be complied with by Prefectures. Municipalities have no say in policy-making and there is no official mechanism in which experiences at the lower-meso levels are taken into account by decision-making at the higher levels. This is illustrated by the fact that, concerning the content, Municipal Development Plans (MDPs) have no relation with departmental plans. There is no coherency and integration of actions. The MDPs have a fixed format, and spending items must fit into national and departmental spending priorities. Goudsmit and Blackburn (2001) therefore consider MDPs intrinsically inflexible.

Table 8.1
Micro-meso-macro levels in Bolivia

Level	Actors / Institutions
Macro	National government
Upper-meso	Departmental government, i.e. the Prefectures
Lower-meso	Local government, i.e. the municipalities
Micro	Rural villages and their people

Concerning the participation of the micro level in the decentralization process, there has been little progress. According to Booth and Piron (2004) the oversight committees that monitor the municipalities finance have been the least well functioning element. Members of these committees are often mere politicians themselves and direct allies of the ruling political elite

in a municipality. Traditional elites have taken most advantage of the new opportunities related to decentralization, while particularly the less-organized marginal groups are still marginalized (Kaimovitz et al., 1999). This is also reflected in the content of the MDPs, which are generally considered a foreign product due to the little influence that the micro level has over the drafting process (Goudsmit and Blackburn, 2001). External consultants, often so-called "experts" in participatory planning, are contracted to formulate a MDP. In practice however, with a population that has no experience at all with such participatory processes, only some needs of the most vocal villagers appear in the final version of a MDP.

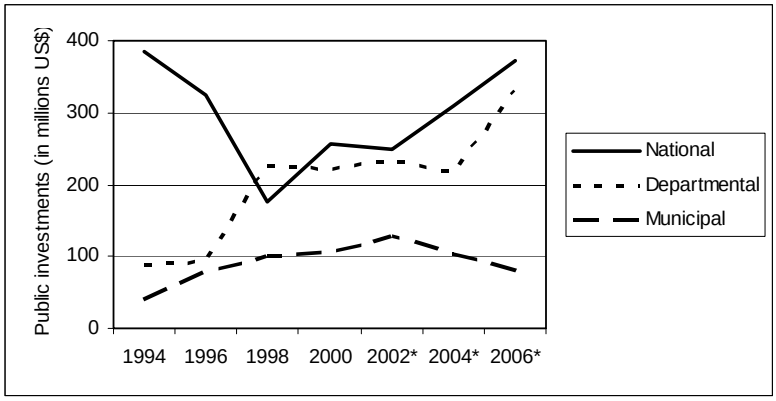
Lack of well-trained professionals in the Bolivian public administration is yet another limiting factor to the decentralization process. Particularly at municipal level, where good leadership is crucial, human capacities are very limited. This is typical of most of the top-down decentralization processes in Latin America, where central governments have hardly invested in capacity building at the local level (Menocal, 2004). In Bolivia, only during the first four years after the approval of the PPL (from 1994 to 1998), activities from the national government focused on educating municipal personnel in e.g. participatory planning and financial administration. However, since 1998, with a new president in charge, governmental support was reduced. This lack of an appropriate capacity building strategy, together with a high turnover of technical personnel, are major reasons that municipalities can not fulfil their role in the development process and in the fight against poverty (Aguilar and Peres, 2002). The best professionals rarely work in public offices; there is no money to contract them and no vision that human resources are important to obtain sustainable results. Moreover, in selecting personnel, political quotas often play a decisive role. Especially within the extremely politicized Prefectures, political friends are often given jobs to reward them for their support during election campaigns. Technical capacities are rarely taken into account. Due to this reward-for-votes system, political parties are the most distrusted among national institutions (Booth and Piron, 2004).

Despite these limitations, municipalities are increasingly recognized as important actors in rural development. This is principally the result of the "National Dialogue" held in 2000, a nation-wide debate among all institutions involved in development issues. During this dialogue it was agreed to assign more money to municipalities for poverty reduction activities, with a strong controlling role of local civil society organizations. One year later, in the Bolivian Poverty Reduction Strategy, decentralization and meso level institutions were seen as inseparable from poverty reduction efforts. Nevertheless, there is still no common vision on how to proceed, and municipalities lack the capacity to coordinate activities within their jurisdiction. Although NGOs and bilateral projects increasingly try to articulate their activities to the MDPs, coherency is far from being achieved. Most projects and NGOs maintain their own dynamic, have their own approaches on how to tackle development problems, and often openly try to preserve their own image and identity. Given that most development agencies have better qualified professionals than municipalities, because of being able to pay more, collaboration with municipalities is seldom seen as very beneficial from a professional point of view. The participation of municipalities in development activities is often restricted to paying their financial contribution to projects executed by other agencies; they generally have no idea if this money is well-spend and even less if sustainable results are obtained. There is thus actually a kind of vicious circle, in which weak national

institutions are bypassed by donor agencies, leading to a lack of national ownership of development programmes, and a further weakening of institutional capacities to lead local development (Booth and Piron, 2004).

Changing the current project approach, with isolated and non-coordinated activities, into a programme approach with a common policy for a specific sector, is therefore essential. In such a Sector-wide Approach (SWAp) "all significant funding for the sector supports a single sector policy and expenditure programme, executed under government leadership" (Aguilar and Peres, 2002). However, until date, only on paper attempts have been made to establish SWAps in Bolivia. A SWAp requires a clear vision and strong governmental support; due to internal political problems in Bolivia in recent years this has been impossible. Moreover, meso level organizations should be involved in formulating a SWAp. This bottom-up link from the meso- to the macro level is virtually inexistent. Priorities are still defined at national level, and the influence of upper- and lower-meso level institutions on the improvement of governance is negligible. According to reported experiences by ECDPM (2004), "organizations working at the meso level often find themselves stuck between the urgent needs and ambitions of their stakeholders and the stubborn reality of government policies". Although interested, donor agencies do also not fully support SWAPs (Aguilar and Peres, 2002); in the absence of governmental leadership they prefer to support small projects where tangible – but small-scale – results can be obtained with local experiences.

Although Bolivia has taken a first step towards decentralization, linkages between participating actors in this process are weak and mostly top-down without a clear vision. Roles among the different levels are unclear and capacity building at the decentralized levels is urgently required to improve the technical independency of meso level institutions (Aguilar and Peres, 2002). Despite these limitations, decentralization still has significantly increased the participation of municipalities and Prefectures in the spending of public investments. Where before the implementation of the Popular Participation Law (in 1994) the national government still executed 75% of public investments, in 1998 this was only 35%, and from 2002 till 2006 about 40-50% (Figure 8.1).



** Calculated with exchange rates for 1 US$ = 6.7 Bs (2002); 7.7 Bs (2004); 7.9 Bs (2006)*
Note: Data for 2006 are planned (budgeted) public investments; Source: Data retrieved from www.vipfe.gov.bo

Figure 8.1
Execution of public investments 1994-2006 (in millions US$)

Finally, the most positive effect of the PPL is that it has changed the structure of the state, and created a potential framework for more integration between micro-, meso- and macro levels. In many places where this was previously inexistent, people now somehow start participating in democratic processes (Booth and Piron, 2004). The framework is thus in place, and there is more room for bottom-up approaches and for supporting local dynamic processes (Nijenhuis, 2002; Zoomers, 2002).

8.4 Prospects for scaling-up SWC in Bolivia

The overall mainly negative impression that arises from the previous section is that actors at all levels fail to support activities towards more sustainable rural development. The two decentralization laws (PPL and ADL) seem to have created mainly a kind of artificial and cosmetic framework for decentralization, in which the genuine participation of the poor is constantly frustrated by incapable local government officials. Often these officials have not the slightest idea what rural development is about, and are only interested in rural development and farmers' needs when political votes are at stake. Sporadically some municipalities receive support and guidance from international development programmes; but after municipal elections the positive results of such collaborations are often lost due to personnel changes. The Prefectures on their turn are involved in several rural development programmes, but are more engaged in the control of financial spending than in formulating and planning adequate strategies or in monitoring the impact of their activities. They are principally (upward) accountable to the national government, rather than downward accountable to the lower-meso- and micro level. Within this extremely politicized context, unstable national governments have provided hardly any guidance and strategic direction in the past years.

Is there still hope for sustainable rural development in Bolivia? Will it be possible to establish an enabling context for the scaling-up of successful examples with SWC and other participatory development activities? Figure 8.2 shows how collaboration between the micro, meso, and macro levels should work to enable scaling-up SWC in Bolivia. Based on this Figure, I will explore in this section the prospects for creating such an enabling context, and I will discuss the major role(s) of actors at the different institutional levels.

Figure 8.2 illustrates the critical importance of effective collaboration and well-functioning linkages between the different institutional levels. From the macro- to the micro level (downward flow), sound policies and collaboration should create the enabling context for the scaling-up of SWC activities and programmes. From the micro- to the macro level (upward flow), constant feedback of experiences and policy impact should support policy-making and influence decisions made by the national government. Bi- and multilateral aid programmes, ideally working within a Sector-wide Approach, should focus on capacity building for strategic leadership on all levels; i.e. support the training of human resources (from policy-makers to local farmer groups) for collaboration based on equity and a common vision of goals to be achieved.

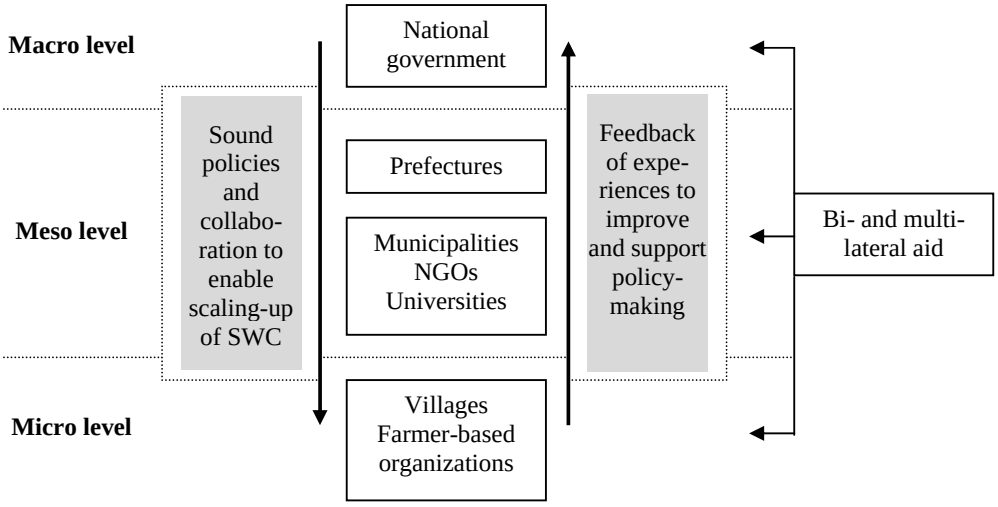


Figure 8.2
Upward and downward linkages between institutional levels in Bolivia.

