Chapter 29
The Role of Biodiversity Research for the Local Scientific Community

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29.1 Collaborative German–Ecuadorian Biodiversity and Ecosystem Research in Southern Ecuador

Joint German–Ecuadorian biodiversity research in the study area is looking back on 15 years of fruitful collaboration and benefit sharing (Bendix and Beck 2012, see also "Preface"). Currently, 50 individual projects are working in the area of southern Ecuador. Biodiversity research started in 1997 with six projects funded by the German Research Foundation (Deutsche Forschungsgemeinschaft, DFG) in the Rio San Francisco valley, mainly aiming at biotic and abiotic inventories of this widely unknown area which turned out as a hot spot of biological diversity. Four years later (in 2001), a first collaborative Research Unit (RU402 "Functionality in a Tropical Mountain Rainforest: Diversity, Dynamic Processes and Utilization Potentials under Ecosystem Perspectives") started with a number of 17 DFG-funded projects, increasing to 25 in the second funding phase of that Research Unit (2005–2007). The main focus of the research program was to investigate ecosystem functioning along various environmental gradients (Beck et al. 2008). Aims and

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J. Bendix et al. (eds.), *Ecosystem Services, Biodiversity and Environmental Change in a Tropical Mountain Ecosystem of South Ecuador*, Ecological Studies 221,
DOI 10.1007/978-3-642-38137-9_29, © Springer-Verlag Berlin Heidelberg 2013

results of the subsequent and current Research Unit (RU816 "Biodiversity and Sustainable Management of a Megadiverse Mountain Ecosystem in South Ecuador" 2007–2013) are presented in detail in this book. In accordance with the statutes and the funding policy of the German Research Foundation, all individual projects contributing to the mentioned programs were and are in the category of basic, non-applied research, which, however, includes capacity building and benefit sharing as documented by the "Supplementary Instructions for Funding Proposals Concerning Research Projects within the Scope of the Convention on Biological Diversity (CBD)". In this context, one main issue was the science-directed development of sustainable land-use systems in the selected research area, the valley of the Rio San Francisco. An important side effect of the programs was the establishment of an effective research infrastructure both in the field and at the cooperating universities. This attracted two further basic research programs collaboratively working in the area: (1) The EU-funded EDIT program (*All Taxa Biodiversity Inventories and Monitoring ATBI + M*) with two additional projects and (2) a DFG-funded project bundle "ABA-Ecuador" (*Accelerated Biodiversity Assessment*).

Regarding benefit sharing activities, two new types of projects arose recently from the basic research programs. First, a so-called Cooperation Project jointly funded by four Ecuadorian universities and the DFG, aims at the autonomous development of research capacity and teaching staff for the South Ecuadorian universities. This is in line with the endeavor of many Latin American universities to change from a merely teaching system to a research-based teaching as also stressed by the World Bank (Thorn and Soo 2006, refer to Sect. 29.5). Furthermore, the success so far achieved by the collaborative research programs has recently been acknowledged by a memorandum of understanding on future joint research promotion by the Ecuadorian National Secretariat for Higher Education, Science and Technology (SENESCYT) and the German Research Foundation (DFG). Second, two knowledge transfer projects co-funded by DFG and Ecuadorian non-university cooperation partners could be launched, aiming on reforestation with indigenous tree species (see Sect. 28.7.2) and the establishment of a rain radar network in South Ecuador (see Sect. 28.7.1).

29.2 Addressing the Claims of the Convention on Biological Diversity: Benefit Sharing as a Major Goal of the German Research Programs

Besides the scientific endeavor, a major goal of the German research programs related to RU816 was benefit sharing from the access to biological resources with the academic, but also with the nonacademic communities in southern Ecuador. This scope is in full agreement with the spirit of the Convention on Biological Diversity (CBD) which in article 12 (Research and Training) underlines the specific

needs of developing countries in scientific and technical education of academic staff at local universities (UN 1993). Additionally, article 13 (Public Education and Awareness) highlights the importance of the involvement of the public regarding the conservation and sustainable use of biological diversity which is also a major concern of the German research programs. Particularly, transfer of knowledge from basic science to application, environmental education, and training shall foster public awareness of the importance of biological diversity for ecosystem functioning and in turn livelihood and daily life. To achieve acceptance by the public, learning from traditional knowledge is also an integral part of the German research programs.

Following a mutual understanding and appreciation of a real partnership, besides access, benefit sharing is the focal point for successful and sustainable research in developing countries summarized under the term Access and Benefit Sharing (ABS) of the CBD. Since no commercial intentions exist in the programs of the German Research Units, benefit sharing is purely research-, education-, and knowledge transfer-oriented.

