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Towards climate change adaptation, sustainable development and conflict resolution – the Cinturón Andino Biosphere Reserve in Southern Colombia

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Abstract

Cinturón Andino is the largest biosphere reserve of Colombia, located in the southernmost region of the state, the so-called Macizo Colombiano. For years threatened by guerilla activities and internal conflicts between indígenas and campesinos, the farmers have now initiated new attempts to adapt to climate change, to implement organic farming in order to secure the water quality and supply for the large cities in the vicinity of the park, to improve their livelihood and to strengthen the social and human capital. This article describes the chosen path to sustainability and provides suggestions for the adaptation of the park to the UNESCO Seville Strategy for biosphere reserves.

Profile

Protected Area

Cinturón Andino Biosphere Reserve

Mountain range

Andes

Country

Columbia

Introduction

In recent decades, Latin-American countries have shown continued interest in implementing UNESCO biosphere reserves, these have not yet been fully consolidated (Danielle et al. 1999). Most parks are installed in Mexico (11), Chile and Argentina (7 each). Colombia has six biosphere reserves, none of which corresponds to the new concepts of the Seville Strategy. Management in each of them is insufficient. In contrast, Cinturón Andino Biosphere Reserve (BR) shows good potential to transform the protected area into a model region of sustainable development. This is why we take it as a case in point for our report. The case study area provides manifold ecosystem services to the rest of the Colombian territory. Careful and sustainable land use and handling of the natural resources is a challenge for inhabitants, farmers and BR management. It can be regarded as a future best practice model of BRs as described by the German Commission for UNESCO (2011) or the Austrian MAB Committee (2011).

The Cinturón Andino – hotspot of biodiversity and water tower of Colombia

In 1979, UNESO declared the Cinturón Andino a biosphere reserve. It is located in the *Macizo Colombiano* departments of Huila, Cauca, Caquetá and Tolima and includes three national parks (Nevado de Huila, Puracé and Cueva de los Guacharos) on an area of 855 000 ha. The BR was created from three existing protected areas and to this day no exact boundaries have been defined for it. To overcome this strange situation, a delimitation was proposed by the authorities, which is illustrated in Figure 2. In 2011, the Institute of Mountain Research (IGF), the Foundation Eco-

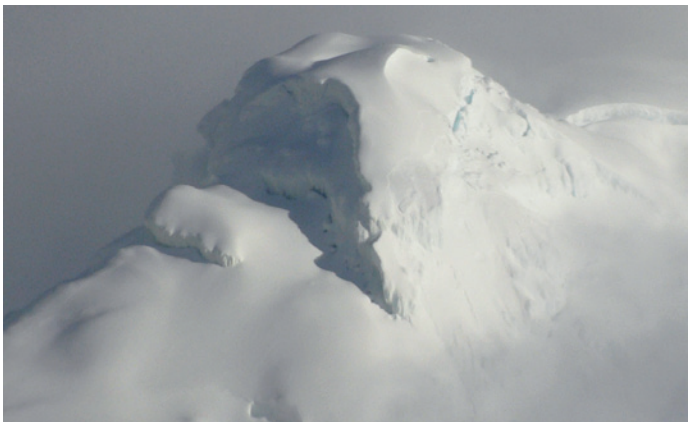

Figure 1 – Nevado del Huila, highest peak in the Cinturón Andino BR.

habitats and the Environmental Studies Group (ASG) of the Universidad del Cauca started a joint research project on Colombian BRs and in the same year began with fieldwork in this protected area. The challenge is to adapt the Colombian BRs to the Seville Strategy. A first workshop with BR managers, held in Bogotá on 18 July 2011, was dedicated to coordinating interaction on a work plan that addresses strategies for the management of BRs in Colombia.