Given that scaling-up strategies can only be successful when they are based on smooth-working micro-meso-macro linkages, they "should be anchored in a national policy framework and be embedded within a country's social and institutional fabric" (Gillespie, 2003). However, numerous limitations in both the downward and the upward flow distort this ideal picture of harmonious collaboration. The challenge is to tackle most critical limitations first, and clear the way for gradual future improvements in how directly-linked institutional levels collaborate. A study in Southern Africa concerning institutional support for sustainable livelihoods (Khanya-aicdd, 2003), identified a set of six critical issues at micro, meso- and macro level that show a remarkable similarity with and applicability to the Bolivian case (Table 8.2).

Table 8.2
Critical issues in institutional support for sustainable livelihoods in Zimbabwe, Zambia and South Africa

Level	Critical issues
Macro	1. Strategic direction, redistribution and oversight
	2. A nation's capacity to assume a strategic role in eradicating poverty
Meso	3. The effective facilitation and coordination of service provision
	4. Support to lower-meso institutions and strategic planning
Micro	5. The active involvement of poor people in their own development
	6. The existence of a responsive and accessible network of service providers

Source: Khanya-aicdd, 2003

These critical issues illustrate typical bottlenecks in the downward flow of collaboration. However, the authors of the Khanya report emphasize that the linking of local realities to central policies (the upward flow) should be a prime objective. In other words, when bottlenecks in the downward flow are tackled by involving higher-level institutions in lower-level activities and making them downward accountable, then the upward flow of information

concerning local experiences and policy impact will automatically improve. Hence, once collaboration improves and power relations are more equal, the whole picture will improve.

For the case of Bolivia, Table 8.2 is of great help to define the roles that institutions and actors at the different levels should have. These roles are formulated shortly in Table 8.3 and henceforth explained in more detail, starting with the micro level.

Table 8.3
Major role(s) of the institutions at micro-, meso- and macro level in Bolivia

Level	Institution	Major Role(s)
Macro	National Government	Formulate sound policies and provide strategic guidance
Upper-meso	Prefectures	Support lower-meso level planning and capacity building
Lower-meso	Municipalities	Plan and facilitate execution of development activities
	NGOs	Generate small-scale and participatory experiences
	Universities	Coordinate research and train extension workers
Micro	Villages	Provide a solid foundation for sustainable development
	Farmer Organizations	Link farmers' interests to the higher levels
Cross-cutting	Bi- and multilateral aid	Build local capacities for strategic leadership

The micro level

The enabling context for scaling-up SWC at the micro level requires primarily that rural villages provide a solid foundation for sustainable development. The "logical strategy for SWC" (Chapter 5) aims at laying such a foundation. In this community-based strategy, better village organization, responsible participation and effective collaboration among the villagers are considered basic conditions for sustainable development. Investments in SWC will increase, when villages are enjoyable and organized, and when people have better prospects to establish profitable households (Chapter 4). Especially in rural Bolivia, where many villages have disintegrated due to migration, good village cohesion generally indicates that the micro level environment is enabling. Although Mansuri and Rao (2004) argue that "there is virtually no reliable evidence on community participation projects actually increasing a community's capacity for collective action", results from the Bolivian mountain valleys show that mobilising rural villages and laying a solid foundation for sustainable development is possible, albeit not in every village (Chapter 6).

The crucial reasons for the failure of many community-based development projects in rural villages are (1) that the amount of time invested is too short and (2) that the applied strategy is not adequate. Regarding time, two years are often required to only lay a solid foundation for sustainable development; even then, continued institutional support is however needed to achieve sustainable results in the long run. The fact that "effective community-based development requires slow, gradual persistent learning by doing" (Mansuri and Rao, 2004), is also often the reason for meso level institutions not being very interested in supporting this kind of projects. Regarding strategies, these are generally not clearly defined and they often lack a vision on how to obtain sustainable results. For enabling future scaling-up activities, participatory processes must be more structured (Esmail, 1997) and villages must be given more responsibilities.

For effective scaling-up, investing in micro level development is thus crucial. Fortunately, funds for community-based activities are increasing, and worldwide investments in community-driven development by e.g. the World Bank have risen from US$ 325 million in 1996 to US$ 2000 million in 2003 (Mansuri and Rao, 2004). Sustained commitment by meso level institutions is however at least as important; i.e. the downward meso-micro linkage must work, with adequate service provision and the political willingness to invest. The best way to maintain the commitment of the meso level is sustained bottom-up demand from organized community groups (Gillespie, 2003). Hence, the upward micro-meso linkage must also work effectively, enabling empowered villages and organized farmer-groups to participate in local development processes. Especially farmer-based economic organizations (Organizaciones Económicas Campesinas, OECAs) have often proven to be quite powerful and influential in Bolivia. Where such organizations are existent and linkages with the meso level already exist, OECAs can be deployed to represent the interest of the micro level actors and to enforce the commitment of e.g. the local governments to support scaling-up initiatives.

The meso level

After Bolivia's decentralization, municipalities have become the most important institution at the lower-meso level in Bolivia that is linked with the micro level. For scaling-up SWC, the municipalities' capacity to *plan* and *facilitate* the execution of SWC activities must tremendously improve.

Planning requires vision; a vision of a desired future situation, preferably on the long term. Currently, local governors are not committed to sustainable local development and do not feel responsible for the impact of their actions in the long run. They are generally in their position for a short period (mayors are rarely re-elected) and often primarily for personal (political) interests, rather than with the goal to develop their municipality. There incapacity to formulate visions that go beyond a time-horizon of 4-5 years leads to the tendency within municipalities "to focus expenditure on easily administered, highly visible and therefore politically rewarding schemes" (Farrington et al., 2002). Activities related to natural resources management, or other more integrated development activities aiming at the generation of long-term results, are seldom mentioned in Municipal Development Plans (MDPs). Capacity building and changing the attitude of local politicians is thus essential. This requires workshops targeted directly to local governors, as well as strategic support and steering from the upper-meso level (the Prefecture). The use of the Strategic Environmental Analysis (SEAN) method, which has been successfully applied in several developing countries for supporting the formulation of an integrated development strategy at local level (Kessler, 2003), could be a good tool for obtaining more realistic MDPs and for giving more emphasis to e.g. SWC activities. Moreover, in SEAN all local stakeholders (also from the micro level) participate, generating as such a mutual understanding of main problems to be tackled and a broader-based commitment for support during execution.

In order to improve planning, formats for the formulation of MDPs must also be made more flexible. They must allow that local development needs and activities related to the scaling-up of SWC can be given priority by each municipality according to their insight. Local NGOs have an important role; by working with (local) governments, NGOs can

significantly influence policy change and scaling-up (Farrington and Thiele, 1997). They must therefore incorporate their activities in the MDPs, and contribute with their practical small-scale experiences to the formulation of better focused objectives. Moreover, NGOs and other (international) organizations with experience in participatory local planning (and awareness-raising) processes such as SEAN should be in charge of local capacity building. By doing so, and by involving local professionals in the fieldwork, the quality of MDPs will improve. Currently, formulating MDPs is often done by inexperienced non-local consultants, who work with planning models that do not allow the genuine participation of the micro level (Goudsmit and Blackburn, 2001). These consultants are not trusted by the population and often make promises that they can not comply with.

Facilitating the scaling-up of SWC also requires municipalities having vision and qualified technical personnel. Currently, Bolivian municipalities depend almost entirely on external organizations for the execution of activities. This lack of human capacity within municipalities, combined with MDPs lacking broad-based support, leads to the execution of dispersed activities and non-coherent intervention strategies. Municipalities must have a direct link with the micro level; for achieving results with scaling-up, local governments must be downward accountable and the micro level must be empowered to discipline local officials (Binswanger and Aryar, 2003). Hence, they must have extension workers in the field to provide services to the farmers, to understand micro level needs, and to plan and coordinate development activities in the villages. Municipalities must assign budgets for contracting extension workers, and become less focused on infrastructural works; currently only 15% of the budget is dedicated to all operating costs, including extension. Although many local politicians think that investing in extension is less rewarding from a political point of view, I am convinced that if local governors make such investments, they will be supported by the micro level voters. It is however primarily essential that local governments themselves become aware of the potential of well-targeted extension to contribute to a more sustainable agriculture and to poverty reduction. This shift can only be made when also international organizations support a stronger focus on extension.

Encouraging experiences concerning the involvement of municipalities in scaling-up processes come from the Philippines, where the Landcare movement enabled mobilizing local governments, NGOs and farmers for better land use management and environmental protection. Changing the attitude of farmers and policy makers about natural resources management laid the basis for the success of this collective movement (Mercado et al., 2001). Catacutan and Cramb (2004) found that especially stability of local politics was critical in fostering the partnership between all participating actors. Landcare in the Philippines is a kind of framework for collaboration and collective action; it enables local governments' support and ensures the dissemination and sharing of knowledge and ideas through its network of actors (Mercado et al., 2001). The smooth collaboration between the micro- and the meso level is what ensures sustainable impact of scaling-up. This is exactly what is required in Bolivia as well. In the Philippines the Landcare movement was initiated by ICRAF after the successful example in Australia. In Bolivia, international aid-agencies, in collaboration with the upper-meso level (the Prefectures) and all lower-level organizations, should take similar initiatives.