29.3 The Collaborative Approach of Research Unit 816

In accordance with the goals of the CBD and within the scope of ABS, the research activities of the German Research Unit 816 of the German Research Foundation (DFG) are focused on the following four pillars (Bendix et al. 2013):

- Conducting and promoting joint multidisciplinary research to investigate biodiversity, ecosystem functioning, and ecosystem services under environmental change in the hotspot area of the south-eastern Ecuadorian Andes.
- Supporting academic education, academic staff development, and the implementation of relevant research technologies at the Ecuadorian partner universities regarding all interdisciplinary issues of biodiversity research.
- Developing science-directed recommendations for the sustainable management of the extraordinary biodiversity, including strict protection and conservation by adequate use, and supporting respective administrative structures in a participatory approach together with the national authorities, NGOs, and local communities.
- Facilitating transfer of the compiled knowledge to the public to boost awareness at site for the needs and benefits of biodiversity research in order to safeguard ecosystem services and human well-being, and in turn, to attain acceptance of the local population.

The successful operation of the German Research Unit in South Ecuador benefits from a well-developed network of focal actors (Bendix et al. 2013). Researchers from Ecuadorian and German universities, together with those from other countries (e.g., Brazil, Peru, Belgium, Austria, and USA), are collaborating in multidisciplinary research projects. In Ecuador the main academic partners are the two

universities of Loja (the Technical UTPL and the National University UNL), the Pontifical Catholic University PUCE in Quito, and more recently also the Universities of Cuenca and Azuay in Cuenca.

Nonacademic partners of the Research Unit are manifold. The network encompasses national institutions such as the Ministry of Environment (MAE) which is supporting the research activities by granting research permissions and, in following the National Strategy of Ecuador on Biodiversity, is benefiting from the results. Additionally, good relations exist with the national planning (SENPLADES) and the research funding (SENESCYT) agencies as well as with the national weather service (INAMHI). On the regional level the provincial governments of Loja and Zamora-Chinchipe are supporting biodiversity research by participating in knowledge transfer projects developed from previous joint studies (Chap. 28). This also holds for the local administrations, e.g., the municipality of Loja and the municipal agency of the city of Cuenca (ETAPA) which is in charge of the Cajas National Park. Private actors particularly related to benefit sharing are NGOs such as Nature and Culture International (NCI). The Ecuadorian branch of NCI is the main partner regarding environmental education and was the driving force for the implementation of the UNESCO Biosphere Reserve Podocarpus—El Condor. Furthermore, NCI has developed community-based participatory approaches for the protection and rehabilitation of important ecosystems (Aguilar 2008). At a local level, private landowners are part of the benefit sharing process who on their side provide land for reforestation experiments (Sect. 28.7.2).

29.4 Environmental Education and Capacity Building

Environmental education and capacity building in Ecuador as major aims of ABS endeavors are supported by the Research Unit 816 and related programs along four lines: (1) involving Ecuadorian scientists at all qualification levels in the research process, (2) supporting the autonomous development of scientific staff at the local universities, (3) promoting biodiversity research and conservation through basic training in research techniques and methodologies for graduate and undergraduate students, academics, and institutional staff, and (4) enhancing public environmental education through public presentations, workshops, and training.

(1) The research program of RU816 was designed and conducted as truly collaborative, employing assistants from the host country at different qualification levels—from the unskilled community worker, the trainee and diploma student, up to the PhD and PostDoc researcher. Whereas the design of the individual research projects of the program was jointly developed by the Ecuadorian and the German principal investigators (PI), the funding of staff (e.g., Ecuadorian and German PhD positions) and instrumentation was mainly provided by the German Research Foundation (DFG). Figure 29.1 shows the noticeable high number of Ecuadorian participants in the research program (in total 134),

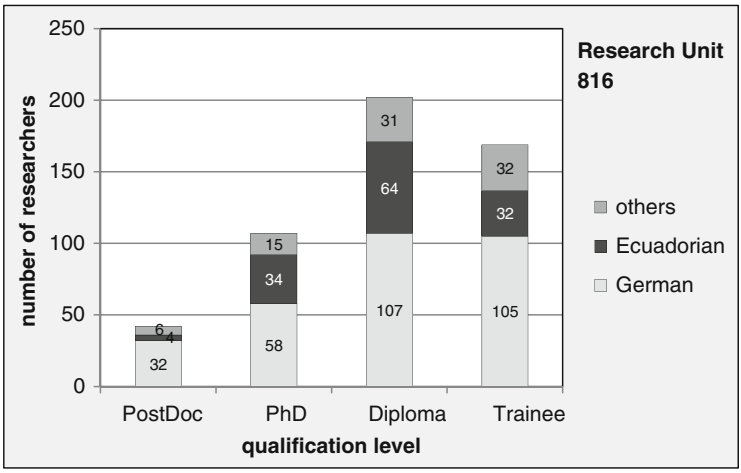

Fig. 29.1 Researchers at different qualification levels working in the Research Unit 816 (2007–2012). *Source*: RU816 Data Warehouse (http://www.tropicalmountainforest.org). Data compilation: T. Lotz, August 2012

particularly in the field of Diploma (Ecuadorian equivalent = licenciatura or ingeniería) students (64).