Cinturón Andino covers a variety of natural landscapes and enormous biodiversity, ranging from glaciers, *páramos*, *super páramos* to andine and sub-andine zones. It is the water tower of Colombia, the source of four important rivers, the Magdalena, Cauca (both to the Caribbean Sea), Patía (to the Pacific) and Caquetá (to the Amazon). The highest elevation is the Nevado de Huila with 5 750 m. It includes a variety of geological formations (Cadena Vólcanica de los Coconucos), seven volcanic craters, 30 mountain lakes, many waterfalls, hot springs, fumaroles, sulfatares. The area of the Cinturón Andino contains 372 species of birds (or 38% of the birds of the Andean region and 21.2%

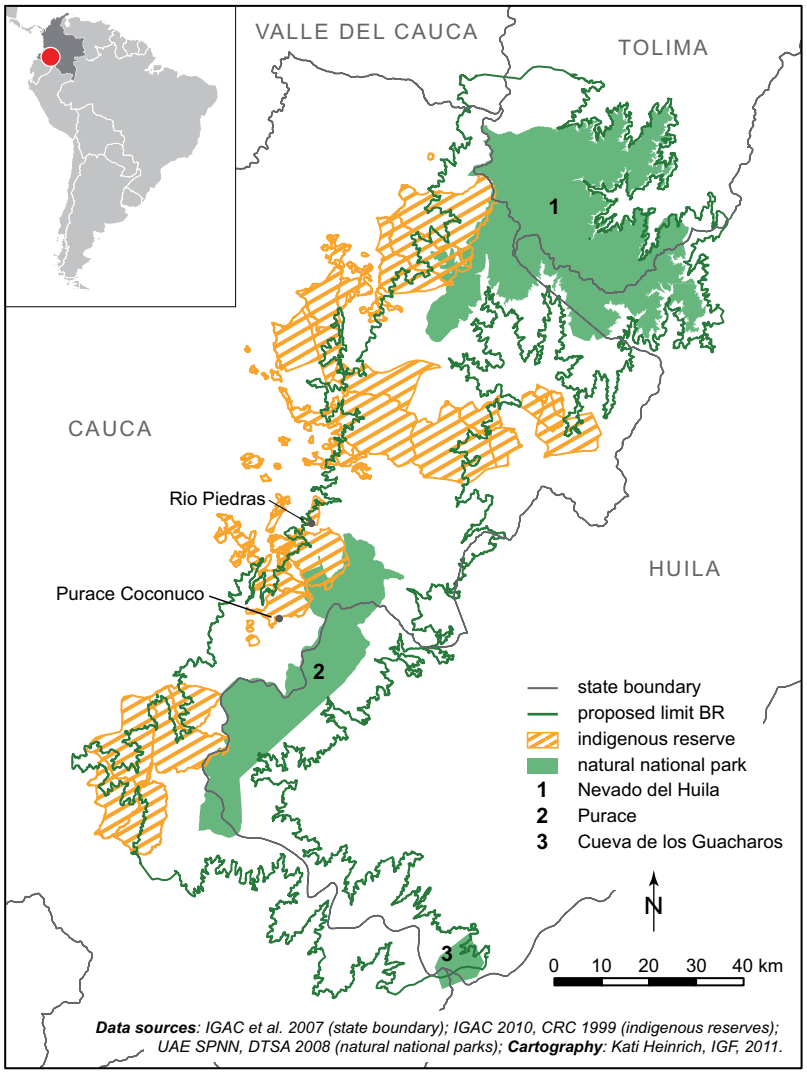

Figure 2 – Location of the Cinturón Andino in Southern Colombia.

of those in Colombia), 73 mammal species (equivalent to 16% of national biodiversity) and 27% of the plant species registered for the neotropics in the *páramo* ecosystem (Paz & Ortega 1999). The living space of the condor *(Vultur gryphus),* the semi-collared hawk *(Accipiter collaris)*, the northern pudu (*Pudu mephistopheles*), the spectacled bear *(Tremarctos ornatus)* and the mountain tapir *(Tapirus pichaque)* make the BR a real attraction for visitors (see Figure 3).

The BR is inhabited by Indian communities from the ethnic groups of the *Paez, Guambiano, Koconuco, Yanacona, Kamtzá, Totoró* and *Ingano* and several peasant communities. Despite the presence of guerrillas, the Colombian army has gained better control of the territory within the last eight years, so that new initiatives of protection and development can start now.

A model region for sustainable development?

The field work in the Cinturón Andino focused on strategies for coping with climate change, for securing participatory work with *indígenas* and *campesinos* and for

Figure 3 – Alto Río Piedras: home of the condor.

strengthening sustainable regional development in the protected area.