From the fore-going discussion becomes clear that extension workers contracted by municipalities should have an essential role in scaling-up activities. These facilitators must be carefully trained (Mansuri and Rao, 2004). Universities must therefore be involved in the training of extension workers. Universities are currently disconnected from the field and they only sporadically execute some research activities. However, young farmers are the main source of potential extension workers. Universities must capitalize this enormous potential, and motivate young farmers to specialize themselves in extension. An example comes from the ICRAFs "Farmers of the Future Programme" that aims at reaching the future generation of farmers through e.g. improvement of curricula and teaching resources, awareness creation, and pilot projects linking schools and communities (Denning, 2001). Universities are a crucial link in a scaling-up strategy for SWC; without them there will be no extension workers, nor well-trained professionals to strengthen other meso level institutions. This requires Universities being dynamic and innovative, with curricula focused on integrated rural development and practical training in the villages. For most Bolivian Universities this would imply enormous changes and an urgent need for building human capacities within their faculties. Collaboration with Universities from abroad and with international aid agencies is thus essential; only then the prospect of involving basic education institutions in a scaling-up strategy will improve.

The macro level

The crucial role of the macro level in creating the required enabling context for scaling-up was already mentioned several times throughout this chapter. Getting policy right must be the device; but how, and what are the prospects to change politics in Bolivia? Bolivia is a country of tremendous inequalities between the rich and the poor, with a Gini-coefficient of 0.60 in 1999 being one of the highest in Latin America (Székely, 2001). The majority of the population is deprived from power and investment opportunities: lack of voice, status, income and access to services. The latest World Development Report clearly states that "policies that fail to address inefficient inequities are the result of political choices, implicitly or explicitly" (WDR, 2005). During the past decades national governments have definitely failed to make the correct political choices, and have not committed themselves to the eradication of poverty.

Attempts to put sustainable development and poverty reduction on the political agenda were always the result of external pressure, rather than being initiated by the national government. The nation-wide debates (the National Dialogues) in Bolivia were organized after social unrest and widespread protests against the neo-liberal course of the national government. Lilin (2001) emphasizes that external pressure fosters weak political commitment and opportunistic behaviour. Similar to the intrinsic motivation needed at the micro level to achieve the genuine participation of farmers, at the macro level politicians must also generate a progress-driven attitude; i.e. feel the intrinsic motivation to establish partnerships and formulate and execute sound policies. Lilin (2001) argues that there is often an enormous social distance between decision-makers and the field. Politicians are disconnected from the field, they have no practical knowledge. This is definitely applicable to the Bolivian case, where both the downward flow from the macro level as the upward flow

towards it, are completely obstructed and practically without communication. Policies are therefore not rooted in national reality, and when issues like sustainable development or poverty eradication are given attention, it is more for political reasons than for the willingness or the commitment to develop the rural area.

This lack of insight at national level in Bolivia, concerning sound policies and adequate practical strategies to address rural development and poverty, is reflected in the attachment of successive national government to the neo-liberal market paradigm. Several peasant organizations claim that the free-market principle has been disastrous for small Bolivian farmers. Cheap import of agricultural products and the continued lack of protective measures on the part of the government have made Bolivian agriculture less competitive (Prudencio and Ton, 2004). As a consequence, farmers have been forced to cut down production costs, and are even less willing to implement sustainable management practices. The case of barley in Sucre is a painful example of the impact of the free-market principle on small farmers: a decade ago the local brewery bought its barley from local farmers, while nowadays cheap barley is imported from Argentina. Hence, one of the very few local products that were still profitable is now no longer competitive. Hellin and Higman (2005) also argue that "it is highly unlikely that the neo-liberal market paradigm alone will lead to poverty reduction in Bolivia". Peasant organizations call for pro-poor policies aiming at Food Sovereignty (Prudencio and Ton, 2004) and the protection of local farmers and their markets. Steering and support of such pro-poor policies must come from the macro level; not only from the national government but foremost from international organizations such as the IMF and the WTO.

Recent policy papers of the Ministry of Farmer Affairs, Agriculture and Livestock give however little hope that a sudden change can be expected at the macro level (MACA 2005a; MACA 2005b). These papers reflect the concern of the Bolivian government with respect to the problems of the rural area, and focus on yet two new paradigms in Bolivia's agricultural and rural development policy: (1) local economic development and (2) productive chain development. Productivity and competitiveness are the new key-words in this approach; government resources must concentrate on products where Bolivia has competitive advantage and market potential in international markets. Technical assistance in this approach will be geared towards market-oriented producers; i.e. farmers that can pay for these services. This will be beneficial for many farmer-based organizations producing on a commercial basis. The great majority of farmers, however, are small subsistence farmers that have no access to markets, and even less to technical assistance they must pay for. Productive chains mean nothing to such farmers; they are not concerned to meeting consumers' needs. They have only very limited contact with markets, and often only sell some of their products to produce collectors or nearby village markets. Hence, this new approach is more a continuation of neo-liberal politics, rather than a serious attempt to protect local markets and small-farmers. And as long as small farmers are socially marginalized and not supported, they will show short-term oriented survival behaviour, leading to outward migration and land degradation (Bebbington, 1996).

Political instability is obviously one of the main reasons for the little progress that Bolivia has made in reducing poverty. The Poverty Reduction Strategy (PRS) process, steered by the IMF and the World Bank, has not been given serious attention, and the coordination and harmonization of activities with the donor community is still insufficient

(ISS, 2006). As a result, the majority of disbursements by the international community to Bolivia are delayed, awaiting signs of serious actions and commitment at the national level. Although the objectives of the first PRS have not yet been achieved in Bolivia, the challenges ahead for the second generation of PRSs have already been formulated (Driscoll and Evans, 2004). These give a good insight in the conditions that must be fulfilled before Bolivia can even start formulating and implementing sound policies for sustainable rural development:

- Develop stronger government focus into an institutionalized commitment;
- From civil society consultations to deeper forms of government accountability;
- From donor co-ordination to alignment and harmonization.

Bolivia still has a long way to go before becoming a trustworthy partner of both the international (donor) community and all micro- and meso level organizations. In the present context the prospects that a scaling-up strategy for SWC will be supported by the macro level are not hopeful. Changes must come from within the national government, and only when the above mentioned challenges are affronted with seriousness the urgently needed SWAps for e.g. sustainable rural development can be formulated and implemented.

8.5 Conclusions

Scaling-up SWC requires fluent micro-meso-macro linkages between institutional levels, where motivated actors within the participating organizations work towards a common goal and with a coherent strategy. In the current political-institutional context in Bolivia, serious constraints within and between the three institutional levels completely block possibilities to scale-up successful examples of small-scale participatory SWC experiences. The most probable scenario is that these islands of success will remain disconnected from the mainland for the coming years; awaiting a turn of the tide within governmental institutions to be scaled-up. Although decentralization has provided more room for supporting local dynamic processes (Nijenhuis, 2002; Zoomers, 2002), lack of human capacity at the meso level is a critical barrier for initiating more sustainable local development. Ruben and Pender (2004) warned that when decentralization is not carefully designed and monitored it can worsen poverty and resource degradation. Indeed, in the absence of support and steering from the macro level, rural development is seldom a serious issue for local governments in Bolivia. And although poverty, at least on paper, is mentioned as Bolivia's key-concern, land degradation and the faith of small subsistence farmers are overruled by the new paradigms of neo-liberal policies: local economic development and productive chain development.

According to Blaikie (1985), soil conservation only has a good chance of success when all following conditions are met: better prices for producers, adequate transfer of technical knowledge and collective discipline in implementing conservation works and in policing. In Bolivia none of these conditions is given. Enough research has been done and enough experiences have shown the technical possibilities and limitations of SWC. What we need is connecting micro level experiences and farmer-based strategies, such as the logical strategy for SWC, to the meso- and the macro level. Bolivia needs investments in human resources and capacity building; dedicated professionals and extension workers, and committed policy-makers with vision who are intrinsically motivated to make progress and do things well for

the sake of the country's future. A radical attitude change is required from the national government: they must make the first step in defining a clear strategy, in expressing their commitment, and in demanding donor countries to help them with this enormous task. This final message is principally aimed at the new Bolivian government, which is supported by all farmer organizations and has a majority in congress, and which therefore has the (probably last) opportunity to make this radical change. Only then, prospects for the scaling-up of SWC activities will improve.

Follow-up to Chapter 9

Changes are required at all institutional levels. However, how to make a start and what is the most promising pathway out of the present situation of stagnation? In the following final chapter (the synthesis), I will integrate the findings of this research, and I will propose two concrete simultaneous steps: one at the micro/meso level interface, and one at the macro/meso level interface.

Chapter 9

Synthesis

"We women were afraid to speak during the village meetings, because men laughed when we started to talk. Now we don't care anymore, sometimes we even know more then they do"

(Villager from Tomoroco)

9. Synthesis

9.1 Towards sustainable land management in Bolivian mountain valleys

In the inter-Andean valleys of rural Bolivia, the prospects for making a sustainable living are gloomy. As predicted by van Niekerk (1994), farmers are trapped in the same vicious circle: their products are not competitive, and under the prevailing circumstances the investments needed to reverse this situation are not profitable. The current debate on rural development in this region has yielded no clear vision of a pathway out of poverty and stagnation. Frustration and disillusionment about the lack of impact of poverty alleviation programmes is growing. Efforts directed at sustainable land management in particular have poor track records, as illustrated by the results of a study on the impact of Dutch development aid programmes in Bolivia (Bebbington et al., 2002), which found that among the least successful interventions were those related to strengthening farmer organizations, and those aiming at soil and water conservation (SWC). It concluded that these activities were not focused on farmers' priority needs: farmers are not primarily interested in conserving their natural resources; they want to earn money.

This crude conclusion illustrates the enormous dilemma facing all agricultural development efforts. It is difficult to stimulate farmers to invest in agriculture and sustainable land management, as such investments do not generate short-term benefits. The potential for agricultural growth is particularly limited by poor market access and environmental restrictions. Hence, focusing solely on agricultural development does not solve poverty (Reardon et al., 2001). The challenge is to execute an integrated *set of strategies* that can make rural livelihoods more efficient and viable (Bebbington et al., 2002). Rural people have known this for quite a while; they are increasingly trying to find solutions through non-rural pathways (Kay, 2004). Thanks to flexible and dynamic strategies, Andean peasantry is managing to survive (Zoomers, 1998). However, it is a constant struggle. The options for generating income and making rural livelihoods more viable are scarce, and constraints are overwhelming. Often the only promising alternative is migration.