The capacity building effect of the collaborative research is also expressed in the increasing number of Ecuadorian PhD students which currently even exceeds the number of German PhDs (Fig. 29.2). Many of today's PhD students were also members of the Research Unit during their undergraduate studies. Thus, not only the absolute number but also the academic level of the involved Ecuadorian scientists has significantly increased during the 15 years lifetime of the research. A reasonable part of the Ecuadorian today's staff members have been former undergraduate and doctoral students of the German research programs. This underpins the contribution of the Research Unit to the careers of Ecuadorian scientists from PhD students to leadership positions in universities, NGOs, and public administration. It should also be stressed that students from other Latin American countries such as Brazil and Peru have been and still are attracted by the research program.

The success in staff promotion has also led to a greater internationalization of the research activities of the collaborating Ecuadorian universities (especially UNL and UTPL). This is mainly due to the increased numbers of publications in international peer-reviewed journals (Fig. 29.3). Whereas the relative contributions by Ecuadorian scientists as authors/coauthors were about 25 % at the beginning (2007), it doubled in the course of the RU816, amounting to 51.4 % in 2009. Out of a total of 155 articles published by RU816 members in international peer-reviewed journals between 2007 and September 2012, one-third (54) has Ecuadorian authors/coauthors.

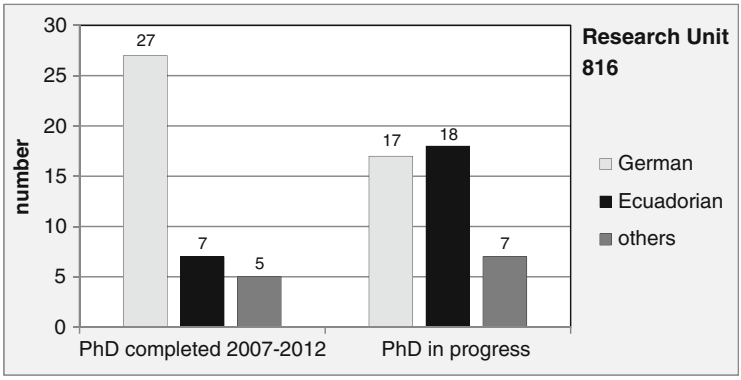

Fig. 29.2 Number of completed PhDs and PhDs in progress with respect to nationality in the Research Unit 816. *Source*: RU816 Data Warehouse (http://www.tropicalmountainforest.org). Data compilation: T. Lotz, June 2012

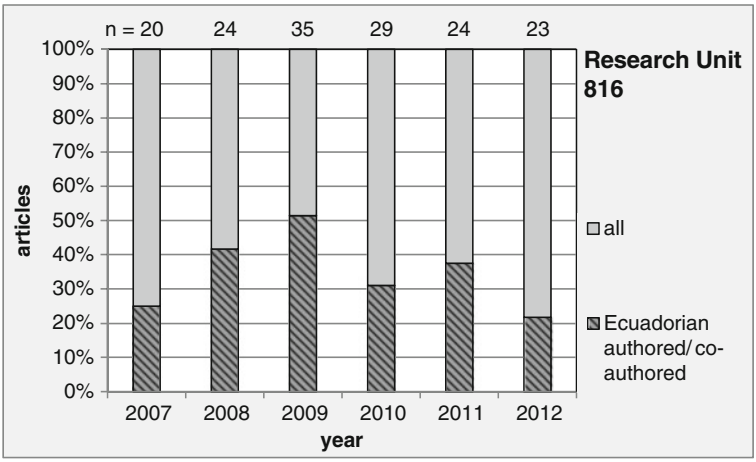

Fig. 29.3 Articles of RU816 members in international peer-reviewed journals (2007–September 2012). *Source*: RU816 Data Warehouse (http://www.tropicalmountainforest.org). Data compilation: T. Lotz, September 2012

(2) The second line, which promotes autochthonous development of university staff, started in 2009 with a specific program of cooperation between the German Research Foundation (DFG) and South Ecuadorian universities. Here, the project was designed by Ecuadorian PIs, who adapted the research goals to those of the program of the German research group to warrant a synergetic use of available resources. The Ecuadorian PhD students and their living costs were provided by the Ecuadorian side whereas the DFG contributed grants for visiting the collaborating German institutes. In addition to scientific staff promotion, technical staff at the Ecuadorian universities is trained by the

German scientists to properly use jointly established research infrastructure (e.g., biochemical and genetic laboratory facilities, field instrumentation, etc.).