Important initiatives to enhance sustainable development, specifically by organic farming and resolving existing conflicts between campesinos and indígenas, already started in 2001 / 2002 with the foundation of the Río Piedras association and the signing of the *Pacto de Conviviencia en la Cuenca Río Las Piedras* (Pact of Cohabitation in the River Piedras Basin), the implementation of ASOCAMPO (in 1998) and the cooperation of indigenous Quintana and Puracé *cabildos.* Until the foundation of the Río Piedras association, violent conflicts, even including murder (the locals call this time *guerra,* war), were common (with criminal acts specifically in the years 1998–2000, Equipo Técnico (2009, p. 15)). They stemmed from the different legal systems of the peasants (land owners working on their own account) and the indígenas (the land is owned by the council, the farmers depend on this organization; substitutes and specific rights by the government). The Río Piedras association succeeded in ending these conflicts and establishing legal security for all inhabitants (Figure 5).

The Joint Program of the United Nations, the Ministry of the Environment and the Institute of Hydrology, Meteorology and Environmental Studies of Colombia (IDEAM), the indigenous *cabildos* and the municipalities of Puracé and Popayán, the SAESP (Sociedad de Aceducto y Alcantarillado de Popayán) supported the initiatives for conservation and adaptation to climate change in the Colombian Massif. In the upper basin of the Cauca river, on the territory of six indigenous groups (*Paletara, Kokonuko, Puracé, Poblazon* and *Quintana*) and two peasant communities, six schools for climate change adaptation education (ECAES: Estrategía de Escuela de Campo; Strategy for Rural Schools) were founded to educate the young generation and to share local and innovative knowledge. A system of *mother* (principal models), *daughter* and *grandchild* organic farms (following the mother-model in different stages) was installed in approximately 900 farms. They cooperate with ECAES to discover and develop measures in agricultural, envi-

Figure 4 – Páramo *with espeletias.*

Figure 5 – Indígeno and campesino in conversation: symbol of a new understanding.

ronmental, and social policies that contribute to sustainable development in their territories.

Actual main challenges are the climate change effects, i.e. increased variability of precipitation (*El Niño* years: lack of precipitations; *La Niña* years: very wet and cold years) and an increase in soil erosion, securing water quality for the cities (organic farming to avoid mineral fertilizers and biocides) and securing or even improving the provision with agricultural products to avoid hunger and poverty.

Analysis and livelihood potential

Profound analyses of climate anomalies are the basis of adaptation strategies. Modern communication technologies, Geographical Information Systems, remote sensing and modelling help to monitor climate, vegetation and soils. Other necessary activities include documenting ongoing events, analysing upcoming risks and vulnerabilities, developing scenarios, detecting dangers and opportunities and working out concrete measures in technology, land use, agriculture and political support. Close cooperation and information sharing between scientists and practitioners, consultants and politicians helps to achieve adequate reactions.

As the BR provides ecosystem services for the tributary lowlands (above all: water provision, erosion protection), all efforts should be made to secure these services. The ecology group of the University of Cauca (http://gea.unicauca.edu.co/) has already established monitoring systems including climate, vegetation, hydrology and socio-economics. This makes specific analyses feasible. For the Río Piedras river basin the following issues seem to make the region vulnerable to climate change:

- increase of precipitation variability (droughts in *El Niño* years, inundations in *La Niña* years, Figure 6) and extreme weather events: thunderstorms, hot or cold periods;
- increase of maximum and minimum temperatures (from 1960–2000 in Puracé: 13.6–16.0 °C max.; 4.0–6.0 °C min., average per day: from 9.07 to 9.53 °C) and precipitations (2012.6–2113.3 mm / y, that is an increase of 100.75 mm per year);
- increase of erosion processes.

Socio-economic and cultural vulnerabilities are:

- small farms at great economic risk;
- variability of prices for agricultural products due to increasing global competition;
- lack of a brand or label for regional agricultural products;
- new regulations for milk delivery to dairies (from 2013 milk has to be pasteurized before delivery).