Notwithstanding its minor importance in generating income, agriculture is still fundamental for many rural families' food security (Bebbington et al., 2002). In most villages, farmers migrate for short periods, and if they stay away for longer, they generally lend their land to others in the village. However, in other villages, farmers actually abandon their land. One of the findings in this thesis research was that in Sirichaca, one of the study villages, more than 30% of the agricultural land has been abandoned in recent decades; all this land is severely degraded. Van Niekerk (1994) argued that "rural livelihoods must modernize or else they will disappear". In Sirichaca, only some of the most viable farmers, those producing for local markets, have somehow modernized. Many less viable farmers have already "disappeared" and left the area; many other families anticipate that their children will abandon agriculture and migrate. As long as agriculture is not sustainable for all farmers, this process will continue, due to degradation and land abandonment. Hence, despite failures in the past, a

key priority in any rural development strategy must be to improve agriculture through sustainable land management.

The question is: how? Is there a pathway towards sustainable land management for all farmers? Recent rural development strategies in Bolivia, backed by neo-liberal policies, are not supportive for non-viable farmers. Their focus on productive chains and local economic development will surely not trigger subsistence farmers to invest in their land. Cash-crop farmers will benefit most. Such strategies increase inequality and are counterproductive to any sustainable development effort. Stimulating local economic development is good, but only when all people have similar chances of participating. The new Green Revolution proclaimed by the UN Millennium Project (2005) puts more emphasis on helping the non-viable farmers. It argues that bigger investments are needed in less-favoured areas, and that soil health should be improved, e.g. with green manure, cover crops and by reducing erosion. To achieve this, extension services must be strengthened with local professionals and participatory methods. The main question, however, remains: how can a strategy actually motivate farmers to invest in sustainable land management?

In my view, sustainable land management is inextricably linked to farmers' future prospects: if the prospects of making a sustainable living are promising, people will take care of their land and its natural resources. But rural development projects have rarely worked on this: they have been unable to improve farmers' prospects and could not motivate farmers to invest in SWC. Hence, a new Green Revolution must not only be green, first and foremost it must be farmer-based; i.e. be grounded on the needs, aspirations and abilities of farmers – whether they are viable or non-viable. It must offer them promising alternatives that restore their hope in a better future. This requires investing in human capacity, informing people and making them aware about their opportunities, as only then can they express needs and aspirations realistically. Empowering people to achieve these opportunities together (through collective action) is what generates sustained intrinsic motivation.

In the next section I will present the main findings of this thesis, and I will explain the components of a strategy that aims at moving people – not only at micro level, but also at higher levels – towards collective action in soil and water conservation.

9.2 Seeking a promising pathway out of stagnation

In the previous section I already revealed some of my thoughts on a pathway out of stagnation; i.e. out of the current "impossible situation" (van Niekerk, 1994) that does not offer farmers in the inter-Andean valleys of Bolivia any feasible alternatives. Given this impossible situation, the research question of "how farmers in this region can be motivated to adopt SWC practices on a large scale" is even more intriguing. What are the components of an alternative strategy, who are involved, how is it implemented, and above all, can it really change farmers' prospects? In this section, after having justified why SWC actions are indispensable in Bolivian mountain valleys, I will provide answers to all these questions.

In contrast to studies in Africa that have demonstrated that land degradation is not as widespread as presumed (Fairhead and Leach, 1996; Howarth and O'Keefe, 1999; Mazzucato and Niemeijer, 2001), this thesis revealed that in the three experimental villages severe land degradation has occurred in the past decades (*Objective 1*), with the result that since 1963

one-third of the cropland fields have been abandoned. As the population has more than doubled, the remaining cropland is under heavy pressure. Changes in land management (with shorter or no fallow periods) in combination with a changed rainfall regime (with less rainfall and longer drought periods) have accelerated land degradation. It is a vicious circle, in which the availability to the crop of soil nutrients and water is increasingly constrained. Due to these changes, farmers have gradually (and in recent decades, more emphatically) lost control over land management. Traditional ways of Andean farming can no longer fulfil the increased demand for food, and institutions are failing to inform farmers of new land management techniques.

As described in Chapter 2, accelerated land degradation was also assessed on rangeland. The degradation results from the combined effect of soil loss, less rainfall, and inappropriate vegetation management. Although the number of livestock has not increased, continuous grazing is having an enormous impact on the scarcer vegetation. Moreover, due to an increased demand for fuelwood, continuous cutting has reduced the natural vegetation cover. However, land degradation is not completely irreversible in this region: field observations found that rangeland in particular has good resilience. Providing action is undertaken soon, partial rehabilitation seems to be the most feasible scenario. Soil and water conservation activities are, therefore, plainly justified for both cropland and rangeland.

Given the importance of agriculture in the area, this thesis focused primarily on soil and water conservation on cropland. The farmers are very well aware of the decreasing production capacity of their cropland and the necessity to control erosion. However, many of them consider the decreased soil productivity beyond their control, and often attribute rainfall changes to the angry Mother Earth. This, combined with a lack of institutional support, has led to a general sense of fatalism and conformism. The validation of SWC practices that was done as part of this thesis (*Objective 2*), demonstrated that promising short-term alternatives are available for combating land degradation on cropland. Even more important, all four practices that were validated as “most effective and most easily replicable” are based on local knowledge. Moreover, these practices (diversion ditches, stone barriers, mixed cropping, and improved manure use) can easily be implemented with local materials.

Hence, in theory, it should not be a big step to convince farmers how – with some modifications to practices they already know – runoff control and soil management can be improved. It seems that all that is needed is an adequate extension strategy that informs and trains farmers, and that enables them to undertake immediate action. Unfortunately, in practice, it does not work like that; even when farmers perceive erosion as a problem and are aware of possible solutions, they often decide not to adopt SWC practices. Most adoption studies have tried to identify the economic and socio-cultural factors that obstruct adoption, but in different locations the factors were always different (Lapar and Pandey, 1999). Almost 30 years ago, Leagans (1979) argued that adoption needs a favourable mental attitude. What is often simply missing is intrinsic motivation, i.e. doing something because it is inherently interesting or enjoyable (Deci and Ryan, 1985). Only if farmers want to practise good stewardship will they adopt conservation practices (Ryan et al., 2003).

What then can trigger intrinsic motivation? In this thesis I analysed the key factors that influence farm households’ decisions to invest in soil and water conservation (*Objective 3*). The findings support the view I expressed above, that farmers with better prospects are more

willing to invest in sustainable land management. They show that better prospects do indeed trigger intrinsic motivation. Progressiveness, or a farmer's orientation to change and to modernize (Hansen et al., 1987), was by far the most important decisive key factor. Attitudinal characteristics like responsibility, participation and dynamism were strongly related to this factor. What is crucial in a SWC strategy is therefore to motivate farmers, i.e. to instil in them a progress-driven attitude by restoring their hopes of a better future. A second important key factor was found to be the economic stratum: farmers with a higher income from agriculture – and to a lesser extent from livestock – invest more in SWC practices. Hence, from a farmers' perspective, a "better" future prospect is primarily linked to generating income and to making a sustainable living. However, improving agricultural production requires a good understanding of the performance of markets (Posthumus, 2005). The combined set of rural development activities that accompany soil and water conservation efforts must therefore be attractive and profitable.

From these findings and from the experiences of the JGRC project in the region, I derived six fundamentals for a strategy that aims at working with farmers in SWC. First, focus on the most progressive farmers: they will inspire and train the others. Second, achieve short-term impact and success in SWC: this will motivate farmers. Third, enhance the profitability of agriculture: this will increase farmers' willingness to invest in SWC. Fourth, invest in satisfying households' basic needs: this will directly improve future prospects. Fifth, stimulate collaboration within a village: this will increase enthusiasm and commitment to invest in SWC. Sixth, promote income diversification: this will improve households' sustainability and diminish risk. These fundamentals are one of the two main inputs of the logical strategy for SWC, developed by the JGRC project. The other input is the strategy's human dimension, a transversal theme that runs through the whole process of working with people in SWC. The human dimension tells that participation only works if those participating are self-confident, and have developed the capacity for collaborative thinking and working. Genuine participation is required in SWC activities. This is generally preceded by a time-demanding process of conscientization, and the triggering of intrinsic motivation.

The point of departure for the logical strategy for SWC, validated in this thesis (*Objective 4*) is to do the right things, in the right way and in a logical sequence. The validation gave several interesting insights into what this implies, especially for possible follow-up activities. Most importantly, it showed that development activities are more successful if first a solid foundation has been laid, consisting of better-organized villages, more equality and the genuine participation of people. Investments in strengthening local capacity and in working towards generating a progress-driven attitude in rural people are, therefore, essential. Furthermore, the results showed that once such a solid foundation is present, SWC contests between organized groups are an adequate tool for training farmers and for involving them in SWC activities. Farmer-to-farmer training works: farmers like to collaborate, but a catalyst is required to keep the process of SWC contests and replication of practices going. Trigger activities such as workshops to impart skills to farmers or the supplying of a basic need (e.g. a small drinking water scheme) are needed in order to improve farmers' prospects and to generate a collective motivation for investing in the future. De Graaff (1996) argues that giving subsidies for such public facilities and executing them, may

be good starter-activities for SWC in semi-arid zones. In the logical strategy, all incentives that create dependency – like food-for-work or money – were avoided.

Facilitating this process of change is mainly the role of development organizations and local governments; but it takes much time. Five years is definitely not enough. In the study villages, almost five years of intensive collaboration proved too short to ensure that the logical strategy for SWC had a sustainable impact. Bodnár (2005) concludes that because achieving impact in SWC may take longer than the project life span, activities should be embedded in a long-term national programme. However, the analysis of the prospects and requirements for the scaling-up of SWC activities (*Objective 5*) showed that Bolivian institutions are currently neither capable of assuming a leading role in facilitating sustainable development, nor prepared to do so. In all the institutions a major constraint is lack of human capacity.

At the macro level, policy-makers are not committed to sustainable development, and have no strategic vision of how to combat land degradation and alleviate poverty. At the meso level, where in many municipalities a kind of decentralization of corruption has taken place (Kohl, 2003), local politics are still far more important than local development. Dedicated professionals and extension workers – indispensable when working intensively with farmers – are therefore not available. Donor countries and international agencies must help in building human capacities at the micro-, meso-, and macro levels. However, a radical attitude change at national level is required, with clear (sector-wide) strategies and total commitment. Rural development needs more partnership to be built (Bebbington, 1996), and a national consensus and solid support from civil society and political parties (Kay, 2004). The prospects for scaling-up SWC activities will only become more hopeful when such attitude changes also trickle down to the lower institutional levels.