(3) The third line aims to increase the scientific skills of graduate/undergraduate students, academics, and institutional staff in biodiversity research through capacity building. Students, academics, and university staff have been involved as research assistants in both the field and laboratory work. Ecuadorian undergraduates have prepared their final theses under the co-supervision of German and Ecuadorian researchers. This has positively influenced their skills in academic work and their understanding of basic procedures of scientific research. Complementary to this, further training activities in relevant topics of biodiversity research (e.g., plant diversity, soil biology, ethnobotany) have been carried out by both Ecuadorian and German researchers in the form of lectures, seminars, workshops, and field and laboratory courses (Table 29.1).

Most activities were conducted in the city of Loja, at universities or public agencies. However, several seminars and workshops have taken place in the field, at the facilities of the Estación Científica San Francisco (ECSF), but also in other locations of the country (Quito, Zamora, El Coca, Santa Elena), or direct in the local communities (Shaime, Laipuna, Sabanilla). During the running period of RU816 (2007–2012) a notable number of 45 capacity building and training activities with a total of 1,515 participants have been conducted by German researchers and Ecuadorian collaborators (cf. documentation in Table 29.1). The highest number of participants (580) and activities (11) was achieved in 2010 (Table 29.2).

Two-thirds of the participants in the capacity building and training activities were academics, but one-third of the activities were either open to the public or specifically addressed to non-academics, e.g., farmers (Table 29.3). The activities (Table 29.1) ranged from 1 day (22) to 1 week (19) and even up to 12 days (4). Additionally, in 2006, an international and interdisciplinary summer school on "Integrative assessment and planning methods for sustainable agroforestry in humid and semiarid regions" (funded by Robert Bosch Foundation, UTPL, DIU,[1] DFG, Organisation: F. Makeschin) was held in Loja with 30 participating students from throughout Latin America.[2]

(4) The fourth line aims to enhance the awareness and acceptance of biodiversity research and conservation in the public by environmental education through public presentations, workshops, and trainings (Table 29.1). A considerable number of lectures and workshops open to the public (15) were held during recent years (cf. Tables 29.1 and 29.3). Also, workshops in the communities with local representatives and farmers have been organized for knowledge transfer. In addition, environmental information on a more popular scientific

[1] Dresden International University.

[2] Lectures from the RU816 by F. Makeschin, (TU Dresden); R. Mosandel, B. Stimm (TU München); M. Richter, A. Gerique (University of Giessen, now University of Erlangen-Nuremberg); E. Beck (University of Bayreuth); J. Bendix, R. Rollenbeck (University of Marburg).

Table 29.1 Capacity building statistics (2007–2012), Research Unit 816, DFG-Ecuador

Project RU816	Type of capacity building and training activity	Title of capacity building and training activity	Teaching staff (with affiliation)	Place	Host institution	Date	Duration of activity	Addressed audience	Number of participants
A5	Public presentation	"Effectos de la perturbación humana a comunidades de epífitas den bosques andinos"	F. Werner (Univ. of Oldenburg)	Casa de la Cultura Ecuatoriana, Loja	RU816	2008, May	1 day	Open to the public, interested people of Loja	20
A5	Field seminar	Curso De Campo Sobre Diversidad De Plantas Vasculares (Árboles Y Epífitas) Y Almacenamiento De Carbono En Bosque Seco Tumbesiano	F. Werner (Univ. of Oldenburg), J. Homeier (Univ. of Göttingen)	ECSF, Loja, field (Reserva Laipuna)	NCI	2010, March	10 days	Academics, university teaching staff, university students	16
A5	Field seminar	Curso De Campo Sobre Diversidad De Plantas Vasculares (Árboles Y Epífitas) Y Almacenamiento De Carbono En Bosque Montano	F. Werner (Univ. of Oldenburg), J. Homeier (Univ. of Göttingen)	ECSF, Loja, field (Reserva Laipuna)	NCI	2012, Marc-h/ April	11 days	Academics, university teaching staff, university students	13
A7	Meeting	First meeting on Collabora-tive Doctorate Pro-gram (sandwich) and Research Incubators	Organizer: L.M. Romero (UTPL); Presen-tation: I. Kottke (Univ. of Tübingen)	Loja	UTPL	2008, June	3 days	Rectors and officials of the American Universities	200
B1/D3	Colloquium	"La circulación atmosférica global"	R. Rollenbeck (Univ. of Marburg), T. Peters (Univ. of Erlangen-Nuremberg)	Casa de la Cultura Ecuatoriana, Loja	RU816	2007, Oct.	1 day	Open to the public, interested people of Loja	20
B2	Field excursion	Geographical field excur-sion to northern Peru	M. Richter, T. Peters (Univ.ofErlange-n-Nuremberg)	Peru, dry forest South Ecuador	RU816, UTPL, UNL	2007, Sept./ Oct.	5 days	Students, institutional staff	25