The natural, social and human capital of the region is high. Fertile soils, abundant water, the (normally) good climate conditions and the variety of possible agricultural products due to the different elevation levels provide a favourable basis for agriculture. Local expertise and openness for innovations form an important basis for future developments. Social and economic networks (cabildos, cooperatives) enhance the strengths of the region. Music bands intensify the social contacts (Figure 7). However, financial capital is precarious (subsidies by the state, low capital of the fincas) and physical capital is reduced to land ownership, the farms and their livestock. Thus the livelihood pentagon is restricted to only three pillars: the natural, social and human capital, of which the natural capital is vulnerable to climate change effects (Figure 8).

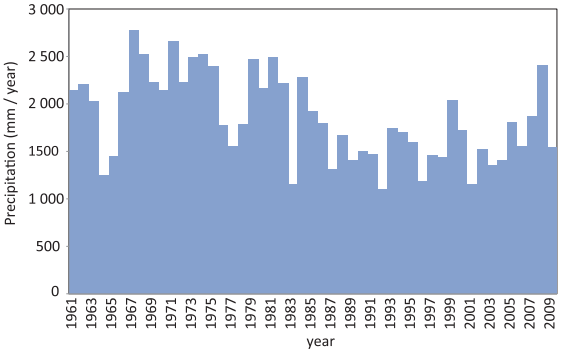

Figure 6 – Rainfall variation 1947–2009. Coconuco station at 3 670 m. Authors' design.

Figure 7 – Musicians in Río Piedras.

Figure 9 – Composting system at the Finca Cajamarca, Cesar Hidalgo, Río Piedras.

Organic farming and climate change adaptation

In Río Piedras and Puracé several adaptation strategies have been developed, initially just for climate change. These have proved very useful, both in the drought of 2009 and in the very wet year 2011. The first objective was improving the retention function of the mountain vegetation and the erosion protection. Protective forests were planted and measures taken to protect the raised bogs of the *páramo*. In an effort to prevent the groundwater getting eutrophied by mineral fertilizers, the farmers, who are organized in councils and cooperatives, decided to introduce organic farming methods. Mineral fertilizer has been replaced by compost from composting systems (so-called *biofábricas*) installed on every finca. These systems are fed with dung, biomass and household waste. The biofábricas of the four agricultural colleges produce 880 kg of compost every two to four months (Figure 9). This is more than each finca needs and the excess is sold on the market. A 40 kg bag of compost fetches up to € 3, a sale of 30 bags, after accounting for the manpower, can yield nearly € 85 profit.

In the milking sheds, the slurry is drained off into tanks and water added (at a rate of 1:10). After a maturing period, it is spread on the pastures at a rate of no more than one litre per 150 m² to prevent eutrophy. Plant protection mixes based on calendula, tobacco, nettle, bracken, camomile etc. are also produced on the fincas and then sprayed on the crops or spread on the soil.

The pastures are subdivided into small portions using electric fences. Trees have been planted and felling stopped to give the livestock some shade and reduce erosion. In addition, steep slopes have been terraced, mainly using organic materials such as bamboo, acacia wood and similar. The tree nurseries are using organic methods to produce mainly indigenous tree species. Fodder plants have been sown to cover dry periods. Delicate plants are grown in greenhouses. Drip irrigation is used in market gardening and fruit growing to overcome dry periods.

These measures protect the groundwater and help prevent erosion, enhance plant health and resistance vis-à-vis dry and wet periods and help produce better crops for the consumers. Bioengineering techniques are also employed in road maintenance to prevent erosion and landslides and ensure year-round use (Figure 11).