I argued in Chapter 5 that "the logical strategy offers a realistic and promising alternative for motivating farmers for SWC". I hold to this argument, despite the gloomy prospects for making a sustainable living noted in the first section of this synthesis. The logical strategy is *promising* because the results show that where people have lost all hope of changing their negative future prospects, farmers can be motivated to conserve soil and water and be good stewards of their land. The logical strategy is *realistic* because it mainly requires the people responsible for planning and implementing the activities to change their attitude, build partnerships, and act collectively for sustainable development. Opponents and sceptics will surely argue that changing attitude has proven to be the most difficult task in development aid, as evidenced by the poor results of development efforts. Though I agree, I also believe in the power of collective movements to bring about real changes in society. I am sure that collective movements can achieve positive goals, especially when such movements are supported from the bottom-up by empowered people.

The research question formulated for this thesis was: "How can farmers in the inter-Andean valleys of Bolivia be motivated to adopt soil and water conservation practices on a wide scale?" The answer to this question is: "By moving people": by moving people at different institutional levels towards collective action in SWC. First and foremost this requires better communication between these levels. From the top to the bottom, farmers must be supported and motivated by means of adequate strategies so they will invest in sustainable land management and establish sustainable livelihoods. From the bottom to the

top, farmers must contribute to local sustainable development, and small-scale experiences must feed adequate sector-wide approaches for scaling-up SWC. Only collective action by committed people with a common goal can make widespread adoption of SWC a reality.

9.3 Moving people: first concrete steps

How to make a start with this enormous task? Moving people towards collective action requires the presence of adequate driving forces. In this final section I will present two concrete steps to ignite these driving forces: one at the interface between micro- and meso levels, the other at the interface between macro- and meso levels. It is crucial that both steps are taken simultaneously and that they are mutually reinforcing; only then will successful results be achieved. Taking two steps simultaneously – if achieved successfully – would mean an enormous jump forward towards a more sustainable future.

The first step, at the micro/meso level interface, is to generate eye-catching experiences with strategies like the logical strategy, focusing firstly on conducting an integrated set of activities to improve peoples' future prospects. Given the crucial importance of municipal support to the villages involved, only the most motivated and progress-driven municipalities should be taken into account. These municipalities must commit themselves to giving long-term support to such strategies. Capacity building at the municipal level is therefore essential in this step; municipal officials must be able to plan local development and support activities in the villages. Local universities must be involved in the training of farmers and extension workers; foreign universities can assist them. A solid partnership between the development agencies working in these municipalities must provide sustained support and guarantee sufficient funding. In order to ensure that a solid foundation for sustainable development is laid as soon as possible, activities must start in villages with a basic potential for development: interested leaders, potential for agricultural development, and migration rates that are not too high. The dissemination of successful achievements to other actors at the micro- and meso level will certainly be a major driving force for scaling-up. Moreover, these bottom-up forces can trigger changes at the macro level, and motivate people there too to take collective action. The concrete action in this step is, therefore, to initiate such eye-catching experiences, by involving the micro- and meso level actors mentioned above.

The other step, to be taken simultaneously, is to make changes at the macro/meso level interface that will enable and support successful experiences at the lower levels. These changes in the institutional and political context must be profound; good governance is not enough. New policies must enable the implementation of a genuine decentralization, with empowered micro- and meso level actors contributing to adequate strategy development. Both steps meet at the municipal level; again, capacity building is crucial. But good professionals – not politically involved puppets – are also required within the Prefectures and national institutions. Ideally, bottom-up forces and forces from within the institutions should trigger these changes. However, there is no time to sit and wait for that to happen; this step requires changes to be made very soon. International agencies and donor countries must therefore be the driving force of changes at this level; they must move people at the meso-macro level towards serious collective action. Only such (relatively) independent actors can disentangle the current conflicting interests at the interface between macro- and meso levels.

The concrete action in this step is, therefore, to create an independent permanent taskforce – with international development experts and apolitical Bolivian scholars – whose recommendations must be implemented by consecutive governments.

Land degradation in this region is not completely irreversible, and partial rehabilitation seems to be the most feasible future scenario. I hope that this thesis has clarified what needs to be done by all people involved in order to bring about such a scenario.

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Summary

This thesis is inspired by my profound concern that land degradation (especially soil erosion) visibly increases in the inter-Andean valleys of Bolivia, and that no action is undertaken to stop it. From August 1999 to December 2003 I worked in the north-Chuquisaca region of Bolivia, in a project financed by the Japan Green Resources Corporation and the Prefecture of Chuquisaca. In this project we searched for adequate soil and water conservation (SWC) practices and strategies to tackle land degradation. In 2001 I started with this PhD research, trying to respond to the following main research question: How can farmers in the inter-Andean valleys of Bolivia be motivated to adopt soil and water conservation practices on a wide scale? I worked with five specific objectives:

1. Assess the seriousness of land degradation in the inter-Andean valleys of Bolivia;
2. Validate available SWC practices in the region;
3. Determine key-factors that influence farm households' decisions to invest in SWC;
4. Validate a strategy that motivates farmers to adopt SWC practices;
5. Analyse the prospects and requirements for the scaling-up of SWC activities.

In Chapter 2 the seriousness of land degradation and its impact are assessed from a historical and a farmer perspective. I used a methodology that is particularly applicable in regions where data are not available. In order to generate the required data, farmers were directly involved in the assessment of soil, productivity and vegetation cover loss over the past decades, both on cropland and on rangeland. The results show that the intensive use of small cropland fields has increased soil degradation and consequently led to less water and nutrient availability. Due to the subsequent productivity loss, many cropland fields have been abandoned. Rangeland is also severely degraded as a result of the excessive removal of vegetation and subsequent soil loss. Hence, land degradation has increased over the past decades. The study reveals that farmers are very concerned; they blame changed rainfall and less available cropland. However, given that farmers consider both factors beyond their control, no serious initiatives are undertaken to solve the land degradation problem. There is thus a need for urgent (integrated) action with regard to SWC.

Obviously farmers do conduct some SWC practices, but their traditional way of farming can no longer fulfil the increased demand for food of the growing population. Sound land management is required to stop land degradation; combining runoff control on cropland and adequate soil management to improve soil quality is essential. Improving soil quality without controlling runoff is not very effective in this region; neither is only runoff control (the traditional approach of SWC projects). Chapter 3 presents a large stock of available SWC practices for this region, however, only four practices can be promoted without major restrictions: diversion ditches, stone barriers, mixed cropping, and improved manure use. Combining these practices is the most promising short-term alternative for combating land degradation, given that they are generally most effective and at the same time most easily replicable by farmers.

In Chapter 4 the focus is on adoption of SWC practices, and on trying to understand why some farmers invest more in their land than others. Based on a large case study in the three experimental villages of the JGRC project, I determined the decisive key-factors influencing farm households' SWC investments. The household's progressiveness most

influences the decision how much to invest; dynamic and responsible families are among the first. Economic stratum is also important; more income from agriculture leads to higher investments in conservation practices. These practices are preferably executed on fields where the required effort is least and where the impact is highest. Based on these results, four fundamentals are given for a SWC strategy that aims at motivating farmers for SWC: 1) focus on most progressive farmers; 2) achieve short-term impact and success in SWC; 3) enhance the profitability of agriculture; and 4) invest in satisfying households' basic needs.

Together with two other fundamentals (stimulate collaboration within a village, and promote income diversification) these are principal inputs for the formulation of the logical strategy for SWC. In Chapter 5 this strategy is presented as a promising strategy for changing mostly passive Bolivian Andes farmers into active participators in natural resources conservation. A crucial and transversal theme is motivation, especially intrinsic motivation, because it enhances the genuine participation of farmers. Therefore, in the logical strategy, first a solid foundation is laid of intrinsically motivated and genuinely participating villagers with a progress-driven attitude. Next, SWC activities are planned and executed within a holistic framework of rural development activities. Collaboration and the use of farmer-trainers enhance sustainability of all activities. Practical experiences with the logical strategy in the five study villages show its potential to motivate farmers for SWC and achieve sustainable changes.

The practical results obtained with the logical strategy are further investigated in the following chapters. In Chapter 6 I analyse the first phase: the laying of a solid foundation for sustainable development. In this phase, activities focus on five basic conditions for sustainable development in rural villages: leadership and organization, responsible participation, effective collaboration, mutual trust and environmental awareness. The results show that the existence of a solid foundation is crucial for the success of other development activities, such as SWC activities. However, given that two years after the project's withdrawal the firmness of the foundation had slightly weakened, I conclude that a better integration of these villages in local development processes is essential to profit from the new dynamics. This is especially true for SWC. To achieve this integration, municipalities must be encouraged to invest in laying this solid foundation in rural villages and in facilitating follow-up activities to keep the dynamic process going. This study shows that such investments result in better organized villages, more equality, and the genuine participation of more people in sustainable village development.

The second phase of the logical strategy is analysed in Chapter 7. In this phase, SWC contests between farmer groups are organized. This chapter analyses the results and impact of these contests, and explores possibilities of using them in an extension strategy for sustainable agriculture. The contests aimed at quickly achieving widespread sustainable results. Mixed successes were obtained. In three villages, participation rates in the SWC activities introduced in the contests were still high even two years after project withdrawal. These were all villages where a solid foundation for sustainable development had been laid before the contests were held. In these villages, large areas are nowadays protected with physical SWC practices, and farmers have started to experiment with different soil management practices. In other villages the impact was less. However, in none of the villages Conservation Leaders did continue with their training activities, and SWC practices were

often not properly maintained. In order to become a more effective extension tool and achieve widespread impact, SWC contests must receive continued support by a catalyst agency. Moreover, other SWC contests should also be organized in which practices are not predefined. SWC contests are a low-budget training tool, and local municipalities can therefore have an important role in organizing them.

Given that both preceding chapters concluded that the impact of the logical strategy is not optimal because of lack of institutional support (especially from local municipalities), Chapter 8 focuses on how to establish effective micro-meso-macro linkages and collaboration between motivated key actors. Both are crucial for the scaling-up of SWC and related development activities. However, in Bolivia these linkages do not work; there are numerous constraints within and between all institutional levels. Lack of human capacity to formulate sound policies and to enable collaboration is the major constraint in the current political-institutional context. Small-scale successful projects with farmer-based SWC strategies therefore remain isolated experiences. The prospects for scaling-up such experiences are not hopeful. Policy-makers are disconnected from the field and neo-liberal principles still prevail. A radical attitude change is required from the national government: they must make the first step in defining a clear strategy, in expressing their commitment, and in demanding donor countries to help them with capacity building at the micro-, meso- and macro level.