B3	Seminar	Methods in soil biology	K. Potthast (TU Dresden)	Loja	UTPL	2007, May	1 day	Students	20
B3	Seminar	"Prueba de fertilización de pasto—impacto en el suelo y consecuencias económicos-sociales y productivas"	H. Lucero (UTPL)	Casa de la Cultura Ecuatoriana, Loja	RU816	2007, Dec.	1 day	Open to the public, interested people of Loja	20
B3	Seminar	Soil mineralogy and soil petrology	F. Haubrich (TU Dresden)	Loja	UTPL	2008, March/April	3 days	Students	20
B3	Seminar	Methods in soil chemistry	K. Potthast (TU Dresden)	Loja	UTPL	2008, June	1 day	Students	20
B3	Seminar	Scientific writing in soil science	E. Bahr (TU Dresden)	Loja	UTPL	2008, April/May	10 days	Students	20
B3	Seminar	Nutrient balances in Ecuadorian soils	E. Bahr (TU Dresden)	Loja	UTPL	2009, Feb.	1 day	Students	10
B3	Workshop	Nutrient balances and methods for soil improvement	E. Bahr (TU Dresden)	Yantzaza, El Tambo, San Lucas	UTPL	2010, March	3 days	Farmers	15
B3	Excursion	Soil properties in coffee plantations	E. Bahr (TU Dresden), D. Chamba (UTPL)	Loja, surroundings	UTPL	2011, March	1 day	Students	10
B3	Seminar	Biophysical characteristics and agroecological indicators for S-Ecuadorian soils	E. Bahr (TU Dresden)	Loja	UTPL	2011, March	1 day	Students	10
B3	Workshop	Preparation of knowledge transfer to farmers	E. Bahr (TU Dresden), L. Izquierdo (UTPL)	Loja	UTPL	2012, Feb.	1 day	Students	10
B3	Workshop	Protection of Ecuadorian soils	E. Bahr (TU Dresden), L. Izquierdo (UTPL)	Yantzaza, El Tambo	UTPL	2012, Feb.	3 days	Farmers	25

(continued)

Table 29.1 (continued)

Project RU816	Type of capacity building and training activity	Title of capacity building and training activity	Teaching staff (with affiliation)	Place	Host institution	Date	Duration of activity	Addressed audience	Number of participants
C1	Course	Professional tree climbing course	A. Wörle (Bayer. Landesanstalt für Wald und Forstwirtschaft); D. Kübler, B. Calvas (TU München)	ECSF	NCI	2012, April	12 days	Institutional staff	16
C2/T1	Public presentation	"Una visión general de las micorrizas y sus roles en los ecosistemas"	J.P. Suárez (UTPL)	Casa de la Cultura Ecuatoriana, Loja	RU816	2008, Feb.	1 day	Open to the public, interested people of Loja	20
C2	Internat. workshop	Mycorrhizas in tropical forest	Organizer: I. Kottke (Univ. of Tübingen) and J.P. Suárez (UTPL); 26 lecturers from 12 countries	Loja	UTPL	2008, Sept.	5 days	Students of Ecuador and RU816	40
C4	Course	Introduction into ArcGis	A. Tutillo Vallejo (Univ. of Erlangen-Nuremberg/ PUCE Quito)	Loja	UNL	2008, Sept.	6 days	PhD students and professionals	12
C4	Course	Introduction into ArcGis	A. Tutillo Vallejo (Univ. of Erlangen-Nuremberg/ PUCE Quito)	Loja	UNL	2008, Dec.	4 days	PhD students and professionals	10
C4	Seminar	"Manejo sustenible del bosque tropical de montaña—El factor humano"	A. Gerique (Univ. of Erlangen-Nuremberg)	Casa de la Cultura Ecuatoriana, Loja	RU816	2007, Sept.	1 day	Open to the public, interested people of Loja	20