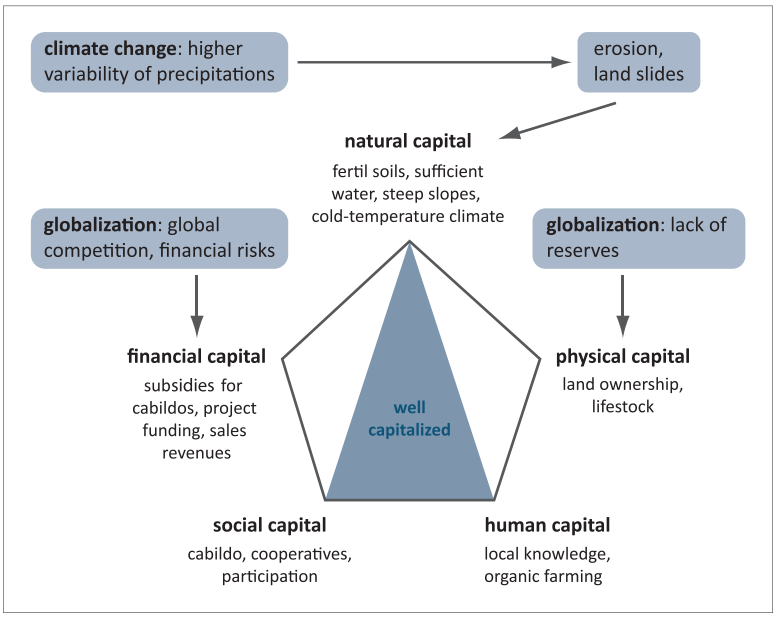

Figure 8 – Vulnerabilities of livelihood. Blue boxes: drivers of vulnerability. Authors' design.

Towards sustainability

The measures taken so far are limited to strengthening natural, social and human capital. After calming the conflicts between indígenas and campesinos, the social capital, specifically in the Río Piedras / Puracé region is high. As is true for many other BRs around the world, community orientations and social capital constitute a significant contribution to regional sustainable development projects in the Cinturón Andina BR. The social capital present in the Cinturón Andina region draws on the societal dimension of sustainability which mirrors the sustainability concept in the social element. A basic thrust of sustainable politics

Figure 10 – Securing the roads.

Figure 11 – Coffea castilla *seedlings, Finca Cajamarca.*

and development at regional level is to take future-oriented decision cooperatively with those who will feel their consequences: the local citizens (Meadowcroft 2004). This demand of opening up decision-making processes for public participation in policy fields that concern sustainability patterns goes back to the 1993 Brundtland reports' suggestions on how to implement sustainable decisions and practices and is also reflected in the Seville Strategy of the UNESCO Man and the Biosphere Programme (Lange 2005; Stoll-Kleemann & Welp 2008). Hence BRs, as sites for a sustainable coexistence of man and the biosphere, need to acknowledge and implement governance models that enable local stakeholders to participate in development processes at regional level. This has to be implemented in Cinturón BR if it wants to be designated as fulfilling the Seville strategy.

Meanwhile, management practice in many BRs has shown that long-lasting cooperation and participation in regional development processes is hard to sustain without the initiative of engaged citizens and a functioning that local civil society (Stoll-Kleemann & Welp 2008). This experience coincides with the obstacles local Agenda 21 initiatives often had to confront: long-term participatory processes need active engagement of local citizens (see Geißel & Kern 2000). Furthermore, judging from the integrative sustainable development concept, regional sustainability is hard to initiate without social capital. Participative processes need an active community to enable change (Geißel & Kern 2000; Pretty 1995). As practice in many BRs has shown, the desired result of a broad integration of local citizens into participative regional development processes did not last in regions that lacked the initiative of engaged citizens and a functioning local / regional civil society (Stoll-Kleemann & Welp 2008). Indeed, true culture of sustainability is impossible without central elements of social capital. In this understanding, the ideal of sustainable social capital concerns first and foremost the organization of self-organization. Collective action without institutional compulsion to cooperate takes alternative linkages between the individuals concerned that social capital can enhance. To sum up, social capital is of crucial relevance for the success of sustainable regional development processes.

To achieve sustainability it is vital that financial and material capital be increased as well. Economic vulnerability remains high, despite organic farming, improved products and the resolution of conflicts. Organically produced crops are of high quality but cannot as yet achieve higher prices on the market. What they need is clear labelling, ideally a quality label that marks the produce out as a premium product. Moreover, the dairy products made on the fincas are currently not being refined. The soft cheese is not fetching high prices. If it were further processed in the region (dairies producing hard cheese, yoghurt and other value-added products), revenue could be raised considerably and capital be generated for further investment.

Adapting the BR to the Seville or even Madrid strategy could deliver an impulse for true sustainability, starting in Río Piedras and Puracé and eventually reaching across the entire BR area. This would make the *Macizo Colombiano* a leading model region of sustainability in Colombia and the BR Cinturón Andino would realize the *full value of parks* (Harmon & Putney 2003).

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