In the synthesis, Chapter 9, I provide the answer to the research question of this thesis. Motivating farmers to adopt SWC practices on a wide scale can be achieved by moving people – at different institutional levels – towards collective action in SWC. From the top to the bottom, farmers must be supported and motivated by means adequate strategies so they will invest in sustainable land management and establish sustainable livelihoods. From the bottom to the top, farmers must contribute to local sustainable development, and small-scale experiences must feed adequate sector-wide approaches for scaling-up SWC. Only collective actions by committed people with a common goal can make widespread adoption of SWC a reality. To make a start, I finalize this thesis by suggesting two concrete parallel steps. A first one is at the micro/meso level interface, where development programmes must generate eye-catching experiences in some key-villages with strategies like the logical strategy. Capacity building at the municipal level is essential, and local universities must be involved in the training of farmers and extension workers. A solid partnership between development agencies must provide sustained support and guarantee sufficient funding. The dissemination of successful achievements to other actors will push scaling-up. Moreover, these bottom-up forces can trigger changes at the higher levels, and also move people there for collective action. A second simultaneous step is at meso/macro level interface. Profound changes at this level should support successful experiences at the lower levels, and new politics must enable empowered micro- and meso level actors to contribute to adequate strategy development. Capacity building is crucial; good professionals are needed within all institutions. This step requires changes to be made very soon. An independent permanent task-force should be created – with international development experts and apolitical Bolivian scholars – whose recommendations must be implemented by consecutive governments.

Land degradation in this region is not completely irreversible, and partial rehabilitation seems to be the most feasible future scenario; provided that people can be moved towards collective action in SWC.

Samenvatting

Dit proefschrift is geïnspireerd door mijn grote bezorgdheid dat landdegradatie (en vooral erosie) zichtbaar toenemen in de inter-Andean valleys van Bolivia, en dat er geen actie wordt ondernomen om het te stoppen. Van augustus 1999 tot december 2003 werkte ik in de noordelijke helft van het Departement Chuquisaca in Bolivia, binnen een project dat gefinancierd werd door de 'Japan Green Resources Corporation' (JGRC) en de departementale overheid van Chuquisaca. In dit project zochten wij naar adequate bodem- en waterconserverings (BWC) maatregelen en strategieën om landdegradatie aan te pakken. In 2001 startte ik met dit PhD onderzoek, met als doel het beantwoorden van de volgende hoofdonderzoeksvraag: Hoe kunnen boeren in de inter-Andean valleys van Bolivia gemotiveerd worden om op grote schaal BWC maatregelen te adopteren? Ik werkte met vijf specifieke doelstellingen:

1. Het evalueren van de ernst van land degradatie in de inter-Andean valleys van Bolivia;
2. Het valideren van beschikbare BWC maatregelen in het gebied;
3. Het bepalen van sleutelfactoren die de beslissing beïnvloeden van boerenhuishoudens om in BWC maatregelen te investeren;
4. Het valideren van een strategie die boeren motiveert om BWC maatregelen te adopteren;
5. Het analyseren van de perspectieven en vereisten om BWC maatregelen op te schalen.

In Hoofdstuk 2 wordt de ernst van landdegradatie en de impact ervan geëvalueerd vanuit een historisch- en boeren perspectief. Ik gebruikte daarbij een methode die vooral toegepast kan worden in gebieden waar geen gegevens beschikbaar zijn. Om de gewenste gegevens te verkrijgen werden boeren direct betrokken bij het evalueren van bodemverlies, bodemproductiviteitsverlies en vegetatieverlies over de laatste decennia, zowel op akkerbouwland als graasgronden. De resultaten laten zien dat het intensieve gebruik van kleine akkers heeft geleid tot bodemdegradatie, wat op zijn beurt heeft geleid tot een lagere beschikbaarheid van water en nutriënten. Vanwege het daaruit volgende verlies aan bodemproductiviteit, zijn veel akkers uit productie genomen. Graasgronden zijn ook sterk gedegradeerd als resultaat van het excessieve gebruik van de vegetatie en het daaruit resulterende bodemverlies. Landdegradatie is dus toegenomen over de laatste decennia. De studie laat zien dat boeren erg bezorgd zijn. Zij geven de schuld aan veranderende regenval en de beperktere beschikbaarheid van akkerbouwland. Omdat boeren beide factoren als onbeheersbaar beschouwen, worden er geen serieuze initiatieven ondernomen om het probleem van landdegradatie op te lossen. Er is dus een urgente noodzaak tot (geïntegreerde) acties ten aanzien van BWC.

Natuurlijk voeren boeren BWC maatregelen uit, maar traditionele landbouwmethodes kunnen de toegenomen vraag naar voedsel van een groeiende bevolking niet aan. Degelijk beheer van het land is nodig om landdegradatie te stoppen, waarbij het essentieel is om tegelijkertijd én de oppervlakkige afstroming van water op akkers te controleren, én de bodemkwaliteit te verbeteren d.m.v. beter bodembeheer. Het is niet erg effectief om het één wel en het ander niet te doen (zoals traditionele BWC projecten dat plachten te doen). Hoofdstuk 3 presenteert een grote hoeveelheid beschikbare BWC maatregelen voor dit gebied, echter, slechts vier maatregelen kunnen gepromoot worden zonder beperkingen: afleidingskanalen, stenen rijen, gemengd gezaaide gewassen, en beter mestgebruik. Het

combineren van deze maatregelen is het meest veelbelovende alternatief om op korte termijn landdegradatie tegen te gaan, omdat ze over het algemeen effectief zijn en te repliceren door boeren.

Hoofdstuk 4 is gericht op de adoptie van BWC maatregelen, en op het leren begrijpen waarom sommige boeren meer in hun land investeren dan anderen. M.b.v. een grote studie in de drie experimentele dorpen van het JGRC project, bepaalde ik de sleutelfactoren die investeringen van boerenhuishoudens in BWC maatregelen bepalen. Vooruitstrevendheid van een huishouden is het meest invloedrijk op de beslissing hoeveel er geïnvesteerd wordt: dynamische en verantwoordelijke families zijn de eersten. Economische klasse is ook belangrijk: meer inkomen uit landbouw leidt tot hogere investeringen in BWC maatregelen. Deze maatregelen worden bij voorkeur aangelegd op velden waar de minste inspanning is vereist en waar de impact het hoogst is. Gebaseerd op deze resultaten identificeerde ik vier pilaren voor een strategie die boeren moet motiveren voor BWC: 1) focus op de meest progressieve boeren; 2) bereik zo snel mogelijk impact en succes in BWC; 3) vergroot de rentabiliteit van de landbouwactiviteiten; en 4) investeer in het bevredigen van de basislevensbehoeften van de huishoudens.

Samen met nog twee andere pilaren (het stimuleren van samenwerking binnen een dorp en het promoten van inkomensdiversificatie) zijn dit de belangrijkste componenten van de ‘logical strategy’ voor BWC zoals uitgevoerd door het JGRC project. In hoofdstuk 5 wordt deze strategie gepresenteerd als een veelbelovende strategie om over het algemeen passieve Boliviaanse Andes boeren te vernaderen in actieve deelnemers in de conservering van natuurlijke hulpbronnen. Een cruciaal en transversaal thema is motivatie, voornamelijk intrinsieke motivatie, omdat dit de daadwerkelijke participatie van boeren vergroot. In de ‘logical strategy’ wordt daarom eerst een fundament gelegd van intrinsiek gemotiveerde boeren en daadwerkelijk participerende dorpelingen met een vooruitstrevende houding. Pas daarna worden er BWC maatregelen gepland en uitgevoerd binnen een holistisch kader van plattelandsontwikkelingsactiviteiten. Samenwerking en het gebruik van boeren trainers vergroot de duurzaamheid van de activiteiten.

De resultaten bereikt met de ‘logical strategy’ worden onderzocht in de navolgende hoofdstukken. In hoofdstuk 6 analyseer ik de eerste fase: het leggen van een solide fundament voor duurzame ontwikkeling. In deze fase zijn de activiteiten gericht op vijf basis condities voor duurzame ontwikkeling in plattelandsdorpen: leiderschap en organisatie, verantwoordelijke participatie, effectieve samenwerking, wederzijds vertrouwen, en milieu bewustzijn. De resultaten laten zien dat dit solide fundament cruciaal is voor het succes van BWC en andere ontwikkelingsactiviteiten. Echter, omdat twee jaar na sluiting van het project dit fundament licht was verzwakt, concludeer ik dat een betere integratie van de dorpen in lokale ontwikkelingsprocessen essentieel is om te kunnen profiteren van de nieuwe dynamiek. Dit geldt met name voor BWC. Om deze integratie te bereiken moeten lokale overheden aangemoedigd worden om te investeren in het leggen van een dergelijk solide fundament in de dorpen, en in het faciliteren van follow-up activiteiten om het dynamische proces op gang te houden. Deze studie laat zien dat zulke investeringen leiden tot beter georganiseerde dorpen, meer gelijkheid, en de daadwerkelijke participatie van meer mensen in de duurzame ontwikkeling van hun dorp.

De tweede fase van de logische strategie wordt geanalyseerd in Hoofdstuk 7. In deze fase worden er BWC-competities georganiseerd tussen boerengroepen. Dit hoofdstuk analyseert de resultaten en impact van deze competities, en verkent de mogelijkheden om ze te gebruiken in een voorlichtingsstrategie voor duurzame landbouw. De competities waren gericht op het bereiken van snelle, grootschalige en duurzame resultaten. Er werden gemengde resultaten behaald. In drie dorpen was de deelname aan BWC activiteiten zelfs twee jaar na sluiting van het project nog steeds hoog. Dit waren allemaal dorpen waar een solide fundament was gelegd voor duurzame ontwikkeling vóórdat de competities werden georganiseerd. In deze dorpen zijn er vandaag de dag grote gebieden beschermd met BWC maatregelen, en boeren zijn gestart met het experimenteren met bodembeheersmaatregelen. In andere dorpen was de impact minder. Bovendien waren in geen enkel dorp 'Conservation Leaders' verder gegaan met hun trainingsactiviteiten, en BWC maatregelen werden vaak ook niet goed onderhouden. Om te bereiken dat BWC-competities daadwerkelijk een effectief werktuig worden met grootschalige impact, moeten zij continu ondersteund worden door een katalyserende organisatie. Bovendien moeten er ook BWC-competities gehouden worden waarbij de maatregelen niet van tevoren vastgelegd zijn. De BWC-competities zijn een vrij goedkoop trainingswerktuig, en lokale overheden kunnen daarom een belangrijke rol hebben in het organiseren ervan.