C4	Seminar, workshop	Levantamiento y análisis cuantitativo y cualitativo de información etnobotánica con fines comerciales, con práctica de campo	A. Gerique (Univ. of Erlangen-Nuremberg), M.F. López (PUCE, Quito)	Quito	PUCE Escuela de Geografia	2009, Oct.	2 days	Under graduate students	25
C4	Presentation	"Seminario-Taller Nacional de Biodiversidad en Recursos Genéticos Nativos para la Alimentación y la Agricultura": La biodiversidad como recurso: el uso de las plantas, su manejo y alternativas sostenibles en comunidades rurales del sur del Ecuador	A. Gerique (Univ. of Erlangen-Nuremberg)	El Coca, INIAP Research Station	SENACYT/ INIAP	2010, Oct.	2 days	Authorities, teaching staff of universities, students	100
C4	Workshop	Plantas útiles de los Shuar del Alto Nangaritza	A. Gerique (Univ. of Erlangen-Nuremberg)	Shaime, Alto Nangaritza	Centro Shaime	2010, Oct.	1 day	Shuar community members	40
C4	Workshop	El uso sustentable de la fitodiversidad como alternativa a la deforestación	A. Gerique (Univ. of Erlangen-Nuremberg)	Zamora, Consejo Provincial Zamora Chinchipe	Consejo Prov., GTZ	2010, Nov.	1 day	Farmer associations, technicians	20
C4	Colloquium	Forum "La Cordillera del Cóndor: Territorio Pluricultural y Biodiverso" (video-conference): La Biodiversidad de la Cordillera del Cóndor como un recurso económico sustentable	A. Gerique (Univ. of Erlangen-Nuremberg)	Zamora, Consejo Provincial Zamora Chinchipe	Consejo Prov., Zamora Chinchipe	2012, May	1 day	Authorities, experts, general public	100

(continued)

Table 29.1 (continued)

Project RU816	Type of capacity building and training activity	Title of capacity building and training activity	Teaching staff (with affiliation)	Place	Host institution	Date	Duration of activity	Addressed audience	Number of participants
D2	Course	Laboratory course on wood anatomy and dendroecology	A. Bräuning (Univ. of Erlangen-Nuremberg); Ing. H. Maza (UNL)	Loja	UNL	2007, Sept.	6 days	Students, institutional staff	15
D2	Course	Laboratory course on wood anatomy and dendroecology	A. Bräuning (Univ. of Erlangen-Nuremberg); Ing. H. Maza, Ing. O. Ganzhi, Ing. D. Pucha (UNL)	Loja	UNL	2011, Sept./ Oct.	6 days	Students, institutional staff	15
D2	Lab.Course	Reconstrucción climática a través de métodos dendrocronológicos	A. Bräuning (Univ. of Erlangen-Nuremberg); Ing. D. Pucha (UNL)	Loja	UNL	2011, Sept./ Oct.	6 days	Students	15
D3	Workshop	1. El clima y los elementos del clima	A. Fries (Univ. of Marburg/UTPL)	ECSF	RU816	2010, Feb.	1 day	MAE, Park Ranger	20
D3	Workshop	2. El clima en Ecuador e instrumentos meteorológicas en la ECSF	A. Fries (Univ. of Marburg/UTPL)	ECSF	RU816	2010, Feb.	1 day	MAE, Park Ranger	20
D3	Workshop	3. Interpolación de datos climáticos para el área de la ECSF	A. Fries (Univ. of Marburg/UTPL)	ECSF	RU816	2010, Feb.	1 day	MAE, Park Ranger	20
Z1	Workshop	Data warehouse (data management)	T. Lotz (Data Manager, Univ. of Marburg)	Loja	UTPL	2010, Oct.	1 day	RU816 members, Ecuadorian PhD students	29
Z1	Workshop	Data warehouse (data management)	T. Lotz (Data Manager, Univ. of Marburg)	Loja	UTPL	2011, Oct.	1 day	RU816 members, Ecuadorian PhD students	38
Z2	Course	Practice and theory of GIS	PhD student and Postdocs of RU816	ECSF	NCI	2008	2 days	MAE	20
Z2, others	Seminar	Taller de Capacitación para coordinadores de los ecoclubes de los colegios	PhD student and Postdocs of RU816	ECSF	NCI	2008, Dec.	2 days	Teachers	20

Z2	Workshop	Practice and theory of DGPS and GIS	J. Zeilinger (Project Unit Manager, ECSF); Jorge Cueva, Luis Chalán (NCI)	ECSF	RU816/NCI	2009, Sept.	3 days	MAE	20
Z2	Presentation	"Seminario-Taller Nacional de Biodiversidad en Recursos Genéticos Nativos para la Alimentación y la Agricultura": La Unidad de Investigación RU816 "Biodiversidad y Manejo Sostenible de un Ecosistema de Montaña Megadiverso en el Sur del Ecuador"	J. Zeilinger (Project Unit Manager, ECSF)	El Coca, INIAP Research Station	SENACYT/ INIAP	2010, Oct.	2 days	Authorities, teaching staff of universities, students	100
Z2	Presentation	La Unidad de Investigación RU816 "Biodiversidad y Manejo Sostenible de un Ecosistema de Montaña Megadiverso en el Sur del Ecuador"	J. Zeilinger (Project Unit Manager, ECSF)	Santa Elena	SENACYT	2010, Nov.	3 days	Authorities, teaching staff of universities, students	200
Z2	Presentation	La Unidad de Investigación RU816 "Biodiversidad y Manejo Sostenible de un Ecosistema de Montaña Megadiverso en el Sur del Ecuador"	J. Zeilinger (Project Unit Manager, ECSF)	Quito	FAO/ SENAGUA	2011, Nov.	5 days	Authorities, teaching staff of universities, students	60

(continued)

Table 29.1 (continued)

Project RU816	Type of capacity building and training activity	Title of capacity building and training activity	Teaching staff (with affiliation)	Place	Host institution	Date	Duration of activity	Addressed audience	Number of participants
Z2	Presentation and excursion	La Unidad de Investigación RU816 "Biodiversidad y Manejo Sostenible de un Ecosistema de Montaña Megadiverso en el Sur del Ecuador"	J. Zeilinger (Project Unit Manager, ECSF)	ECSF	RU816	2012, Jan.	1 day	Students of the UNIVERSIDAD ESTATAL AMAZÓNICA	22
Z2	Presentation	Socialization of the LiDAR projekt in the Rio San Francisco valley	J. Zeilinger (Project Unit Manager, ECSF)	ECSF	RU816	2012, Feb.	1 day	Authorities, Institutions of San Francisco, Zamora	12
Z2	Presentation	Socialization of the LiDAR projekt in the Rio San Francisco valley	J. Zeilinger (Project Unit Manager, ECSF)	Sabanilla, Junta Parroquial	RU816	2012, Feb.	1 day	Local communities of San Francisco and surroundings	12

Table 29.2 Number of participants and events in capacity building and training activities per year of the RU816 running period (based on Table 29.1)

Years	2007	2008	2009	2010	2011	2012	Total
Participants	120	402	55	580	148	210	1,515
No. of events	6	11	3	11	6	8	45

Table 29.3 Addressed audience of capacity building and training activities in the course of the running period of RU816 (based on Table 29.1)

Addressed audience	Academics	Non-academics	Academics and non-academics
Participants	1,131	192	192
No. of events	30	9	6

level is necessary for stakeholders and interested locals. The results of international research programs are mainly published in English in scientific journals or books making their access by the local people difficult. Thus, it is necessary to translate the results into laymen's language in order to raise awareness and foster the feeling of responsibility of all citizens for biodiversity and related ecosystem services. One example is the joint publication of a booklet by NCI and the Research Unit (Kiss and Bräuning 2008) summarizing and "translating" the scientific results into Spanish for a wider readership. Additionally, annual symposia with keynote talks in Spanish and monthly research meetings both open to the public were and are still organized in Loja.[3] The lecture hall building of the research station is used to conduct classes and field courses for pupils on biodiversity and the environment, but also specific courses for local administrators (Table 29.1).

29.5 Shared Access to Research Facilities, Technology, and Information

The importance of the research programs for the development of the universities in southern Ecuador is noticeable (Bendix et al. 2013). At the beginning of the research in 1997, UTPL for instance was just a teaching university without any biological or ecological disciplines. Fifteen years later, the situation has completely changed. Recently, UTPL has promoted biological research personnel and infrastructure as well as teaching staff. In the scope of collaboration with the German programs, laboratories for molecular biology, soil analysis, and geographical information systems have been established and equipped. Improving their facilities in this way, the cooperating Ecuadorian university could increase its international attractiveness far beyond the cooperation with the German research group: UTPL

[3] As regularly and obligatory activity of the entire RU816 they are not included in Table 29.1.

hosts more than 600 visiting professors per year and supports more than 300 research visits of its own scientists abroad. The funding of science development by national agencies was increased to 4 million US$ in 2009 (Bendix et al. 2013).

At the UNL, the joint research program similarly led to the establishment and extension of important research infrastructure: (1) Improvement of the soil analysis lab, (2) complementation of the UNL Herbarium "Reinaldo Espinosa" by 3,500 new specimens, (3) improvement of the equipment of UNL laboratories for dendrochronology and (4) plant physiology, and (5) a tree nursery which is indispensable for the long-term reforestation experiments of the research group.