Beide voorgaande hoofdstukken concludeerden dat de impact van de 'logical strategy' niet optimaal is vanwege het ontbreken van institutionele ondersteuning (met name van lokale overheden). Hoofdstuk 8 richt zich daarom op het leggen van effectieve verbindingen tussen de micro, meso en macro niveaus, en op samenwerking tussen gemotiveerde sleutel actoren. Beiden zijn cruciaal voor het opschalen van BWC- en andere ontwikkelingsactiviteiten. In Bolivia werken deze verbindingen momenteel niet; er zijn talrijke beperkingen binnen en tussen de institutionele niveaus. Gebrek aan competentie om degelijk beleid te formuleren en samenwerking mogelijk te maken is de belangrijkste beperking in de huidige politiek-institutionele context. Kleinschalige succesvolle projecten met op boeren gefundeerde strategieën blijven daarom geïsoleerde ervaringen. De vooruitzichten voor het opschalen van zulk soort ervaringen zijn niet hoopvol. Beleidsmakers hebben geen binding met het veld en neoliberale principes voeren de boventoon. Een radicale verandering in de houding van de nationale regering is vereist: zij moeten de eerste stap maken middels het definiëren van een duidelijke strategie, het uitspreken van hun betrokkenheid, en het vragen van hulp aan donor landen voor 'capacity building' op micro, meso en macro niveau.

In de synthese, Hoofdstuk 9, beantwoord ik de onderzoeksvraag van dit proefschrift. Het motiveren van boeren om op grote schaal BWC maatregelen te adopteren kan worden bereikt door mensen – op verschillende institutionele niveaus – te bewegen om collectief actie te ondernemen. Van de top naar beneden toe moeten boeren worden gesteund en gemotiveerd door middel van adequate strategieën, opdat zij zullen investeren in duurzaam landgebruik. Van de bodem naar boven toe moeten boeren bijdragen aan duurzame ontwikkeling, en kleinschalige ervaringen moeten gebruikt worden voor het formuleren van een adequate sector-brede aanpak voor het opschalen van BWC. Alleen collectieve acties door betrokken mensen met een gezamenlijk doel kan de wijdverspreide adoptie van BWC maatregelen mogelijk maken. Om een start te maken suggereer ik om twee concrete parallelle

stappen te nemen. De eerste stap is binnen het micro/meso domein. In het oogspringende ervaringen moeten worden gegenereerd met strategieën zoals de ‘logical strategy’, waarbij men zich eerst moet richten op een set geïntegreerde activiteiten en het verbeteren van de toekomstperspectieven van de bevolking. ‘Capacity building’ op gemeentelijk niveau (lokale overheid) is essentieel, en lokale universiteiten moeten worden betrokken bij de training van boeren en voorlichters. Solide partnerships tussen ontwikkelingsorganisaties moeten voorzien in ondersteuning en het garanderen van voldoende financiële middelen. De verspreiding van succesvolle resultaten richting andere actoren moet opschaling een push geven. Bovendien kunnen deze naar boven gerichte krachten veranderingen op de hogere schaalniveaus in gang zetten, en ook mensen dáár bewegen tot collectieve actie. Een tweede simultane stap is binnen het meso/macro domein. Verregaande veranderingen op deze niveaus moeten succesvolle ervaringen op de lagere niveaus ondersteunen, en nieuw beleid moet er voor zorgen dat versterkte micro en meso niveau actoren kunnen bijdragen aan het ontwikkelen van adequate strategieën. ‘Capacity building’ is cruciaal; er zijn goede technisch getrainde mensen nodig binnen alle instituten. Deze stap vereist dat veranderingen op korte termijn worden doorgevoerd. Een onafhankelijke task-force moet in het leven worden geroepen – met daarin internationale ontwikkelingsexperts en apolitieke Boliviaanse wetenschappers – wier aanbevelingen geïmplementeerd moeten worden door opeenvolgende regeringen.

Land degradatie in dit gebied is niet totaal onomkeerbaar, en gedeeltelijke herstel lijkt het meest haalbare toekomstige scenario; vooropgesteld dat de daarbij betrokken mensen bewogen kunnen worden tot collectieve actie in BWC.

Resumen

Esta tesis está inspirada por mi profunda preocupación que la degradación de tierras (especialmente la erosión del suelo) aumenta visiblemente en los Valles Interandinos de Bolivia, y que no se emprende acciones para pararlo. Desde Agosto del 1999 hasta Diciembre del 2003 trabajé en la región Chuquisaca norte de Bolivia, en un proyecto financiado por la Corporación de Recursos Verdes del Japón (JGRC) y la Prefectura de Chuquisaca. En este proyecto investigamos prácticas y estrategias adecuadas de conservación de suelos y aguas (CSA) para frenar la degradación de tierras. En el año 2001 empecé mi trabajo de doctorado, intentando de responder a la siguiente pregunta principal de investigación: ¿Cómo motivar a los campesinos de los Valles Interandinos de Bolivia para que adopten prácticas de conservación de suelos y aguas a gran escala? Para ello trabajé con los siguientes cinco objetivos específicos:

1. Evaluar la seriedad de la degradación de tierras en los valles Interandinos de Bolivia;
2. Validar las prácticas de CSA disponibles en la región;
3. Determinar factores claves que influyen las decisiones de las familias campesinas de invertir en CSA;
4. Validar una estrategia para motivar campesinos de adoptar prácticas de CSA;
5. Analizar las perspectivas para la ampliación de actividades de CSA.

En el Capítulo 2 la seriedad de la degradación de tierras y su impacto son evaluados desde una perspectiva campesina e histórica. Para el efecto he utilizado una metodología que es particularmente aplicable en regiones donde no hay datos disponibles. Para generar los datos requeridos, los campesinos fueron directamente involucrados en la evaluación de las pérdidas de suelo, productividad y cobertura vegetal en las décadas pasadas, tanto en tierras cultivables como áreas de pastoreo. Los resultados muestran que el uso intensivo de pequeños campos cultivables ha incrementado la degradación del suelo y consecuentemente ha resultado en una menor disponibilidad de agua y nutrientes. A causa de la pérdida de productividad del suelo, muchos campos cultivables han sido abandonados. Áreas de pastoreo se encuentran muy degradadas también como resultado de una remoción excesiva de la vegetación y la subsiguiente pérdida del suelo. Entonces, la degradación de tierras ha incrementado en las décadas pasadas. El estudio revela que los campesinos están muy preocupados; ellos lo atribuyen a cambios pluviométricos y la baja disponibilidad de tierra cultivables. Sin embargo, dado que los campesinos consideran ambos factores fuera de su control, no hay iniciativas serias de solucionar el problema de la degradación de tierras. Hay una necesidad urgente de tomar acciones (integradas) concerniente la CSA.

Obviamente los campesinos ejecutan prácticas de CSA, pero sus prácticas agrícolas tradicionales ya no pueden satisfacer la creciente demanda alimenticia de una población que va en aumento. Se requiere un buen manejo de la tierra para parar la degradación de tierras; combinar el control del escurrimiento en tierras cultivables con un manejo adecuado del suelo es esencial. Mejorar la calidad del suelo sin controlar el escurrimiento no es muy efectivo en esta región; ni tampoco lo tiene el sólo control del escurrimiento (el enfoque tradicional de los proyectos de CSA). El Capítulo 3 presenta un gran stock de prácticas de CSA disponibles en esta región, sin embargo, solamente cuatro prácticas pueden ser promocionadas sin mayores restricciones: zanjas de coronación, barreras de piedra, cultivos mixtos, y el uso

mejorado del estiércol. Combinar estas prácticas es la alternativa más prometedora a corto plazo para combatir la degradación de tierras, dado que es generalmente lo más eficaz y al mismo tiempo fácilmente replicable por los campesinos.

En el Capítulo 4 el enfoque está en la adopción de prácticas de CSA, y en intentar de entender porqué algunos campesinos invierten más en sus tierras que otros. Basado en un Estudio de Caso grande en las tres comunidades experimentales del proyecto JGRC, he determinado los factores claves decisivos que influyen las inversiones de las familias campesinas. El progresismo de la familia es el factor que más influye en la decisión de dónde invertir; las familias dinámicas y responsables son las primeras que invierten. El estrato económico es también importante; más ingresos agrícolas conducen a mayores inversiones en prácticas conservacionistas. Estas prácticas son ejecutadas preferiblemente en campos donde el esfuerzo es menor y donde el impacto de las mismas es mayor. Basado en estos resultados, identifiqué cuatro fundamentos de una estrategia de CSA que apunta a motivar campesinos para la CSA: 1) enfocar en los campesinos más progresistas; 2) obtener impacto y éxito a corto plazo en la CSA; 3) aumentar la rentabilidad de la agricultura; y 4) invertir para satisfacer las necesidades básicas de una familia campesina.

Junto con dos otros fundamentos (estimular la colaboración dentro de una comunidad, y promocionar la diversificación de ingresos) estos son los componentes principales de la estrategia lógica de CSA ejecutada por el proyecto JGRC. En el Capítulo 5 se presenta esta estrategia como una estrategia prometedora para cambiar campesinos Andinos Bolivianos mayormente pasivos en participantes activos en la conservación de los recursos naturales. Un tema crucial y transversal es la motivación, especialmente la motivación intrínseca, porque aumenta la participación genuina de los campesinos. Por lo tanto, en la estrategia lógica, primero se cimienta un fundamento sólido consistente de comunitarios intrínsicamente motivados y participando genuinamente con una actitud progresista. Después, se planifican y ejecutan prácticas de CSA dentro de un marco holístico de actividades de desarrollo rural. La colaboración y el uso de capacitadores campesinos aumentan la sostenibilidad de las actividades.