Very important for multidisciplinary biodiversity research in a foreign country is the availability and guaranteed unlimited access to a field station with well-managed experimental and monitoring sites. Above all, the research program benefits from the close cooperation with the local branch of the foundation NCI which provides the well-equipped research station ECSF (Estación Científica San Francisco). It offers accommodation and board, provides basic research infrastructure like soil, water, and IT labs, runs a herbarium, and holds a lecture hall. Furthermore, many parts of the research area are owned by the foundation, e.g., the protected natural mountain forest RBSF (Reserva Biológica San Francisco). Similarly, wide areas where the natural forest has been converted into pastures or exotic tree plantations are also available for research. Access to research areas of the cooperating universities is permitted.

A central element of benefit sharing is the access to and the transfer of knowledge. The knowledge on biodiversity and underlying ecosystem processes/services produced by the Research Unit is compiled in a central data warehouse (Nauß et al. 2007; Lotz et al. 2012) which is open to all contributing scientists and cooperating organizations. To date, the data warehouse is not only keeping more than 5 Mio stored data values, but also offers access to digital publications which is usually not possible for Ecuadorian universities. Furthermore, the quarterly newsletter of the RU816 has continuously gained importance as a fast outlet for science news of the Ecuadorian and German researchers, but also as a medium of communication between all academic and nonacademic partners. Since the hosting institute of the RU816 data base project was accepted as an "official" data center by DataCite (a member of the International DOI Foundation IDF), the newsletter is officially citable by a Digital Object Identifier (DOI) and thus became a persistently available document which helps to boost the international visibility of the joint research, in particular of the Ecuadorian partners.

29.6 Conclusions

Fifteen years of joint collaborative research have significantly changed the scientific scene in southern Ecuador, in particular with regard to interdisciplinary ecological and biodiversity research. The main achievements can be summarized as follows:

- The local universities have established new and internationally compatible curricula related to ecology and biodiversity.
- They have established and implemented respective research infrastructure, particularly labs for geo- and biosciences including the first sequencing capabilities.
- The first generation of Ecuadorian graduates is now in leading positions, thus promoting the development of biodiversity research and teaching in their universities towards an internationally competitive institution.
- With this, the cooperating Ecuadorian universities have started the transition process from teaching universities to international competitive research universities which is underpinned by their excellent positions in the national university ranking (e.g., UTPL is at second place, all contributing universities within the leading 15).
- The younger Ecuadorian graduates and PhD students are now familiar with the processes and demands of scientific work and have gained English and/or German language and publication skills. Once graduated as PhDs, they are capable to push the development of Ecuadorian research universities through their publications and their involvement as lecturers.
- Last but not least, 15 years of ecosystem research have provided a wealth of scientific data covering all aspects of interdisciplinary biodiversity and ecosystem research. Although the research area represents one of the most complex ecosystems of the world, synthesis of the up to now available data (see Chap. 27) allows a level of understanding which appears unparalleled in tropical ecosystem analysis. Ongoing field experiments open new opportunities for further joint research activities.

The Ecuadorian state assigns a primary service function for the public to research subjects investigated by Ecuadorian scientists. Its national strategy on biodiversity, as part of the "Regional Biodiversity Strategy for the Tropical Andean Countries" (2005), puts much emphasis on conservation of biodiversity by habitat conservation. National priority fields are the production of bio-knowledge, including knowledge on biodiversity and conservation, and the assessment of impacts of environmental change (climate and land-use changes) on ecosystems and their services. Of major importance is research on the provisioning service *water* and on the potentials of diverse *land uses,* which can help to protect water resources and biodiversity. With the current local expertise and the baseline data stock the consortium can and will come into a new phase of purely co-funded German–Ecuadorian research which is currently under development. Based on the gained knowledge and the established infrastructure, an extension of the research program to the dry forest in the South-West Ecuador (Laipuna Natural Reserve) and to the páramo (El Cajas National Park) is envisaged. In that respect a German–Ecuadorian consortium has compiled a research plan for a "Platform for Biodiversity and Ecosystem Monitoring and Research in South Ecuador": A subprogram focused on basic research of environmental impacts on biodiversity and ecosystem services and two subprograms on sustainable land use and on global change monitoring will transfer results gained from basic research into application.

This is intended to be realized with knowledge transfer programs as presented in Chap. 28. The development of prototypes for a sustainable management and a functional monitoring system with Ecuadorian university and nonuniversity cooperation partners will further boost the capacity building activities and, thus, will at the same time match the national aims of Ecuador and the CBD objective "...fair and equitable sharing of the benefits arising out of the utilization of genetic resources" (UN 1993).

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