Los resultados prácticos obtenidos con la estrategia lógica son investigados en los Capítulos siguientes. En Capítulo 6 analizo la primera fase: la cimentación de un fundamento para el desarrollo sostenible. En esta fase las actividades enfocan en cinco condiciones básicas del desarrollo sostenible en comunidades rurales: liderazgo y organización, participación responsable, colaboración efectiva, confianza mutua, y conciencia ambiental. Los resultados muestran que la existencia de un fundamento sólido es crucial para el éxito de la CSA y otras actividades de desarrollo. Sin embargo, dado que dos años después del retiro del proyecto la solidez del fundamento se había debilitado ligeramente, concluyo que para aprovechar de esta nueva dinámica, una mejor integración de estas comunidades en procesos locales de desarrollo es esencial. Esto es especialmente importante en la CSA. Para alcanzar esta integración, municipalidades deben ser estimuladas de invertir en la cimentación de un fundamento sólido en comunidades rurales, y en facilitar actividades de seguimiento que puedan mantener la dinámica del proceso. Este estudio muestra que esas inversiones resultan en comunidades mejor organizadas, más igualdad, y la participación genuina de más gente en el desarrollo sostenible comunal.

La segunda fase de la estrategia lógica es analizada en Capítulo 7. En esta fase los concursos de CSA entre grupos de campesinos son organizados. Este capítulo analiza los resultados e impactos de los concursos, y explora las posibilidades de utilizarlos en una estrategia de extensión para una agricultura sostenible. Los concursos apuntan a obtener en poco tiempo resultados sostenibles y ampliamente difundidos. Se obtuvo resultados mixtos. En tres comunidades, la tasa de participación en las actividades de CSA introducidas durante los concursos fue aún elevada inclusive dos años después del retiro del proyecto. Estas fueron todas comunidades donde un fundamento sólido para el desarrollo sostenible fue cimentado antes de ejecutar los concursos. Grandes áreas son hoy en día protegidas con prácticas de CSA en estas comunidades, y campesinos han empezado a experimentar con diferentes prácticas de manejo del suelo. En otras comunidades el impacto fue menor. Además, en ninguna de las comunidades los Líderes Conservacionistas habían continuado con sus actividades de capacitación, y las prácticas de CSA fueron a menudo no correctamente mantenidas. Los concursos de CSA, para poder ser una herramienta efectiva de extensión y para obtener impactos a más gran escala, deben recibir apoyo continuo de una agencia catalizadora. Además, deben organizarse también concursos de CSA con prácticas no previamente definidas. Los concursos de CSA son una herramienta de extensión de bajo costo, por ende, municipalidades locales pueden tener un rol importante en organizarlos.

Ambos capítulos precedentes concluyeron que el impacto de la estrategia lógica no es óptimo, debido a la falta de apoyo institucional (especialmente por parte de los municipios). Por lo tanto, Capítulo 8 enfoca en establecer enlaces efectivos entre los niveles micro-meso-macro, y en la colaboración entre actores claves motivados. Ambos aspectos son cruciales para la ampliación de CSA y actividades de desarrollo relacionadas. En Bolivia estos enlaces actualmente no funcionan; hay numerosas limitaciones dentro y entre los niveles institucionales. La falta de capacidad humana para formular políticas coherentes y para facilitar la colaboración es el mayor limitante en el contexto político-institucional actual. Proyectos exitosos a pequeña escala que trabajan con estrategias de CSA participativas muchas veces no pasan de ser experiencias aisladas. Las perspectivas para la ampliación de estas experiencias no son prometedoras. Las personas que formulan las políticas frecuentemente se encuentran desconectadas del campo, y principios neo-liberales aún son dominantes. Se requiere de un cambio de actitud radical por parte del gobierno nacional: ellos deben dar el primer paso en definir una estrategia clara, en expresar su compromiso, y en demandar a los países donantes su ayuda en capacitar profesionales a los niveles micro, meso y macro.

En el Capítulo 9, en la síntesis, doy la respuesta a la pregunta de investigación principal de esta tesis. Motivar a los campesinos para que adopten prácticas de CSA a gran escala puede ser logrado cuando se mueva la gente – a diferentes niveles institucionales – hacia acciones colectivas en CSA. Desde arriba hacia abajo, campesinos deben ser apoyados y motivados a través de estrategias adecuadas, de modo que quieran invertir en el manejo sostenible de sus tierras. Desde abajo hacia arriba, campesinos deben contribuir al desarrollo local, y experiencias a pequeña escala deben ser utilizadas para formular un enfoque sectorial adecuado para la ampliación de CSA. Solamente la ejecución de acciones colectivas con gente comprometida puede hacer la adopción a mayor escala de la CSA una realidad. Para empezar, sugiero dos pasos paralelos concretos. Primero a nivel micro/meso, donde se deben

generar experiencias llamativas con estrategias como la estrategia lógica, enfocando antes que nada a un conjunto integrado de actividades para mejorar las perspectivas futuras de la gente. Capacitar recursos humanos a nivel municipal es esencial, y universidades locales deben ser involucradas en la capacitación de campesinos y extensionistas. Sociedades sólidas entre agencias de desarrollo deben proveer un apoyo sostenido y garantizar suficiente fondos. La difusión de logros exitosos a otros actores estimulará la ampliación. Además, estas fuerzas de abajo hacia arriba pueden provocar cambios a los niveles superiores, y mover también la gente allá para acciones colectivas. Un segundo paso simultáneo es a nivel meso/macro. Cambios profundos a este nivel deben apoyar las experiencias exitosas a niveles inferiores, y nuevas políticas deben permitir que actores apoderados a nivel micro/meso contribuyan al desarrollo de estrategias. Capacitar recursos humanos es crucial; buenos profesionales son necesitados en todas las instituciones. Este paso requiere cambios a corto plazo. Una comisión permanente e independiente debe ser creada – con expertos internacionales de desarrollo y profesionales apolíticos nacionales – cuyas recomendaciones deben ser implementadas por gobiernos consecutivos.

La degradación de tierras en la región no es completamente irreversible, y la rehabilitación parcial parece ser el escenario futuro más alcanzable; a condición de que la gente involucrada pueda ser movida hacia acciones colectivas en CSA.

Curriculum Vitae

Aad Kessler was born on the 11th of November 1966 in Wageningen, the Netherlands. At a very young age he lived a couple of years in Iraq, where his father was a drainage specialist at the International Institute for Land Reclamation and Improvement (ILRI). The interest in southern countries was always there, and in 1985 Aad started the study Tropical Land Use at the Wageningen University. In 1989 he went to Costa Rica for a practical period, which was his first acquaintance with Latin America. He graduated in 1991 with specializations in soil erosion, soil and water conservation, and Geographical Information Systems.

His first job was a NOP-project in Burkina Faso, Mali and Niger for the group of Erosion and Soil & Water Conservation (ESW). He studied the intervention approach and the different practices of five soil and water conservation projects. This work was published in 1995, together with other authors, as Tropical Resource Management Paper 8. After this, he worked half a year at ILRI as assistant of the Drainage Course, and then left in 1994 to work for FAO in Chile.

In Chile he worked two years at a regional project as Associate Professional Officer (APO), and supervised watershed management, GIS and participatory research activities in Argentina, Bolivia, Brazil, Chile, Paraguay and Uruguay. In 1997 he left for his second APO assignment to Peru, where he worked in Cusco at the FAO project FEMAP, within the local office of counterpart organization Pronamachcs. In Cusco he combined fieldwork in small rural villages with work at institutional level, focusing specifically at collaboration among local governments and NGOs. His employment with FAO ended in 1999.

In August 1999 he was appointed by the Japan Green Resource Corporation (J-Green) as Technical Director of the JALDA project in Sucre, Bolivia. He worked for 4½ years as coordinator of all the research and execution activities of this project, together with a team of Bolivian and Japanese experts. Given the amount of data and field experiences generated by this project, he decided in 2001 to start a PhD research at the ESW group, parallel to his project work. This combination provided the opportunity to enrich the project's strategy and to give it a more scientific basis. In 2003 the project published a set of 10 guidelines and research reports, as well as instructive technical leaflets concerning all validated SWC practices (available at http://www.green.go.jp/gyoumu/kaigai/manual/bolivia/).

In 2004 he returned with his Paraguayan wife and three children to Holland and started to work at the ESW group of Wageningen University with the analysis of all remaining data and the writing of a series of scientific articles. This thesis is the final result of his PhD research. Since June 2006 he is working at the ESW group as teacher and researcher on (Sustainable) Land Management Policies. Aad can be contacted at: Aad.Kessler@wur.nl.

PE&RC PhD Education Statement Form

With the educational activities listed below the PhD candidate has complied with the educational requirements set by the C.T. de Wit Graduate School for Production Ecology and Resource Conservation (PE&RC) which comprises of a minimum total of 22 credits (= 32 ECTS = 22 weeks of activities)

Review of Literature (3 credits)

- A logical strategy for soil and water conservation in the inter-Andean valleys of Bolivia (2003)

Writing of Project Proposal (5 credits)

- Motivating land users for wider adoption of soil and water conservation practices: a practical strategy at municipal level in the Bolivian Andes (2002)

Post-Graduate Courses (3 credits)

- Environmental analysis (1997)
- Agro-ecological zoning (1996)
- Project formulation and evaluation (1995)

Deficiency, Refresh, Brush-up and General Courses (3 credits)

- Scientific writing (2005)
- Impact assessment (2005)

PhD Discussion Groups (3 credits)

- Sustainable land use and resource management
- Sustainable development and economic profitability in Chuquisaca
- Inter-institutional platform on strategic planning and institutional collaboration (Chuquisaca)

PE&RC Annual Meetings, Seminars and Introduction Days (1.25 credits)

- Annual (one-week) meetings of the project's steering committee (Bolivia) (1996-1999)
- Annual meetings of the projects backstopping missions (Chile and Peru, with FAO) (2000-2003)
- PE&RC annual meeting: The truth of science (2005)

International Symposia, Workshops and Conferences (5 credits)

- First Latin American Congress of IUFRO (Valdivia-Chile) (1998)
- ISCO Conference (Buenos Aires, Argentina) (2000)
- National workshop on formulating the Bolivian strategy for soils (2003)
- International symposium on land degradation and desertification, Uberlandia, Brazil (2005)
- COST 634 meeting on soil erosion, Rouen, France (2005)

Laboratory Training and Working Visits (2 credits)

- CIP-CONDESAN-Peru, Watershed management and erosion control in Cajamarca (2000)
- EMBRAPA-Brazil, No-tillage systems and farmer organisations (2001)